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Research Title

The burden of non-communicable diseases among people living with HIV and the extent, cost and framework development of integrated HIV and non-communicable diseases care at primary health care facilities in Southern Africa

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Dedication

I dedicate this work to my late parents, Mr. Julius Muza Moyo and Mrs. Peerless Mutambo Moyo. They were not only loving and supportive parents but also pillars of strength and wisdom in my life. Their guidance, encouragement, and unwavering belief in my abilities have shaped me into the person I am today.

Though my parents may no longer be with us in the physical realm, their love and legacy continue to inspire me every day. This work stands as a tribute to their enduring influence and the profound impact they have had on my life.

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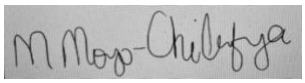
Declaration: Authorship

"I declare that the thesis, which I hereby submit for the degree Doctor in Philosophy in Public Health at the University of Pretoria, is my own work and has not previously been submitted by me for a degree at another university."

Signature:  Date: 30 Aug 2024

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KK- Adapted the search strategy for the three databases and search of studies for inclusion in the review and participated in the writing of the review.

CH- Contributed to the interpretation of data and writing of the review.

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2. **Moyo-Chilufya M**, Mgutshini T, Musekiwa A, Hongoro C. A framework for implementing integrated HIV and NCD care at primary health care facilities in Southern Africa

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Conferences

1. **International Conference on Public Health In Africa (CPHIA) 2023, Lusaka Zambia – Oral online presentation titled** The perspectives of HIV Program Managers on the extent of integration of HIV and non-communicable disease care for people living with HIV in Southern Africa – a qualitative study
2. **World Congress of Epidemiology (WCE)2024, Cape Town , South Africa – Poster presentation titled** The burden of non-communicable diseases among people living with HIV in Sub-Saharan Africa: a systematic review and meta-analysis.
3. **Ekurhuleni Research Conference 2024, Johannesburg, South Africa** – Oral presentation titled The cost of HIV and non-communicable disease integrated care at two primary health care facilities in South Africa – a case study.

Executive Summary

Background

Sub Saharan Africa (SSA) grapples with a complex health landscape battling both HIV/AIDS and non-communicable diseases (NCDs). The adoption of integrated care for HIV and NCDs in SSA holds promise in curbing premature mortality from NCDs among people living with HIV (PLHIV) by 2030, aligning with Target 3.4 of Sustainable Development Goal (SDG) 3. In addition to mental illnesses, cardiovascular diseases, cancers, chronic respiratory diseases and diabetes stand as significant NCDs accounting for a considerable portion of global mortality, particularly in low and middle income countries (LMICs), where they contribute to 78% of NCD deaths and 85% of premature deaths. With seven out of the top ten global causes of death being NCDs, the urgency to address this issue is paramount. As the Southern and Eastern Africa region is home to 55% of PLHIV globally, it is a focal point for integrating HIV and NCD care. However, the current burden, extent and frameworks of HIV/NCD integrated care in SSA remains inadequately documented.

Aim and Objectives

The main aim of this study is to develop a framework for the integration of NCD care with HIV services in primary health care facilities in limited resource Southern Africa. The objectives of this study are to carry out a systematic review and meta-analysis on the burden of NCDs among PLHIV, to determine the extent of HIV/NCD care integration in primary health care facilities in Southern African countries, to measure the cost of integrating HIV/NCD care at primary health care in South Africa as a case study of a

Southern African country and to develop a framework for integrating HIV/NCD care in primary health care facilities in Southern African countries, where one does not exist, including the determination of acceptability of the proposed framework by national HIV programme managers.

Methods

Multi-methods were employed to achieve the thesis objectives. The systematic review and meta-analysis adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA-20) guidelines. To determine the extent of HIV/NCD care integration in Southern African countries, a qualitative study was conducted using 45 to 60 minute online semi-structured interviews with national HIV programme managers, complemented by a documentary data collection instrument.

For the costing study, the activity-based costing method was used to compare the costs of integrating HIV/NCD care at two primary health care facilities in South Africa, analysed as case studies. Additionally, a framework for integrating HIV/NCD care was developed using a modified “Best fit” framework synthesis method.

Results

The systematic review analysed 188 studies from 21 countries in SSA, revealing a significant burden of NCDs among PLHIV. Obesity/overweight and depression were the most common conditions among PLHIV in SSA, at 32.20% (95%CI: 29.70, 34.70) and 30.4 % (95%CI: 25.30, 35.40), respectively. Hypertension was also notable, affecting 20.1 % (95 % CI: 17.5, 22.70) of PLHIV in SSA. Cervical cancer and chronic respiratory diseases had the least number of studies. Significant progress has been made in Southern African countries in integrating screening and treatment (where applicable) for hypertension,

diabetes, cervical cancer and chronic respiratory diseases within HIV services. Despite this, there is a need to strengthen the screening of mental health conditions. The comparative costing study at two primary health care facilities in South Africa found that the annual cost of integrated HIV/NCD care per patient, assuming no complications was $261.6 and $226.3 respectively. Additionally, seven new themes emerged to constitute the developed framework for integrated HIV/NCD care at primary health care facilities in Southern Africa.

Conclusion

The study highlighted a significant burden of NCDs among PLHIV and revealed varying extent of HIV/NCD integrated care levels across Southern African countries. Despite the notable progress, there is a need to further strengthen health systems. Significant advancements have been achieved in integrating screening for diabetes, chronic respiratory diseases and cardiovascular conditions but there remains gaps for mental health care. The cost analysis found that the average annual HIV/NCD integration cost per patient (stable and without complications), at the primary health care level is at $200. The analysis also underscored the importance of developing cost databases. These findings have led to the creation of a framework for implementing integrated NCD care within HIV programmes at primary healthcare facilities, influencing both current practices and future research in this area.

Keywords: Cost, integrated HIV/NCD care, People living with HIV, Primary health care , Sub Saharan Africa

Table of Contents

DEDICATION II

ACKNOWLEDGEMENTS III

DECLARATION: AUTHORSHIP VI

DECLARATION: PUBLICATIONS VII

EXECUTIVE SUMMARY XI

DEFINITIONS OF TERMS XVI

ACRONYMS AND ABBREVIATIONS XVII

CHAPTER 1: INTRODUCTION 1

1.1 Thesis Introduction 2
1.2 Thesis Background 4
1.3 Problem Statement 9
1.4 Significance of Research 11
1.5 Research Question 12
1.6 Aim 12
1.7 Objectives 12
1.8 Methodology 13
1.9 Layout of the thesis/dissertation 13

CHAPTER 2: LITERATURE REVIEW 19

CHAPTER 3: PROTOCOL & RESULTS PAPER - THE BURDEN OF NON-COMMUNICABLE DISEASES AMONG PEOPLE LIVING WITH HIV IN SUB-SAHARAN AFRICA 41

CHAPTER 4: THE EXTENT OF HIV/NCD INTEGRATION 94

CHAPTER 5: THE COST OF INTEGRATED HIV/NCD CARE 120

CHAPTER 6: A FRAMEWORK OF INTEGRATED HIV/NCD CARE 127

CHAPTER 7: SYNTHESIS OF FINDINGS 151

7.1 Introduction 152
7.2 Background 152
7.3 Summary of key findings 153
7.4 Discussion 158
7.5 Strengths of the study 164
7.6 Limitations of the study 165
7.7 Conclusions 166
7.8 Implications for future research and practice 168

8.0 REFERENCES 171

9.0 APPENDICES 173

Appendix A: University of Pretoria Ethics Approval and renewal 2024 174
Appendix B: University of Pretoria Ethics Approval and Amendment 2023 175
Appendix C: University of Pretoria Ethics Approval 2023 176
Appendix D: University of Pretoria Ethics Approval 2022 177
Appendix E: Ekurhuleni Health District Research Permission 2022 178
Appendix F: Participant's information and informed consent – Extent of Integration 179

APPENDIX G: INFORMED CONSENT – COSTING STUDY 184
APPENDIX H: PROOF OF SUBMISSION: EXTENT OF INTEGRATION PAPER 188
APPENDIX I: PROOF OF SUBMISSION -FRAMEWORK PAPER 189

Definitions of Terms

Activity based costing: An approach that objectively allocates costs to key activities that relate to the care continuum of patients within specified care settings.

Best Fit Framework Synthesis: This method involves both framework and thematic analysis techniques to compile the synthesis and is usually accompanied by a systematic review of literature.

Communicable Diseases: Illnesses that spread from one person to another or from an animal to a person, or from a surface or a food. They are caused by micro-organisms like bacteria, viruses, parasites and fungi that can be spread directly or indirectly. Examples of communicable diseases are HIV, tuberculosis and cholera.

Extent of Integration: In this study, we define the extent of integration as the number of major non-communicable diseases that have been integrated into HIV services at primary healthcare level.

Integration of HIV & non-communicable disease (NCD) care: In this study we define the integration of HIV/NCD care as the incorporation of NCD care into HIV services at primary healthcare level.

Non-communicable Diseases: These are chronic conditions such as heart disease, stroke, cancer and diabetes that do not result from an infectious process, and can often be prevented or delayed by changes in lifestyle. Risk factors for NCDs are in three categories:

- **Modifiable behavioural risk factors:** These include tobacco use, physical inactivity, unhealthy diet and the harmful use of alcohol.

- **Metabolic risk factors:** These consist of elevated blood pressure, overweight/obesity, hyperglycaemia (high blood glucose levels) and hyperlipidaemia (high levels of fat in the blood).

- **Environmental factors:** There are several environmental factors that contribute to NCDs but the largest of these is air pollution.

Southern African Development Community: It is a regional economic community consisting of 16 countries from Southern Africa.

Acronyms and abbreviations

ABC Activity Based Costing

AIDS Acquired Immune Deficiency Syndrome

BFFS Best Fit Framework Synthesis

CVDs Cardiovascular Diseases

CRDs Chronic Respiratory Diseases

DALYs Disability adjusted life years

HIV Human Immunodeficiency Virus

LMIC Low and middle income countries

NCDs Non communicable diseases

PHC Primary Health Care

PLHIV People living with HIV

PRISMA The Preferred Reporting Items for Systematic Reviews and Meta-Analysis

SADC Southern African Development Community

SDG Sustainable Development Goals

SSA Sub Saharan Africa

UNAIDS Joint United Nations Programme on HIV/AIDS

WHO World Health Organization

WHO PEN WHO package of essential noncommunicable disease interventions for primary health care

Chapter 1: Introduction

Chapter 1 presents an overview and explains the motivation for the research. It outlines the problem statement, research aim, and objectives, setting the foundation for the study.

1.1 Thesis Introduction

The global surge in non- communicable diseases (NCDs) is alarming, with NCDs causing 41 million deaths annually, accounting for 74% of worldwide deaths. [1] Notably, 86% of premature deaths (ages of 30-69) occur in low-and middle-income countries (LMICs). [1]

Cardiovascular diseases (CVDs), cancers, chronic respiratory diseases(CRDs) and diabetes primarily constitute NCDs, responsible for over 80% of NCD related deaths. Mental illnesses are also significant, with 700 000 global suicide deaths in 2019, indicating a rising burden [2]. The LMICs, already burdened by communicable diseases, face additional challenges with NCDs, exacerbated by unplanned urbanisation in Sub Saharan Africa (SSA). Urban areas often have high population density, inadequate infrastructure, poor sanitation and limited access to safe water, increasing risk factors for both communicable diseases and NCDs. [3] Urban lifestyles characterized by high sodium and fat diets, low fruit and vegetable intake, and reduced physical activity, further escalate NCD prevalence. [3]

The Human Immunodeficiency Virus (HIV) attacks white blood cells, weakening the immune system and increasing susceptibility to infections like tuberculosis and certain cancers. Acquired Immunodeficiency Syndrome (AIDS) represents the most advanced stage of HIV. With 39.9 million people living with HIV (PLHIV) globally, 63% are in Africa. Antiretroviral therapy allows individuals to live longer, often reaching lifespans similar to the general population before progressing to AIDS. [4] The United Nations' 95-95-95 targets, aim for 95% of people to be tested for HIV, 95% of those diagnosed to receive

treatment, and 95% of those on treatment to achieve viral suppression, by 2025. [5]

The upsurge in NCDs among PLHIV is partly due to the implementation of universal testing and treatment of HIV/AIDS. Increased coverage of antiretroviral treatment (ART) has enabled a longer lifespan, resulting in a higher likelihood of mortality due to NCDs, surpassing that of HIV/AIDS-related deaths. [6] Sub Saharan Africa accounts for most of the global HIV/AIDS burden with the majority of PLHIV originating from Eastern and Southern Africa. [7] This highlights the need for comprehensive healthcare approaches to address both communicable and NCDs effectively.

1.2 Thesis Background

Integration of HIV and NCD Care

Both HIV and NCD care cascades encompass prevention, diagnosis, enrolment into care, disease management and palliative care, and these similarities support their integration despite differing intricacies. [8]

Integrated health care includes various dimensions, such as legal and policy integration, systemic linkages, and service integration, which can take forms like full service - level and multi-facility integration. [9]

According to WHO (2023), [10] integration involves organizing and managing health services to ensure individuals receive necessary care conveniently, effectively, and cost-efficiently, coordinating tasks to provide high-quality, continuous care throughout life. This includes chronic condition management and a continuum, from gestation to adulthood. This thesis specifically examines the integration of HIV and NCD services at primary health care facilities for adult patients. It considers functional, service and organizational types of integration in Southern Africa's primary health care (PHC) context. [10]

Full clinical service-level integration for this study is defined when all major NCD screening and/or care services are included within the HIV care programme. Integrated HIV/NCD care strengthens health systems' capacity to address PLHIV's comprehensive needs at PHC facilities, aiding the 95-95-95 targets [5] and potentially improving patient survival through disease prevention and early treatment access. [11-13]

Achwoko D et al [14] highlighted the need to utilise existing HIV healthcare platforms in LMICs, especially in SSA. Patel P et al.'s systematic review and meta-analysis [11] on NCDs among HIV infected individuals in LMICs recommended prioritizing integrated HIV and NCD care for early diagnosis and treatment of NCDs as co-morbidities with ageing. There is a growing call for studies on the cost-effectiveness of integrating HIV and NCD services.[8, 15-18]

In 2013, UNAIDS noted country variations in facilities integrating HIV counselling and testing (HCT) with ART and NCD care services[19], but details on integrated care and NCD burden among PLHIV were lacking. The recent Global HIV/AIDS report[9], includes a section on integrated HIV/ NCD care, with data from peer reviewed journals but lacks regional data as provided for HIV/AIDS, indicating underreporting of the NCD burden among PLHIV despite rising interest in integrated care. This study aims to determine the burden, extent and cost of HIV/NCD integration and to develop a framework for integrating HIV/NCD care in the Southern African countries where none exists.

The WHO Building Blocks and Integrated HIV/NCD Care

The WHO six building blocks of a good health system, namely; leadership and governance, health information systems, health financing, human resources for health, essential medical products and technologies and service delivery will be used to investigate integrated HIV/NCD care in Southern African countries. Based on modified indicators and their measurement strategies of monitoring the WHO building blocks of health systems, this study will determine whether there is an imbalance in any of the building blocks. Figure 1

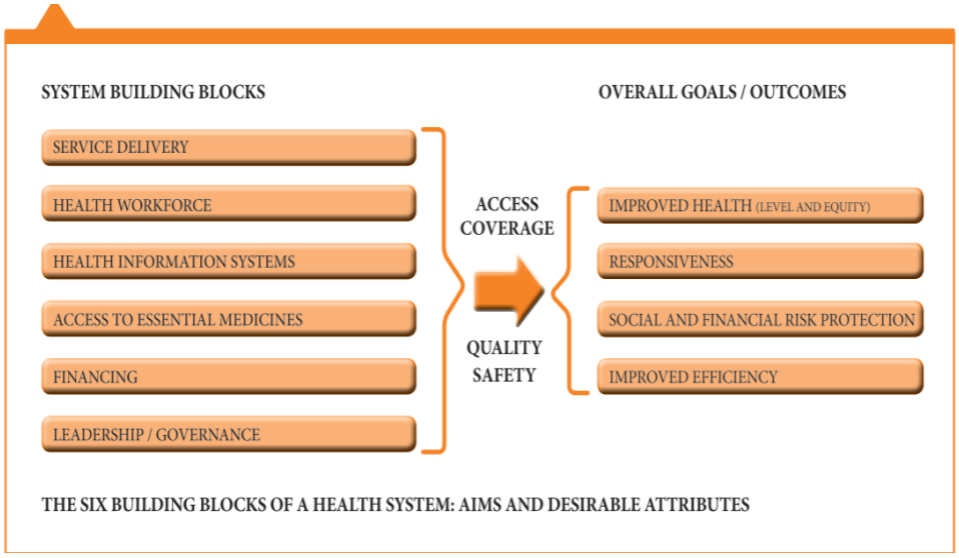

Figure 1: The WHO six building blocks of a good health system [20]

The Burden of NCDs and HIV/AIDS in SADC Countries

There are 16 countries that constitute the SADC region, namely: Angola, Botswana, Comoros, Democratic Republic of Congo, Eswatini, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, United Republic of Tanzania, Zambia and Zimbabwe [21]. Countries in the SADC region with very low HIV prevalence (below 1%) are Comoros, Mauritius, Madagascar, and Seychelles. HIV may not be a major problem in these countries, but NCD related deaths are still quite high. For purposes of this study, countries with HIV prevalence below 4% were excluded. (Table 1)

Burden of HIV and NCD related deaths in SADC member states in 2022			
Country	Number of People Living with HIV/AIDS	HIV Prevalence Adult: (15-49)	NCD related Deaths in General Population
Eswatini	220,000	25.9%	46%
Lesotho	324,000	19.3%	45%
South Africa	8,450,000	19.6%	51%
Botswana	340,000	16.4%	46%
Zimbabwe	1,300,000	11%	39%
Mozambique	2,400,000	11.6%	36%
Namibia	220,000	11.0%	43%
Zambia	1,400,000	10.8%	35%
Malawi	1,000,000	7.1%	40%
United Republic of Tanzania	1,700,000	4.3%	34%
Angola	310,000	1.5%	32%
Mauritius	12,000	1.4%	88%
Seychelles	934	0.95%	79%
Democratic Republic of Congo	490,000	0.6%	34%
Madagascar	70,000	0.4%	45%
Comoros	<200	<0.1%	45%

Table 1: HIV Prevalence and NCD-related deaths in the general population [22-25]

South Africa is a good example of a Southern African country with a relatively high HIV prevalence and NCD related deaths. In 2023, the prevalence of HIV among adults in South Africa was 19.6% with 8.5 million PLHIV (Table 1), [22] the highest globally, and

with the largest ART programme in the world. [22, 26] NCDs account for 51% of total deaths in South Africa. [27] Additionally, the probability of dying from the four main NCDs in 2016 as indicated by WHO between the ages of 30 and 70 years in South Africa was approximately 26%. [27]

The National Department of Health in South Africa implemented the integrated chronic disease model [28] although the coverage is not fully expounded. Several studies have been conducted, investigating NCDs among PLHIV within South Africa. [29-42] One such study was conducted among PLHIV in a rural community in KwaZulu Natal (KZN), South Africa. [43] In this study of 570 participants, 33% were HIV infected and the prevalence of NCD risk factors were relatively high. Hypertension, hyperglycaemia and hyperlipidaemia were similar in both the HIV uninfected and infected groups while obesity was more prevalent in PLHIV [43], a basis for further investigation of NCDs and their respective risk factors among PLHIV.

However, in the other Southern African countries, national integrated chronic disease model(s) implementation is vague, warranting further investigation.

1.3 Problem Statement

Due to the existing dual burden of HIV and NCDs in SSA, investigation of NCDs among PLHIV is a research priority. Indeed, the burden of NCDs is not exclusive to PLHIV, and NCD care health systems in SSA are weak , but as a step towards universal health care (UHC), integrating NCD care with already existing HIV care platforms could enable

countries to strengthen their health systems, leveraging on the country experience of already well-established HIV care programs. Following the success of these integrated platforms, extension to the general population becomes more feasible.

The WHO has identified research in tobacco control, nutrition, obesity and physical inactivity, as research priorities for prevention and control of the major NCDs in the general population and are applicable to PLHIV. The WHO package of essential noncommunicable (PEN) disease interventions for PHC are population wide interventions to reduce risk factors that include NCD prevention and control, management of NCDs (detecting, screening and treatment) [44]. The WHO PEN includes protocols and tools that are specific to the control of NCDs with the aim of strengthening national capacity to integrate and scale up care of NCDs at primary healthcare facilities using cost effective means. The PEN can be utilised in integrating HIV/NCD care among PLHIV in LMICs.

Furthermore, there is a gap on how NCD care is integrated into the existing HIV care programmes in SSA countries, [9, 17, 45] and the cost effectiveness data of integration models is uncommon. [17] The WHO NCD country profile gives detailed reports on the burden of NCDs within countries but is not specific on the burden among PLHIV. [27] Additionally, while there is an increase in research on HIV/NCD integrated care, programmatic data are rarely reported. The few available reports on HIV that incorporate NCD integrated care have a minor section and do not include sufficient information on the current trends of NCDs in PLHIV in LMICs [19]. However, more recently, in the 2020

Global AIDS update, [9] the different forms that integration of NCDs takes among PLHIV is discussed but it does not discuss cost effectiveness of integration.

The ideal situation would be for PLHIV receiving ART at a healthcare facility to be screened for the major NCDs and receive treatment within the same facility when needed, and refer patients when required.

1.4 Significance of Research

This research is expected to:

- Inform policy makers and practitioners (e.g. Ministries of Health in Southern Africa region) on the current burden of NCDs among PLHIV.
- To determine the extent of integration and cost of HIV/NCD care in Southern Africa.
- To develop a framework for integrated HIV/NCD care and to determine its acceptability by key stakeholders in a resource –limited setting where one does not exist.
- Inform policy on findings that could aid in planning for interventions on NCD prevention and care for PLHIV.

1.5 Research Question

What is the prevalence of NCDs and their associated risk factors among PLHIV and how can integrated NCD and HIV care be achieved in low resourced PHC facilities in Southern African countries?

1.6 Aim

The aim of this study is to develop a framework for the integration of NCD care with HIV services in PHC facilities in limited resource Southern Africa.

1.7 Objectives

1.7.1 To carry out a systematic review and meta-analysis on the burden of NCDs and associated risk factors among PLHIV in SSA.

1.7.2 To determine the extent of HIV/NCD care integration in health care facilities in Southern African countries.

1.7.3 To determine the cost of integrating HIV/NCD care in PHC facilities in South Africa as a case study of a Southern African country.

1.7.4 To develop a framework for integrating HIV/NCD care in PHC facilities in Southern African countries, where one does not exist, and to determine acceptability of the proposed framework by national HIV programme managers.

1.8 Methodology

A comprehensive account of the methodology is presented in the subsequent chapters presented as manuscripts. The methods are adequately described in each manuscript/publication.

1.9 Layout of the thesis/dissertation

This thesis is structured into several key sections, beginning with preliminary pages and culminating in seven distinct chapters. Each chapter is designed to address specific objectives of the study and has its own reference section:

Chapter 1: Introduces the thesis, outlining the general context and scope.

Chapter 2: Provides a comprehensive literature review relevant to the research topic.

Chapter 3: Presents a protocol and results paper for Objective 1, titled “The burden of non-communicable diseases among people living with HIV in Sub-Saharan Africa: a systematic review and meta-analysis”.

Chapter 4: Contains a manuscript for Objective 2, titled “The perspectives of HIV Program Managers on the extent of integration of HIV and non-communicable disease care for people living with HIV in Southern Africa : a qualitative study”

Chapter 5: Features a manuscript for Objective 3, titled “The integrated care costs for HIV and non-communicable diseases in South Africa: a comparative case study.”

Chapter 6: Presents the manuscript for Objective 4, titled “A framework for implementing integrated HIV and non-communicable disease care at primary health care facilities in Southern Africa.”

Chapter 7: Provides a summary of findings, general discussion and conclusion.

The thesis concludes with appendices providing supplementary information.

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Chapter 2: Literature Review

Chapter 2 presents a brief narrative on the literature that describes the burden, extent, cost, and the framework for integrated HIV and non-communicable diseases care in Sub Saharan Africa.

Abstract

Background

Sub Saharan Africa (SSA) faces a syndemic of HIV and non-communicable diseases (NCDs), being the region with the highest number of people living with HIV (PLHIV) globally. To address this, global think tanks, like the World Health Organization (WHO) recommend integrating HIV and NCD services. The successful gains from the well-established HIV care services at the primary health care (PHC) level risk being undermined by NCD-related deaths. Despite a consensus on the need for integration, there is limited data across the continent detailing the burden of the major NCDs, the cost, extent and frameworks for integrating HIV and NCD care at PHC level in SSA. This study aimed to review existing literature on the burden, extent, cost and frameworks of integrated HIV/NCD care at PHC level in the region.

Methods

A literature search was performed using PubMed Central and Google Scholar with specific keywords related to the thesis. Articles were selected if they included relevant information aligned with the study's objectives.

Findings

Several articles examined cardiovascular diseases (CVDs), particularly hypertension which is a major risk factor for CVD, and diabetes among PLHIV in SSA. However, there were fewer studies on the burden of cervical cancer and chronic respiratory diseases. There was a notable number of articles discussing mental illnesses among PLHIV.

Literature on the extent of integration of HIV and NCD services was sparse. Few articles addressed the cost and cost-effectiveness of integrated HIV/NCD care in the region, but those that did suggested that integration could be cost-effective. Additionally, only a few frameworks for integrating NCD care into HIV services at the PHC level in SSA were identified.

Conclusion

There is limited information on the burden, cost, extent and framework of integrated HIV/NCD care in SSA. Consequently, additional research is needed to better understand these aspects, which will promote and inform the implementation of integrated NCD care within HIV services at the PHC level in the region.

Keywords: Cost, extent, framework, HIV, integration and non-communicable diseases.

Introduction

HIV and non-communicable diseases (NCDs) such as diabetes, and cardiovascular diseases (CVDs) are both major public health challenges. [1]Traditionally, HIV programs have focused primarily on communicable disease management, while NCDs have been managed separately, often in different healthcare settings. However, the intersection of these conditions is increasingly recognized, especially as people living with HIV (PLHIV) experience longer life spans due to advances in antiretroviral therapy (ART). This shift has brought to light the growing prevalence of NCDs among this population and the need to integrate NCD services in existing HIV services.

Integration at primary health care (PHC) occurs at three levels, the micro (patient level), meso (health facility and community level) and macro level (policy level). [2] The advantages of integrating healthcare services are well-documented, and there is widespread agreement that this approach is essential for delivering comprehensive healthcare. Some of the benefits of integrated care include improved retention of patients and improved screening and detection of NCDs. [2, 3] The current challenge lies in the practical implementation of integrated HIV and NCD care at PHC facilities, particularly in under-resourced areas of Southern Africa. In SSA, even though the integration of HIV/NCD care is generally well accepted, there is insufficient data on the public domain describing the burden of the major NCDs and mental illnesses among PLHIV, from a nationally representative study population. Data on the extent of HIV and NCD care

integration in the region is even more limited, and there is a significant lack of information on the costs associated with integrating HIV/NCD care.

This study aimed to examine the existing literature on the burden, extent, cost and frameworks of integrated HIV/NCD care at PHC level in SSA.

Methods

A search was conducted on PubMed Central and Google Scholar using keywords related to the study, including HIV, NCD, integration, cost, SSA, extent, model and framework. The search was updated in July 2024 in order to capture the latest relevant publications. Articles were included if they addressed the topic and contained data related to HIV and NCDs such as prevalence, costs or frameworks.

The burden of NCDs among PLHIV

Cardiovascular Diseases

Cardiovascular diseases constitute a significant portion of all NCD related deaths globally, comprising 44% (17.9 million) of total fatalities. [1] While there is limited data on CVDs among PLHIV in LMICs, the burden of hypertension, a major risk factor for CVD is well documented in SSA. [4-13] People living with HIV are predisposed to CVDs due to factors such as HIV itself, effects of antiretroviral therapy (ART), and the increased risk associated with ageing. Several cardiovascular risk factors have been observed in PLHIV, including hypertension, obesity, diabetes, metabolic syndrome, and cardiovascular events (such as myocardial infarction and stroke) [14-18]. Hypertension, in particular, has been extensively studied among PLHIV in SSA with reported prevalence rates ranging

from 1.0% to 44.0%. [19]

This variability underscores the importance of further research to understand and address the cardiovascular health needs in this population. This thesis aims to address this issue.

Cancers

Cancers contribute to 22% (9 million) of all NCD-related deaths globally. [20] The PLHIV face an elevated risk of certain cancers compared to the general population. Among the most notable are the three main AIDS defining cancers (ADCs): Kaposi sarcoma, aggressive B-cell non-Hodgkin lymphoma and cervical cancer [21]. Despite the decrease in the burden of these ADCs with the introduction of combination ART, PLHIV still experience significantly higher risks compared to the general population. [21] Additionally, PLHIV face increased risks of non-ADCs, which continue to rise despite the availability of combination ART. These include cancers such as anal, liver, lung, oral cavity/pharynx cancers and Hodgkin lymphoma. [21, 22] Addressing these heightened risks is crucial in comprehensive HIV care and treatment strategies. This thesis aims to also explore this issue.

Diabetes

Diabetes contributes to 4% (1.6 million) of NCD deaths globally. [20] Among PLHIV, the prevalence of diabetes and other metabolic disorders is higher compared to the general population, with rates in SSA ranging from 1% to 13%. [19, 23] Similar to the general population, the burden of diabetes among PLHIV varies based on factors such as diet, genetic predisposition, and physical inactivity.

Nevertheless, PLHIV face an elevated risk of type 2 diabetes due to the virus itself and adverse effects of ART, analogous to other NCDs. [24] This investigation aims to ascertain the prevalence of diabetes among PLHIV in the region and to explore methodologies for implementing integration in a comprehensive manner.

Chronic Respiratory Diseases (CRDs)

Chronic respiratory diseases (CRDs) make up 9% (3.8 million) of all NCD deaths worldwide. [20] The PLHIV are particularly vulnerable to CRDs due to the nature of the infection and the impact of certain antiretroviral drugs on the pulmonary system. [25] Asthma is one of the most common CRDs among PLHIV with reported prevalence rates of 4.3% in SSA. This study aims to investigate the current burden of CRDs in the region and explore methods for implementing integration in under-resourced settings.

Mental Illnesses

Depression is the commonest mental health disorder among PLHIV. [23, 26] Depression and anxiety are more prevalent among PLHIV compared to the general population. [27] A study conducted in South Africa in 2007/8 reported that disruptive side effects of ART and stigma were associated with anxiety and stigma, with depression [28] among PLHIV and on ART. Stockton et al [29] conducted a study in Malawi where the prevalence of depression among PLHIV was at 27%, with poor retention observed in the general study population. Aspects of HIV care engagement, such as adherence, were not associated with depression in this study, but other findings have suggested that depression may affect adherence, which in turn may lead to escalated disease progression. [30]

Furthermore, Dessauvagie et al, [31] in a systematic review, reported prevalence of mental illnesses ranging from 24 to 50% among perinatally HIV infected adolescents of SSA. Some of the factors associated with mental illnesses among adolescents living with HIV include, but are not limited to, older age, poverty, not being in school, unsatisfactory relationships with health workers, longer travel time to the clinic, and poor social support. [31] This study aims to determine the burden of depression and explore the implementation of integrated HIV services that include mental health components.

NCD Risk Factors

Metabolic risk factors for NCDs include raised blood pressure, overweight/obesity, hyperglycaemia and hyperlipidaemia, [32] while the modifiable behavioural risk factors comprise of tobacco use (including second-hand smoke), physical inactivity, unhealthy diet, and the harmful use of alcohol.

Tobacco is known to be highly carcinogenic and daily tobacco smoking has been associated with several morbidities, including CVDs and lung cancer. [33, 34] Additionally, environmental air pollution is a major risk factor for NCDs comparable to current tobacco use and is responsible for millions of deaths from ischemic heart disease, chronic lung diseases and cancers. [20, 33] Physical inactivity and an unhealthy diet are associated with CVD, type 2 diabetes and certain cancers such as colon and breast cancer, hypertension, obesity and high low density lipoprotein (LDL) cholesterol. [35] The harmful use of alcohol is also associated with CVDs, cancers and liver diseases. [32] Regular screening and monitoring of NCD risk factors is crucial for reducing premature

mortality from NCDs through prevention, treatment and promotion of mental health and wellbeing by 2030. [32, 36, 37] The thesis also aims to ascertain the burden of risk factors and to investigate the implementation of integration that mitigates these.

NCDs and HIV Infection

Among PLHIV, NCDs are on the increase. [23, 38-40] PLHIV are at risk of contracting NCDs from HIV infection itself, from ART and from the risk associated with increasing age [19, 23]. Individuals on ART are now able to live longer, presenting opportunities for the development of chronic comorbidities, including CVD, diabetes, cancers, lipodystrophy and metabolic abnormalities [23, 38, 41].

NCDs and Economic Development

NCDs are a challenge to economic development. [20, 32] Globally, 37% of the deaths occur in people aged 30-69 years old, which is the working age group. Employers face high staff turnover due to prolonged absenteeism and eventually deaths. Household costs associated with health care increase in families that are already faced with financial difficulties in LMICs due to the chronic nature of the disease. [32, 42] NCDs tend to foster poverty as usually it is breadwinners whose lives are lost, thus leaving families in financial difficulties, especially in LMICs. According to WHO, NCDs threaten progress towards the 2030 Agenda for Sustainable Development Goals, that includes a target of reducing premature deaths from NCDs by one-third by 2030. [32, 42] For example, in South Africa, NCDs remain the major cause of death in the young working population and was previously reported to have a loss of US$1.88 billion from its gross domestic product due

to management of NCDs between 2006 and 2015. [42]

Models of Integrated HIV/NCD care in low- and medium-income countries (LMICs)

Njuguna et al [43] described five models of integrated HIV/NCD care in SSA. These are community-based HIV/NCD screening in the general population, screening for NCDs and respective risk factors among PLHIV enrolled in care, integrated care of HIV/NCD in healthcare facilities, differentiated care for stable HIV/NCD, and population health for all patients with any need. All the models described have their pros and cons, and population health for all patients is likely to have a positive impact on universal health coverage (UHC). For purposes of this study, the models that were investigated are screening and treatment for NCDs and their risk factors among PLHIV at primary health care facilities.

The extent of integrated HIV/NCD care at PHC facilities

In 2012, Ye et al [44] outlined a method for quantifying integration within an integrated service network in Canada. This approach produces three key metrics: a partnership score, an agency score, and a global integration score. While this method could be adapted to measure integration at the PHC level in Southern Africa with adequate resources, this thesis initially defined the extent of integration in qualitative terms. The extent of integration was defined as the inclusion of major noncommunicable diseases, namely; CVDs, diabetes, cancers and chronic respiratory diseases alongside mental illnesses, within HIV care services at PHC facilities. In examining the Southern African landscape, the thesis aimed to assess the extent of integration within the region. Given

the limited availability of publicly accessible data on the progress of integrated care, the focus has been primarily on the integration of HIV care with NCDs, especially CVDs (monitoring hypertension as a major risk factor for CVD) and diabetes. Additionally, recent articles have explored the integration of mental healthcare services with HIV care. However, comprehensive data on the national programmatic outcomes of integrating HIV and NCD care services in the region remains sparse.

A scoping review by Chireshe et al [45] revealed that integrated healthcare systems were reported in only eight countries in Sub-Saharan Africa: South Africa, Uganda, Kenya, the United Republic of Tanzania, Zambia, Malawi, Zimbabwe, and Swaziland. These countries have expanded their previously HIV-dedicated care facilities to include NCD services. Furthermore, Adeyemi et al [46] also found that some countries in East Africa had initiated HIV/NCD care and had some guidelines available. Kintu et al, [3] delved more into key considerations for policies on HIV/NCD integration but did not discuss the levels of integration. There is a clear deficit of data that explicitly discusses the extent of integration of HIV/NCD from national perspectives, hence providing a gap for further study. Chireshe et al, [45] highlights that most of the studies are project funded and hence are not nationally representative studies. There is an emergent need for national governments to consider exploring the progress of integration in their countries.

The cost of Integrating HIV/NCD care in SSA

Understanding the cost of HIV/NCD integration in healthcare is crucial, especially when considering the financial constraints that limit the implementation of integrated care, [47] that is often highlighted for its potential cost-effectiveness, but data from LMICs is limited. Nugent et al [48] have noted a lack of hard data from African primary studies to support the cost effectiveness of integrated HIV/NCD care, although study participants (healthcare workers and patients) generally believed that it would be cost effective.

Hyle et al [49] reported that cost effectiveness analysis in high income countries supports the cost effectiveness of integrated care, but evidence from LMICs remains sparse. In contrast, Sando et al [50] examined the integration of HIV/NCD care in Uganda and found that it was indeed cost effective, reducing the number of CVD events and averting several disability-adjusted life years (DALY's). This suggests that HIV/NCD integration is financially beneficial in the long term by preventing severe health outcomes that are expensive to manage. Similarly, Wroe et al, [51], in their study conducted in Malawi, used activity based costing (ABC) method to estimate that integrating NCDs into HIV care cost approximately US$327 per capita for 6,541 clients, or a total cost of US$2 138 907.10. This integration increased the overall HIV service budget by 15% but allowed for the care of a larger patient population. This highlights that while initial costs might rise, the overall cost per patient could be lower when the population served is larger, and the integrated HIV/NCD approach could lead to better health outcomes and resource utilization.

Shade et al [52] highlighted that the cost of integrating hypertension care into HIV services in rural East African health facilities added 2% to 4% to the cost of HIV care, which is a relatively modest increase. The additional costs were due to expenses related to medication and laboratory tests.

Shiri et al [53] conducted a socio economic cohort study in Tanzania and Uganda and found that the cost of integrating hypertension and diabetes into the HIV programs were higher compared to standalone treatments. This higher cost was attributable to the costs for medication and diagnostics. However, the finding that facility based personnel costs were similar across conditions suggests that the added costs were more related to the direct medical needs rather than to the operational expenses. Integrated care offers a cost effective method of patient care.

The Frameworks for integrated HIV/NCD care in Southern Africa

There are limited published conceptual or theoretical frameworks specifically focused on integrating HIV and non-communicable diseases (NCDs) care. Most existing frameworks address integrated PHC services for NCDs more broadly, including HIV care among other services, particularly in Southern Africa. The WHO's Innovative Care for Chronic Conditions (ICCC) framework has been foundational for the few frameworks that integrate HIV and NCD services. [54] The ICCC framework is structured around three levels of integration: the micro level (patient interaction), the meso level (healthcare organization and community), and the macro level (policy). It emphasizes that the best outcomes are

achieved through a collaborative triad of patients and families, healthcare teams, and community supporters. This triad is most effective when each member is informed, motivated, and equipped to manage chronic conditions, with strong communication and collaboration at all levels of health care. The effectiveness of this triad is enhanced by backing from the larger healthcare organization, the community at large, and conducive policies. When these elements are seamlessly integrated, patients and families actively participate in managing their chronic conditions, receiving robust support from both the healthcare team and the community. Decision makers can also use these “building blocks” to successfully implement integration of HIV and NCD services. Figure 1

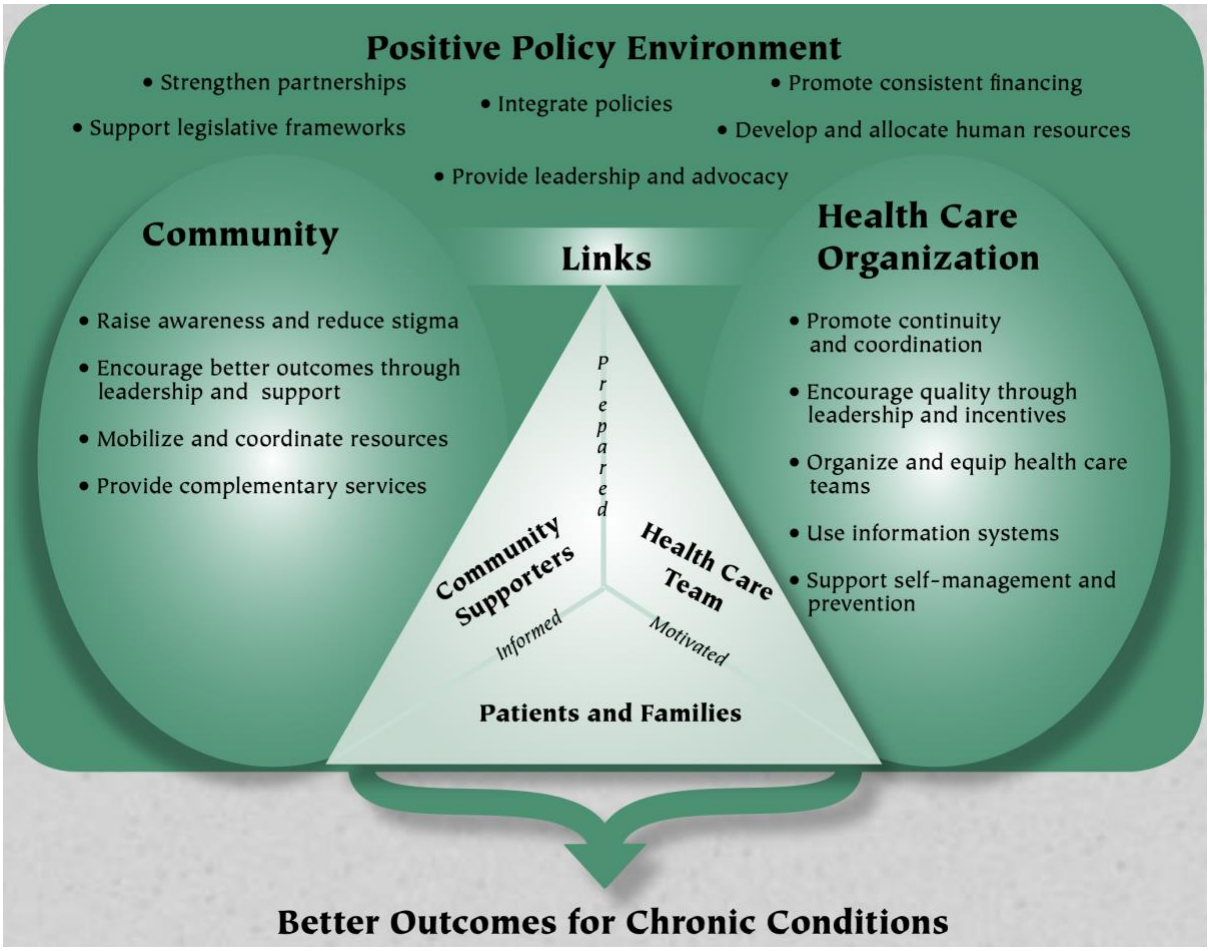

Figure 1: The innovative care for chronic conditions framework [54]

In 2017, the WHO Regional Office for Africa (WHO Afro) developed a framework aimed at integrating essential NCD services into PHC. [55] This framework was designed to strengthen PHC systems by incorporating comprehensive NCD management into existing services. The goal was to improve access to essential NCD care, enhance the efficiency of health systems, and better address the growing burden of NCDs in the region. The key themes in this framework were the need to adapt and utilise WHO

guidance documents for the prevention and control of NCDs at PHC level, building capacity for human resources for health to ensure that they are strengthened to deliver NCD prevention and control services at PHC level, improving access to essential NCD services in PHC facilities and ensuring that NCD surveillance systems are integrated into health management information systems. Another framework on integrating chronic disease care into PHC services in SSA was later developed by Simon et al. [56] This framework was also developed utilising the ICCC framework and the chronic care model (CCM) alongside data from systematic reviews and a primary study that specifically investigated integrating diabetes services into HIV care. Table 1 below provides a summary of the framework themes developed by Simon et al.

Framework themes	
1.	Effective team-working to deliver continuity and coordinated proactive care
2.	Organizational leadership, culture, and mechanisms to promote quality and safety
3.	Equipped health care teams to deliver evidence-based patient-centred care
4.	Empowerment and support of patients for self-management and prevention
5.	Use of data collection systems to facilitate effective care and follow-up
6.	Community partnerships to promote awareness, mobilize resources and support health service provision
7.	Improving patient access to chronic disease care
8.	Task shifting
9.	Clinical mentoring
10.	Stigma and confidentiality
11.	Patient provider partnerships

Table 1: Framework themes for integrated chronic disease care into primary healthcare services

Simon et al [56] used the Best Fit Framework Synthesis method (BFFS) to develop the new framework for integrating essential NCD services into PHC. [57] The BFFS method

involves creating *a priori* themes from selected studies and then coding data from reviewed studies according to the relevant themes. This approach systematically identifies and utilises published frameworks, models or theories which are further refined by primary studies included in the review. It utilises both framework and thematic analysis to develop the framework. By combining framework and thematic analysis (BFFS method), Simon et al [56] produced a framework that complements the WHO Afro's 2017[55] framework and the recent WHO guidelines on the implementation of integrating NCDs services into PHC services. [2]

Conclusion

There is a notable lack of data on the burden of NCDs among PLHIV in SSA. Information on the progress of integrating HIV and NCD services in the region is also scarce, and detailed costing data for HIV/NCD care remains limited. The situation highlights the need to build on existing frameworks and develop a framework for integrated HIV/NCD care. These gaps provide a solid foundation for pursuing the study objectives of this thesis.

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Chapter 3: Protocol & Results Paper - The burden of non-communicable diseases among people living with HIV in Sub-Saharan Africa

Chapter 3 presents the protocol and results paper for the systematic review and meta-analysis that aimed to determine the burden of non-communicable diseases among PLHIV in Sub Saharan Africa.

The systematic review and meta-analysis protocol was published in the BMJ Open journal, titled, “Protocol for updated systematic review and meta-analysis on the burden of non-communicable diseases among people living with HIV in sub-Saharan Africa.” https://bmjopen.bmj.com/content/12/5/e055895

The findings of the systematic review and meta-analysis were published in the EclinicalMedicine -The Lancet journal titled, “The burden of non-communicable diseases among people living with HIV in Sub-Saharan Africa: a systematic review and meta-analysis.” https://www.thelancet.com/journals/eclinm/article/PIIS2589-5370(23)00432-7/fulltext

BMJ Open

Protocol for updated systematic review and meta-analysis on the burden of non-communicable diseases among people living with HIV in sub-Saharan Africa

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ABSTRACT

Introduction Sub-Saharan Africa (SSA) is faced with the dual epidemics of HIV/AIDS and non-communicable diseases (NCDs). Cardiovascular diseases, cancers, chronic respiratory diseases, diabetes and mental illnesses are the five major NCDs, causing death globally with low-income and middle-income countries, contributing 78% of all NCD deaths and 85% of premature deaths. There has been increased interest in the integration of HIV and NCDs care, especially in SSA that accounts for 55% of people living with HIV (PLHIV) globally. This systematic review and meta-analysis will estimate the overall prevalence or incidence of NCDs (or its risk factors) among adults living with HIV in SSA.

Methods and analysis The Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines will be used. Two authors will independently screen the title and abstracts of the articles identified from the search. Study participants will be any adult (≥18 years old) living with HIV in SSA. Exposure of interest will be HIV (with or without ART). Outcomes of interest are prevalence or incidence of any NCD/NCD risk factors. A random-effects meta-analysis will be used to estimate pooled prevalence or incidence of the five major NCDs among PLHIV, using Stata software. χ^2 test and I^2 statistic will be used to measure statistical heterogeneity between studies. If there is significant heterogeneity, subgroup analysis will be used to investigate potential sources. Publication bias will be assessed using funnel plots and the Stata 'metabias' command.

Ethics and dissemination Ethical review will not be required because it is a systematic review. Data will be kept in the institutional data repository. Study findings will be disseminated through peer-reviewed publications and conference presentations.

PROSPERO registration number CRD42021258769.

Strengths and limitations of this study

- ⇒ The study aims to report the current burden of the five major non-communicable diseases (NCDs) and their respective risk factors among people living with HIV in sub-Saharan Africa.
- ⇒ Peer-reviewed studies published since 2010 will be reviewed.
- ⇒ PubMed/Medline, EBSCOhost and Scopus databases will be used to search for indexed publications.
- ⇒ Increased heterogeneity for some of the NCDs/risk factors may not allow for meta-analyses.

INTRODUCTION

Sub-Saharan Africa (SSA) is faced with the syndemic of HIV and non-communicable diseases (NCDs) that have been widely reported to be on the increase globally.[1–4] In 2016, NCDs accounted for 41 million deaths annually (71% of all deaths globally),[3] with over 85% of premature deaths (between the ages of 30 and 69 years) from NCDs, occurring in low-income and middle-income countries (LMICs).[3 5]

Cardiovascular diseases (CVDs), cancers, chronic respiratory diseases (CRDs) and diabetes are historically the four main groups of diseases that account for over 80% of all NCD-related deaths.[3 6 7] However, the WHO has recently classified mental illnesses as one of the main NCDs.[8] Moreover, in 2016, suicide was responsible for 800 000 deaths globally.[8] The NCDs are on the increase in LMICs that are also burdened with infectious diseases,[9–11] including COVID-19 pandemic, which is a current challenge. Furthermore, WHO has reported disruptions in NCD services due to the COVID-19 pandemic globally, including in 41 African countries. The main reasons for the disruption to the NCD services are the decrease in inpatient volume due to cancellation of elective services, closure of population-level screening, government or public transport lockdowns hindering access to the health facilities for patients, NCD-related clinical staff deployed to provide COVID-19 relief, closure of outpatient disease-specific consultation clinics, insufficient personal protective equipment available for healthcare providers to provide services, insufficient staff to provide services, closure of outpatient NCD services as per

government directive, decrease in outpatient volume due to patients not presenting and inpatient services/hospital beds not available and stock out of essential medicines, medical diagnostics or other health products at health facilities.[12] This disruption in NCD services has highlighted the need for poor resourced settings such as SSA to strengthen their health systems, also as a means of improving preparedness for future epidemics. Moreover, patients with pre-existing comorbidities were at a higher risk of severe disease due to the coronavirus, and hence a need to ensure that patients with NCD are well managed also as part of strengthening the health systems.

The increase in NCDs has been attributed to physical inactivity, unhealthy diets, harmful use of alcohol and tobacco in LMICs, just as in the developed countries.[3] Lifestyle changes in SSA due to the growth of urbanisation that entails more sedentary life style as urban work is often less physical, exposure to unhealthy diets that are high in salt, fat and sugar and pollution, among other factors have contributed to the NCD burden.[13] Among people living with HIV (PLHIV), there have been reports that HIV itself or antiretroviral therapy (ART) side effects predispose individuals further to NCDs.[14] In addition, the general increase in lifespan implies increased risk to age-related NCDs.

Modifiable behavioural risk factors for NCDs include, tobacco use (including secondhand smoke), physical inactivity, unhealthy diet and the harmful use of alcohol which consequently lead to raised blood pressure, overweight/obesity, hyperglycaemia and hyperlipidaemia.[7] Environmental air pollution has also been identified as a key risk factor for NCDs in general.[8]

Daily tobacco smoking has been associated with several morbidities, including CVDs and lung cancer.[15] Air pollution is also a major risk factor for NCD comparable to current tobacco use and is responsible for millions of deaths from ischaemic heart disease, chronic lung diseases and cancers.[8] Physical inactivity is also associated with CVD, type 2 diabetes, hypertension, obesity and high low density lipoprotein cholesterol and certain cancers such as colon and breast cancer.[16] Unhealthy diet is associated with obesity, increased risk of hypertension, diabetes, CVDs, cancers and CRDs. The harmful use of alcohol is also associated with CVDs, cancers and liver diseases.[2 7]

The NCDs are a challenge to economic development.[7 8 17] Globally, 37% of the deaths occur in people aged 30–69 years old, which is the working age group. As a result, employers face high staff turnover due to prolonged absenteeism and eventually deaths. Additionally, household costs associated with healthcare, increase in families that are already faced with financial difficulties in LMICs due to the chronic nature of the disease.[7 17] Indeed, NCDs tend to foster poverty as usually it is breadwinners whose lives are lost, thus leaving families in financial difficulties, especially in LMICs. According to WHO, NCDs threaten progress towards the 2030 Agenda for Sustainable Development that includes a target of reducing premature deaths from NCDs by one-third by 2030.[6 7] For example, in South Africa, NCDs remain the major cause of death in the young working population and was previously reported to have a loss of US$1.88 billion from its gross domestic product due to management of NCDs between 2006 and 2015.[17]

Among PLHIV, NCDs have equally been documented to be on the increase.[1 2 18 19] It has previously been reported that PLHIV are at risk of having NCDs from HIV infection itself, from ART and from the risk associated with increasing age. Individuals on ART are now able to live longer and therefore have an increased risk of chronic comorbidities, including CVD, diabetes, cancers, lipodystrophy and metabolic abnormalities.[2 18 20] SSA accounts for 55% of the 38 million PLHIV[21] globally. Therefore, it is imperative that NCDs among PLHIV are investigated and that public health systems in SSA implement integrated NCD/HIV care for PLHIV, allowing for comprehensive healthcare provision. Patel *et al*,[2] a systematic review, included articles published between 2010 and 2016 on the burden of NCDs among PLHIV in LMICs. However, it has not been updated and there have been several publications between 2017 and 2021. This systematic review will update the evidence from 2010 to the present date and report on changes in trends of NCD burden in the HIV population. The updated systematic review will include CRDs that were excluded in the previous systematic review.[2] The systematic review and meta-analysis will be conducted using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses of 2020.[22]

AIM

The aim of the systematic review and meta-analysis is to determine the burden of NCDs and NCD risk factors among PLHIV in SSA.

Objectives

1. To determine the prevalence or incidence of any NCD (five main NCDs) among PLHIV in SSA.
2. To determine the prevalence or incidence of risk factors of any NCD among PLHIV in SSA.
3. To determine if there is an association between being on ART and NCDs and/or NCD risk factors among PLHIV in SSA.

METHODS

Eligibility criteria

Any study published between 2010 to the current date, that focuses on the burden of any of the five major NCDs and their respective risk factors among PLHIV in SSA will be eligible. Two authors will independently screen the title and abstracts of the articles identified from the search. Study participants will be any adult (≥18 years old) living with HIV in SSA. The main exposure of interest will be HIV. Outcomes of interest are prevalence or incidence of any NCD or NCD risk factors in HIV populations. Study designs that will be reviewed are observational studies

(cross sectional and cohort), HIV and NCD reports, systematic reviews, Demographic and Health Surveys and other similar studies.

Information sources

The electronic databases that will be searched for eligible peer reviewed articles are PubMed/MEDLINE, Scopus and EBSCOhost online databases. A PubMed/MEDLINE search strategy will be developed and adapted for all other databases. Boolean operators, Medical Subject Heading terms and key words will be used as part of the search strategy. Where necessary, study authors will be contacted for verification of published data.

Grey literature will also be searched for relevant studies. A hand search for key HIV/AIDS and NCD journals will be conducted.

Bibliographies of the included studies will be checked as a measure to identify further eligible studies. Included studies will be corroborated with those included in the previously published systematic reviews.

All studies investigating NCDs and their associated risk factors among PLHIV since 2010 will be included. HIV studies that do not include any of the five main NCDs will be excluded. Clinical trials and systematic reviews will be included for bibliographic searches but will be excluded for the meta-analysis. Studies within the scope of this study that were published before 1 January 2010 will be excluded. The date of the last search will be documented.

Outcomes

Primary outcomes

- The prevalence or incidence of any NCD (five main NCDs) among PLHIV in SSA.
- The prevalence or incidence of NCD risk factors for any NCD among PLHIV in SSA.

Secondary outcomes

- ORs or risk ratios for association of exposure to ART and NCDs and NCDs risk factors among PLHIV in SSA.

  The keywords to be used in the search are HIV/AIDS, NCDs, CVD, hypertension, hyperlipidaemia, dyslipidaemia, diabetes, cancer, cervical cancer, mental illnesses, depression, CRDs and asthma.

Search strategy

A modified search strategy of Patel *et al*[2] will be used. Below is PubMed/Medline search strategy for 'cardiovascular disease' as indicated by Patel *et al*. A similar strategy will be employed for the other four NCDs and risk factors of interest.

Cardiovascular (PLWH* OR PLWHA* OR "people living with HIV" OR "people living with HIV/AIDS" OR "people living with" OR "people living with aids" OR "people living with hiv" OR "people living with hiv/aids" OR "people living with hiv/aids plwha" OR "people living with hiv/aids plwhas" OR "people living with hiv aids" OR "people living with hiv aids plwha" OR "people living with hiv aids plwhas" OR "people living with hiv and aids" OR "people living with hiv infection" OR "people living with hivs" OR "people living with human immunodeficiency virus" OR "people living with human immunodeficiency virus/acquired immunodeficiency syndrome" OR "people living with human immunodeficiency virus acquired immunodeficiency syndrome" OR "people living with hiv" OR "HIV Infections"[mesh] OR "HIV infection" OR "HIV infections" OR PLWHIV OR "HIV positive" OR "HIV-positive" OR "HIV+" OR "HIV infected" OR "HIV-infected" OR "HIV seropositivity"[mesh] OR "HIV seropositivity") AND OR Cote d'Ivoire[mesh] OR Ethiopia[mesh] OR Kenya[mesh] OR Malawi[mesh] OR South Africa[mesh] OR Uganda[mesh] OR Zambia[mesh] OR Ivory Coast[tiab] OR Cote d'Ivoire[tiab] OR Ethiopia[tiab] OR Kenya[tiab] OR Malawi[tiab] OR South Africa[tiab] OR Uganda[tiab] OR Zambia[tiab] OR "sub Saharan Africa" OR "sub-saharan Africa" OR Africa[tiab] OR Africa[mesh] OR "sub saharan Africa" OR "developing country" OR "developing countries" OR Cameroon[tiab] OR Central African Republic[tiab] OR Chad[tiab] OR Congo[tiab] OR Equatorial Guinea[tiab] OR Gabon[tiab] OR Democratic Republic of the Congo[tiab] OR Burundi[tiab] OR Djibouti[tiab] OR Ethiopia[tiab] OR Kenya[tiab] OR Rwanda[tiab] OR Somalia[tiab] OR Sudan[tiab] OR Tanzania[tiab] OR Uganda[tiab] OR Angola[tiab] OR Botswana[tiab] OR Lesotho[tiab] OR Malawi[tiab] OR Mozambique[tiab] OR Namibia[tiab] OR South Africa[tiab] OR Swaziland[tiab] OR Zambia[tiab] OR Zimbabwe[tiab] OR Benin[tiab] OR Burkina Faso[tiab] OR Cote D'ivoire OR Gambia OR Ghana OR Guinea OR Guinea-Bissau OR Liberia OR Mali OR Mauritania OR Niger[tiab] OR Nigeria[tiab] OR Senegal[tiab] OR Sierra Leone[tiab] OR Togo[tiab] OR Cameroon[mesh] OR Central African Republic[mesh] OR Chad[mesh] OR Congo[mesh] OR Equatorial Guinea[mesh] OR Gabon[mesh] OR Democratic Republic of the Congo[mesh] OR Burundi[mesh] OR Djibouti[mesh] OR Ethiopia[mesh] OR Kenya[mesh] OR Rwanda[mesh] OR Somalia[mesh] OR Sudan[mesh] OR Tanzania[mesh] OR Uganda[mesh] OR Angola[mesh] OR Botswana[mesh] OR Lesotho[mesh] OR Malawi[mesh] OR Mozambique[mesh] OR Namibia[mesh] OR South Africa[mesh] OR Swaziland[mesh] OR Zambia[mesh] OR Zimbabwe[mesh] OR Benin[mesh] OR Burkina Faso[mesh] OR Cote D'ivoire[mesh] OR Gambia[mesh] OR Ghana[mesh] OR Guinea[mesh] OR Guinea-Bissau[mesh] OR Liberia[mesh] OR Mali[mesh] OR Mauritania[mesh] OR Niger[mesh] OR Nigeria[mesh] OR Senegal[mesh] OR Sierra Leone[mesh] OR Togo[mesh] OR "Africa, Central"[Mesh] OR "Africa, Eastern"[Mesh] OR "Africa, Southern"[Mesh] OR "Africa, Western"[Mesh]) AND (Cardiovascular Diseases[mesh] OR Heart Diseases[mesh] OR hypertension[mesh] OR stroke[mesh] OR cardiovascular OR "heart disease" OR hypertension OR "high blood pressure" OR stroke OR "heart attack" OR "Coronary Disease"[Mesh] OR "Cerebrovascular Disorders"[Mesh] OR "Pulmonary Embolism"[Mesh] OR "Peripheral

Arterial Disease"[Mesh] OR "Peripheral Vascular Diseases"[Mesh] OR "Rheumatic Heart Disease"[Mesh] OR "Venous Thrombosis"[Mesh] OR "coronary disease" OR "pulmonary embolism" OR "cerebrovascular disorder" OR "cerebrovascular disease" OR "peripheral arterial disease" OR "rheumatic heart disease" OR "deep vein thrombosis" OR "ischemic heart disease" OR "heart failure" OR "coronary heart disease" OR "cardiovascular disease" OR "Inflammation"[Mesh] OR inflammation OR inflame* OR "Atherosclerosis"[Mesh] OR atherosclerosis OR "Metabolic Syndrome X"[Mesh] OR "metabolic cardiovascular syndrome" OR "metabolic syndrome" OR "metabolic syndrome X" OR "insulin resistance syndrome X" OR "metabolic X syndrome" OR "cardiovascular biomarker" OR "inflammation biomarker" OR "endothelial function" OR "Interleukin-6"[Mesh] OR IL-6 OR "C-Reactive Protein"[Mesh] OR "C Reactive Protein" OR "C-Reactive Protein" OR "Carotid Intima-Media Thickness"[Mesh] OR "carotid intima media thickness" OR "carotid intima-media thickness" OR "Cholesterol"[Mesh] OR cholesterol OR "Angiography"[Mesh] OR angiography OR "HydroxymethylglutarylCoA Reductase Inhibitors"[Mesh] OR "Hydroxymethylglutaryl CoA Reductase Inhibitors" OR "HMG-CoA Statins" OR "HMG-CoA Reductase Inhibitors" OR "Fluorodeoxyglucose F18"[Mesh] OR 18F-FDG OR "18F FDG" OR "Fluorodeoxyglucose F 18" OR "2-Fluoro-2-deoxy-D-glucose" OR "Venous Thromboembolism"[Mesh] OR "venous thromboembolism" OR cardiometabolic OR "Myocardial Infarction"[Mesh] OR "myocardial infarction" OR "myocardial infarct" OR "Vascular Diseases"[Mesh] OR "vascular disease" OR "Coronary Artery Disease"[Mesh] OR "coronary artery disease" OR "Myocarditis"[Mesh] OR myocarditis OR "Cardiomyopathies"[Mesh] OR cardiomyopathy OR cardiomyopathies OR "cardiac disease" OR "cardiac arrhythmias" OR "Arrhythmias, Cardiac"[Mesh] OR arrhythmia* OR "myocardial disease" OR "myocardial diseases" OR myocardiopathy OR myocardiopathies OR carditis OR "dyslipidemias"[MeSH] OR dyslipidemia OR hyperlipidemia OR hypercholesterolemia OR hypertriglyceridemia OR triglyceride OR triglycerides OR HDL OR LDL OR VLDL OR "Lipoproteins, HDL"[Mesh] OR "Lipoproteins, LDL"[Mesh] OR "Lipoproteins, VLDL"[Mesh] OR hyperlipoproteinemia OR lipoprotein(a) OR hyperlipidaemia OR hypercholesterolaemia OR hypertriglyceridaemia OR "Blood Pressure"[MeSH] OR "blood pressure" OR "systolic blood pressure" OR "diastolic blood pressure" OR SBP[tiab] OR DBP[tiab])

Study selection

Two independent review authors will screen the potentially relevant titles and abstracts according to the pre specified eligibility criteria. Selected articles from the respective databases will be transferred to EndNote V.20 (https://endnote.com/). These articles will then be transferred to Rayyan software (https://www.rayyan.ai/) for screening of titles and abstracts. Full-text articles will be retrieved after screening the titles and abstracts. Any disagreements arising from record screening will be resolved through discussion.

Data extraction

A predesigned data extraction form will be used by two review authors who will independently extract data on prevalence or incidence of any NCD (CVD, cancer, mental illness (specifically, depression), CRD and diabetes) among PLHIV, prevalence or incidence of NCD risk factors (hypertension, hyperlipidaemia, dyslipidaemia, physical inactivity, obesity, smoking and pollution) in PLHIV, study design, sample size, participants' age, recruitment methods, study country and date of study publication. The same review authors will independently assess each included study for risk of bias with respect to sequence generation, incomplete outcome data, selective reporting and other potential sources of bias.

Discrepancies will be resolved by discussion or by consulting with a third review author. Data will beexported to Stata V.16 (Stata IC/V.16.0, StataCorp) for meta-analysis.

The strength of the body of evidence will be assessed using the Grading of Recommendations, Assessment, Development and Evaluations framework.

Missing data

Study authors will be contacted concerning missing data on either outcomes or risk of bias.

Data synthesis

Meta-analysis will be performed using the 'metan' and 'metaprop' commands in Stata V.16. A random-effects meta-analysis will be used to estimate pooled prevalence or incidence of the five major NCDs among PLHIV. The pooled prevalence or incidence of hypertension, hyperlipidaemia, obesity, overweight and waist circumference in addition to the prevalence of modifiable risk factors (tobacco use, alcohol intake, diet and physical activity) will be determined. The main outcome of interest will be the prevalence of NCD and NCD risk factors among PLHIV with respective 95% CIs. Forest plots will be constructed to display meta-analysis results. χ^2 test and I^2 statistic will be used to measure statistical heterogeneity between studies. If there is significant heterogeneity, subgroup analysis will be used to investigate potential sources; this may include the type of NCD, country or gender (male/female). Publication bias will be assessed using funnel plots and the Stata 'metabias' command.

As part of the analysis, we will compare the systematic review results with Patel *et al*[2] and note any differences in the cumulative prevalence/incidence of NCDs among PLHIV post 2016.

The study is scheduled to start in December 2021 and end by June 2022.

Patient and public involvement

No patient involved.

Contributors MM: conception of the study, writing-original draft and editing; AM: conception and design of the study, writing-reviewing and editing, supervision. All authors approved the final version to be submitted.

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Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

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Following the protocol is the results paper for the systematic review and meta-analysis describing the burden of non-communicable diseases among people living with HIV in Sub Saharan Africa. The findings revealed a significant burden of NCDs and NCD risk factors in this population, with hypertension being the most extensively studied followed by overweight/obesity, smoking and diabetes. Cervical cancer and chronic respiratory diseases were the least studied NCDs. Overweight/obesity and depression had the highest prevalences in this population. Despite the systematic review and meta-analysis including 188 studies, these only represented 21 countries, representing less than 50 % coverage of the region.

The burden of non-communicable diseases among people living with HIV in Sub-Saharan Africa: a systematic review and meta-analysis

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Summary

Background Non-communicable diseases (NCDs) are increasing among people living with HIV (PLHIV), especially in Sub-Saharan Africa (SSA). We determined the prevalence of NCDs and NCD risk factors among PLHIV in SSA to inform health policy makers.

Methods We conducted a systematic review and meta-analysis on the prevalence of NCDs and risk factors among PLHIV in SSA. We comprehensively searched PubMed/MEDLINE, Scopus, and EBSCOhost (CINAHL) electronic databases for sources published from 2010 to July 2023. We applied the random effects meta-analysis model to pool the results using STATA. The systematic review protocol was registered on PROSPERO (registration number: CRD42021258769).

Findings We included 188 studies from 21 countries in this meta-analysis. Our findings indicate pooled prevalence estimates for hypertension (20.1% [95% CI:17.5–22.7]), depression (30.4% [25.3–35.4]), diabetes (5.4% [4.4–6.4]), cervical cancer (1.5% [0.1–2.9]), chronic respiratory diseases (7.1% [4.0–10.3]), overweight/obesity (32.2% [29.7–34.7]), hypercholesterolemia (21.3% [16.6–26.0]), metabolic syndrome (23.9% [19.5–28.7]), alcohol consumption (21.3% [17.9–24.6]), and smoking (6.4% [5.2–7.7]).

Interpretation People living with HIV have a high prevalence of NCDs and their risk factors including hypertension, depression, overweight/obesity, hypercholesterolemia, metabolic syndrome and alcohol consumption. We recommend strengthening of health systems to allow for improved integration of NCDs and HIV services in public health facilities in SSA. NCD risk factors such as obesity, hypercholesterolemia, and alcohol consumption can be addressed through health promotion campaigns. There is a need for further research on the burden of NCDs among PLHIV in most of SSA.

Funding This study did not receive any funding.

Keywords: Non-communicable diseases; People living with HIV; Sub-Saharan Africa; HIV/AIDS; Systematic review; Meta-analysis

Introduction

Non-communicable diseases (NCDs) have become a global public health emergency, particularly in low- and middle-income countries (LMICs) where most (85%) premature deaths occur due to NCDs.[1] NCDs affect the developing economies of LMICs[2] since most deaths occur in the productive age group (30–69 years), leading to a diminished workforce. Employees are often absent from work due to the chronic nature of NCDs and in the event of death, families are left with financial difficulties. The World Health Organization (WHO) has iterated that NCDs threaten progress towards achieving the 2030 Sustainable Development Goals (SDG's), particularly SDG target 3.4, which aims to reduce premature deaths due to NCDs by one-third through prevention, treatment, and promotion of mental health and well-being.[3]

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Research in context

Evidence before this study

The previous systematic review by Patel and colleagues published in 2018, which included 52 low-and-middle-income country (LMIC) studies from 2010 to 2016, found pooled prevalence estimates of 21.2% for hypertension, 27.2% hypercholesterolemia, 7.8% obesity, 24.4% depression, 1.3%–1.7% invasive cervical cancer and 1.3%–18% diabetes, among people living with HIV. However, several studies on the prevalence of NCDs and their risk factors have now been published, and there is an urgent need to update the evidence.

Added value of this study

In this study, we included updated evidence from 188 studies from 21 countries, representing 2,838,350 people living with HIV (PLHIV) from Sub-Saharan Africa (SSA), which has the largest number of PLHIV, from 2010 to July 2023. Our findings show that the burden of NCDs/NCD risk factors among PLHIV in SSA is 20.1% for hypertension, 30.4% for depression, 21.3% for hypercholesterolemia, 32.2% for overweight/obesity, and 5.4% for diabetes. We also report on the burden of more NCDs/risk factors, including chronic respiratory diseases that were not included in the previous systematic review.

Implications of all the available evidence

Our findings confirm that the burden of NCDs among PLHIV is a public health emergency that SSA needs to address. The provision of integrated HIV and NCD services at primary health care facilities needs to be strengthened. The NCD risk factors such as obesity, harmful use of alcohol and tobacco use, can be addressed by health promotion campaigns.

The introduction of antiretroviral therapy (ART) for people living with HIV (PLHIV) has increased their life expectancy; however, this has also increased their risk of acquiring NCDs as they age. NCDs are increasing in Sub-Saharan Africa (SSA), the region with the highest burden of HIV.[1] In SSA, urbanisation has exacerbated the burden of modifiable risk factors for NCDs[4,5] such as sedentary lifestyles, unhealthy diets, harmful use of alcohol and tobacco, and exposure to pollution.[6,7] On top of these factors, the effects of HIV along with the adverse effects of ART,[8,9] may increase the risk of NCDs among PLHIV.[10] According to the WHO, deaths due to the four major NCDs (cardiovascular disease (CVD), diabetes, cancers, chronic respiratory diseases (CRDs), and mental illnesses have increased.[11] In particular, among PLHIV, the four most common conditions are CVDs, cervical cancer, diabetes, and depression.[1]

Knowledge of the burden of NCDs among PLHIV can inform health-policy makers on how to strengthen health systems in SSA. This knowledge will likely foster the integration of NCD/HIV care at primary health care facilities in the region, and hence improve comprehensive healthcare delivery.

A 2018 published systematic review on the burden of NCDs among PLHIV in LMICs[12] included articles published between 2010 and 2016. Several articles have been published since 2016, and the evidence needs to be updated. In this systematic review, we updated evidence on the burden of NCDs and NCD risk factors among PLHIV in SSA. We included studies published from 2010 to July 2023, and we report on changes in trends of the burden of NCDs among PLHIV.[13] Our systematic review also included chronic respiratory diseases (CRDs), which were excluded from the previous systematic review.[12]

Methods

The systematic review protocol was registered on PROSPERO (registration number: CRD42021258769) and methods are described in full in the published protocol.[13]

Eligibility criteria

Studies published between 2010 and July 2023 that focused on the burden of any of the five major NCDs and their respective risk factors among PLHIV in SSA were eligible for inclusion. Studies published before January 1, 2010 were excluded. We did not include articles that we could not access. Clinical trials and systematic reviews were noted for bibliographic searches but were excluded from the systematic review.

Two authors independently screened the titles and abstracts of the articles identified from the search. Study participants were any adult (≥13 years old) living with HIV in SSA. The main exposure of interest was HIV. Outcomes of interest were prevalence of any NCD or NCD risk factors in HIV populations. Study designs that were reviewed included observational studies (cross sectional and cohort), interventional studies, case control studies, longitudinal studies, HIV and NCD reports, Demographic and Health Survey (DHS) articles, and other similar studies.

Data sources

We searched for eligible peer reviewed articles on the PubMed/MEDLINE, Scopus, and EBSCOhost online databases. A PubMed/MEDLINE search strategy was developed and adapted for all other databases as suggested by Patel and coworkers.[12] Boolean operators, Medical Subject Heading (MESH) terms, and key words were used as part of the search strategy. Bibliographies of the included studies were used to identify further

eligible studies. Grey literature was also searched for relevant studies. Included studies were corroborated with those included in previously published systematic reviews. The date of the last search was July 19, 2023.

Search strategy

Details of the search strategy are provided in Supplementary materials–Appendix I. EndNote X20 (Clarivate Analytics, Philadelphia, PA) and Rayyan software[14] were used to collect, review, de-duplicate, and manage citations.

Data extraction

A predesigned data extraction form was used by two review authors (MMC and KM), who independently extracted data on the prevalence of any of the following NCDs among PLHIV: cervical cancer, depression, CRD, and diabetes. We also extracted data on the prevalence of NCD risk factors, including hypertension, hypercholesterolemia, obesity, smoking, and alcohol consumption in PLHIV. For each article, we recorded the study design, sample size, participants' age, recruitment methods, study country, and date of publication. Discrepancies were resolved by discussion with a third review author (AM). The data were exported to Stata V.17 (Stata IC/V.17.0, StataCorp) for meta-analysis.

Data synthesis

Meta-analysis was performed using the 'metan' and 'metaprop' commands in Stata V.17. A random-effects meta-analysis was used to estimate pooled prevalence of hypertension, diabetes, cervical cancer, CRDs, depression, hypercholesterolemia, overweight/obesity, metabolic syndrome, current smoking, and alcohol consumption. The main outcome of interest was the prevalence of NCD or NCD risk factors among PLHIV with respective 95% confidence intervals (CI). We zeroed negative 95% CIs to avoid negative prevalence measures. Forest plots were constructed to display meta-analysis results. The Chi-square test and I^2 statistic were used to measure statistical heterogeneity between studies. We used the Doi plots and LFK index (lfk command)[15] to check the potential effect of publication bias on the meta-analysis. Approximately, LFK index between −1 and 1 may indicate symmetry (absence of publication bias) while values outside of this range may signify potential for publication bias.[15]

Role of funding

This study did not receive any funding.

Results

Results of the search

We retrieved 7857 studies from three electronic databases (PubMed/Medline, Scopus, and EBSCOHost). After removing 1350 duplicate records and 2487 records that had titles mismatching our study topic, we were left with 4020 records for abstract screening. Abstract screening resulted in the exclusion of 3448 non relevant records. We tried to retrieve the full texts of 572 records, but were unable to retrieve 17 records, which left 555 full-text reports that were assessed for eligibility by two review authors. Finally, 367 records were excluded after full-text screening, and 188 studies were included in this systematic review and meta-analysis (Fig. 1).

Characteristics of included studies

The 188 included studies were from 21 countries representing 2,838,350 PLHIV (Table 1), in SSA (Fig. 2), namely; Benin,[16] Burkina Faso,[17–19] Burundi,[20,21] Cameroon,[22–34] Cote d'Ivoire,[35] Democratic Republic of Congo (DRC),[36,37] Eriteria,[38] Eswatini,[39] Ethiopia,[40–64] Ghana,[65–73] Guinea Bissau,[74] Kenya,[4,75–95] Lesotho,[96] Malawi,[97–104] Mozambique,[105] Nigeria,[94,95,106–123] South Africa,[8,124–150] United Republic of Tanzania,[10,94,95,151–163] Uganda,[94,95,164–189] Zambia,[190–196] and Zimbabwe.[194,197–200] We reviewed two multi-country studies, as indicated in Fig. 2.[94,95]

Many of the included studies were cross sectional (n = 153, 81%), and we only reviewed two intervention studies that included baseline data on the burden of NCDs/risk factors (Fig. 3).

In total, 96 (53%) studies reported prevalence of hypertension among PLHIV in SSA, followed by overweight/obesity (n = 85, 45%), smoking (n = 84, 45%), diabetes (n = 73, 39%), depression (n = 38, 20%), current consumption of alcohol (n = 61, 32%), hypercholesterolemia (n = 41, 22%), and metabolic syndrome (n = 22, 12%) Cervical cancer (n = 12, 6%) and CRD (n = 11, 6%) were reported in the fewest studies (Fig. 4).

The burden of NCDs among PLHIV

Detailed results are given separately for each NCD/risk factor.

Hypertension

Most studies (n = 97)[20,150,151,154,156,158–162] reviewed, reported on hypertension among PLHIV in SSA with a pooled prevalence of 20.1% (95% CI:17.5–22.7). Most of the studies (n = 18) were from Uganda.[16,165,167,170–174,176,179–183,186–189] South Africa followed with 15 studies.[8,125,126,131–133,135–137,140,141,145,148–150] In 2021, Chiwandire[126] reported trends for hypertension over three time points (2005, 2008, and 2017) in South Africa, and this study is indicated three times on the forest plot. Tanzania,[10,16,151,152,155,157,159–163] and Kenya,[4,16,75–79,86,90,92,93] each had eleven studies. Ethiopia[40,42,47,50,53,55,61,64] and Nigeria[16,108,109,113,114,119,121,123] each had eight studies. Cameroon[22,23,27,29–31] had six studies,[25,107,108,112,113,118,120,122] while Ghana[65,66,68,71,72] had five studies. Malawi[97,98,100,104] and Zimbabwe[194,197,199,200] each had four studies while Zambia,[190,194] and Burkina Faso[17,19] each had two studies. Burundi,[21] DRC,[36] Lesotho,[96] and Mozambique[105] each had one study. Despite the definition of hypertension being

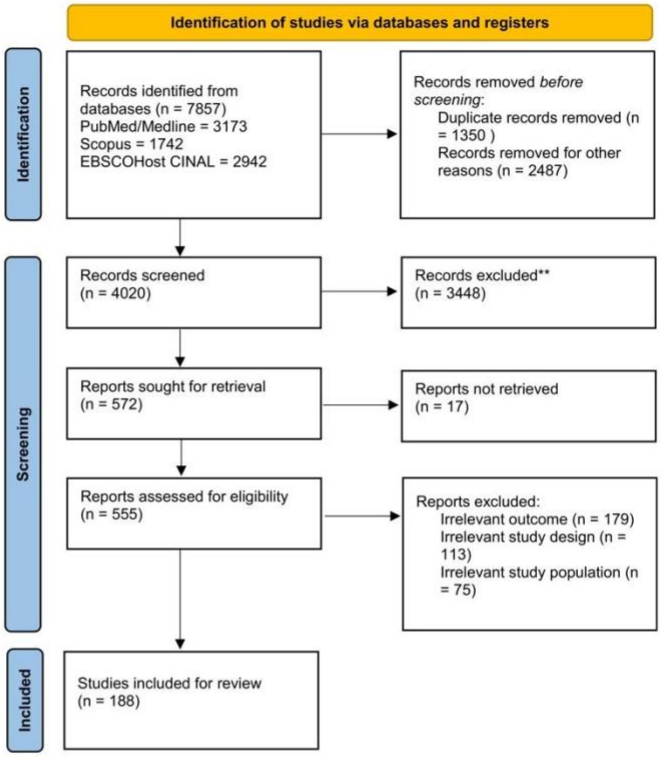

Fig. 1: Selection of studies on non-communicable diseases among people living with HIV (PLHIV) in Sub-Saharan Africa (SSA).

similar across studies, the prevalence of hypertension ranged very widely from 1% in Kenya[76] and South Africa[145] to 52.9% in South Africa,[150] hence there was very high heterogeneity across studies (I^2 = 98.1%) (Fig. 5). However, the LFK index (=1.59), and the Doi plot (Supplementary material; Appendix III: Fig. A) indicated evidence of minor upward potential for publication bias.

Depression

We reviewed 38 studies reporting depression among PLHIV in SSA with a pooled prevalence of 30.4% (95% CI: 25.3–35.4). Most studies (n = 10) reporting depression were conducted in Ethiopia.[41,43–45,48,51,52,56–58] Nigeria followed with seven studies[106,112,115–119] while Cameroon[24–26,28,32] had five studies. Uganda[164,169,173,175] and South Africa[124,129,138,147] had four studies each. Ghana,[70,73] Malawi[101,102] and Zambia[193,195] each had two studies. Tanzania,[156] and Zimbabwe[198] each had one study. Different tools were used to measure depression across studies, but the most common tool was the patient health questionnaire module for depression (PHQ-9). The prevalence of depression across studies was very wide, from 5.3% in Nigeria[116] to 81.6% in Ethiopia[52] with very high heterogeneity (I^2 = 97.4%) (Fig. 6). The LFK index (3.57) and the corresponding doi plot (Supplementary material; Appendix III: Fig. B) suggested potential of major upward publication bias.

Diabetes

In this review, 73 studies reported the burden of diabetes among PLHIV in SSA with a pooled prevalence of 5.4% (95% CI: 4.4–6.4). Most of the studies reporting the prevalence of diabetes were from South Africa (n = 13),[126,127,130–133,135–137,140,141,145,146] followed by Ethiopia (n = 9)[40,46,47,49,50,54,55,59,64] and Tanzania (n = 9).[10,95,152–154,159,161–163] Kenya[4,76,78,87,90,91,95] and Uganda[95,165,167,173,180,182,183] each had seven studies. Cameroon,[27,29–31] Ghana,[65–67,69] Malawi,[97,98,100,104] Nigeria,[95,108,110,114] and Zimbabwe[194,197,199,200]

Study ID	Country	Study setting	Study design	Number of PLHIV	Age in years/age range	Female Sex	Hypertension	Depression	Diabetes	Cervical Cancer	CRD	Smoking	Alcohol	Overweight/ obese	Hypercholesterolemia	Metabolic syndrome
Codjo 2022	Benin	HIV clinic	Cross sectional	114	18+	72%	√	X	√	X	X	√	X	X	X	√
Diallo 2017	Burkina Faso	HIV clinic	Cohort	3367	15+	70%	√	X	X	X	X	X	X	X	√	X
Guira 2016	Burkina Faso	HIV clinic	Cross sectional	300	18+	69%	X	X	X	X	X	X	√	√	√	√
Tougouma 2021	Burkina Faso	HIV clinic	Cohort	123	36-50	79%	√	X	√	X	X	√	X	√	√	X
Ndizeye 2019	Burundi	HIV clinic	Cross sectional	680	25-65	100%	X	X	X	√	X	√	√	X	X	X
Harimenshi 2023	Burundi	HIV clinic	Cross sectional	1250	35-50	82%	√	X	√	X	X	√	√	√	X	X
Dimala 2016	Cameroon	HIV clinic	Cross sectional	200	21+	70%	√	X	X	X	X	√	√	√	X	X
Dzudie 2021	Cameroon	Database	Cross sectional	9839	18+	66%	√	X	X	X	X	√	√	√	X	X
Gaynes 2012	Cameroon	HIV clinic	Cross sectional	400	18+	74%	X	√	X	X	X	X	X	X	X	X
Kanmogne 2016	Cameroon	HIV clinic	Cross sectional	169	18+	80%	X	√	X	X	X	X	X	X	X	X
L'akoa 2013	Cameroon	HIV clinic	Cross sectional	100	18-62	52%	X	√	X	X	X	X	X	X	X	X
Ngu 2018	Cameroon	HIV clinic	Cross sectional	311	22-73	84%	√	X	√	X	X	√	X	√	X	X
Ngum 2017	Cameroon	HIV clinic	Cross sectional	300	22-74	73%	X	√	X	X	X	X	X	X	X	X
Noumegni 2017	Cameroon	HIV clinic	Cross sectional	452	30-74	80%	√	X	√	X	X	X	X	√	√	√
Nsagha 2015	Cameroon	HIV clinic	Cross sectional	215	21-73	75%	√	X	√	X	X	√	X	√	√	X
Rhee 2016	Cameroon	HIV clinic	Cross sectional	500	16-65	73%	√	X	√	X	X	X	X	√	X	X
Filiatreau 2022	Cameroon	HIV clinic	Cohort	426	21-40	59%	X	√	X	X	X	X	X	X	X	X
Pambou 2023	Cameroon	HIV clinic	Cross sectional	112	50-77	63%	X	X	X	X	X	√	√	√	√	X
Parcesepe 2022	Cameroon	Database	Cross sectional	12,507	18+	66%	X	X	X	X	X	√	X	X	X	X
Jaquet 2014	Cote d'Ivoire	Database	Cross sectional	2998	25+	100%	X	X	X	√	X	X	X	X	X	X
Mukeba-Tshialala 2017	DRC	HIV Clinic	Cross sectional	445	18+	58%	√	X	√	X	X	X	X	X	√	X
Ndona 2012	DRC	HIV clinic	Cross sectional	102	18+	51%	X	X	√	X	X	√	√	X	X	X
Achila 2022	Eritrea	HIV clinic	Cross sectional	382	18-82	67%	X	X	X	X	X	X	X	√	√	X
Harris 2021	Eswatini	HIV clinic	Cross sectional	50	50-75	52%	X	X	X	X	X	√	X	X	X	X
Ataro 2018	Ethiopia	HIV clinic	Cross sectional	425	18-68	70%	√	X	√	X	X	√	√	√	√	X

(Table 1 continues on next page)

Study ID	Country	Study setting	Study design	Number of PLHIV	Age in years/age range	Female Sex	Hypertension	Depression	Diabetes	Cervical Cancer	CRD	Smoking	Alcohol	Overweight/ obese	Hypercholesterolemia	Metabolic syndrome
(Continued from previous page)																
Beyene 2019	Ethiopia	HIV clinic	Cross sectional	411	18-62	42%	X	√	X	X	X	X	X	X	X	X
Bitew 2016	Ethiopia	HIV clinic	Cross sectional	393	18+	59%	X	√	X	X	X	√	√	X	X	X
Bosho 2018	Ethiopia	HIV clinic	Cross sectional	286	18+	79%	√	X	X	X	√	√	√	√	√	√
Dorsisa 2020	Ethiopia	HIV clinic	Cross sectional	303	18+	53%	X	√	X	X	X	√	√	X	X	X
Duko 2018	Ethiopia	HIV clinic	Cross sectional	401	18+	71%	X	√	X	X	X	X	X	X	X	X
Duko 2019	Ethiopia	HIV clinic	Cross sectional	363	18+	66%	X	√	X	X	X	X	X	X	X	X
Faurholt-Jepsen-2019	Ethiopia	HIV clinic	Cross sectional	332	18+	67%	X	X	√	X	X	X	X	X	X	X
Fiseha 2019	Ethiopia	HIV clinic	Cross sectional	408	18+	67%	√	X	√	X	X	√	√	√	X	X
Gebremariam 2017	Ethiopia	HIV clinic	Cross sectional	417	18+	58%	X	√	X	X	X	X	X	X	X	X
Gebrie 2020	Ethiopia	HIV clinic	Cross sectional	407	18+	60%	X	X	√	X	X	√	√	X	X	X
Getahun 2020	Ethiopia	HIV clinic	Cross sectional	560	18+	62%	√	X	√	X	X	X	√	√	X	X
Kemal 2021	Ethiopia	HIV clinic	Cross sectional	353	18+	45%	X	√	X	X	X	√	√	X	√	X
Lukas 2021	Ethiopia	HIV clinic	Cross sectional	382	19-63	54%	√	X	X	X	X	X	X	√	X	√
Mohammed 2015	Ethiopia	HIV clinic	Cross sectional	393	21-75	70%	X	X	√	X	X	X	X	X	X	X
Mulugeta 2021	Ethiopia	HIV Clinic	Cohort	302	18+	51%	√	X	√	X	X	√	√	√	X	X
Seid 2020	Ethiopia	HIV clinic	Cross sectional	395	25-34	61%	X	√	X	X	X	X	X	X	X	X
Tareke 2018	Ethiopia	HIV clinic	Cross sectional	407	18+	58%	X	√	X	X	X	X	X	X	X	X
Tesfaw 2016	Ethiopia	HIV clinic	Cross sectional	417	18+	60%	X	√	X	X	X	X	X	X	X	X
Tadesse 2022	Ethiopia	HIV clinic	Cross sectional	351	18+	70%	X	X	√	X	X	√	√	√	X	X
Tilahun 2022	Ethiopia	HIV clinic	Cross sectional	228	18+	55%	X	X	X	X	X	√	X	X	√	X
Woldeyes 2022	Ethiopia	HIV clinic	Cross sectional	333	18+	68%	√	X	X	X	X	√	√	√	√	√
Woldeyes 2022b	Ethiopia	HIV clinic	Cross sectional	285	19-83	68%	X	X	X	X	X	√	√	X	X	X
Zelalem 2022	Ethiopia	HIV clinic	Cross sectional	267	18-65	100%	X	X	X	X	X	√	√	X	X	X
Zewudie 2022	Ethiopia	HIV clinic	Cross sectional	388	18+	61%	√	X	√	X	X	√	√	X	X	X

(Table 1 continues on next page)

Study ID	Country	Study setting	Study design	Number of PLHIV	Age in years/age range	Female Sex	Hypertension	Depression	Diabetes	Cervical Cancer	CRD	Smoking	Alcohol	Overweight/ obese	Hypercholesterolemia	Metabolic syndrome
(Continued from previous page)																
Appiah 2019	Ghana	HIV clinic	Cross sectional	345	18+	85%	√	X	√	X	X	√	X	√	√	X
Sanuade 2021	Ghana	HIV clinic	Cross sectional	525	19-40	16%	√	X	√	X	X	√	√	√	√	X
Sarfo 2019	Ghana	HIV clinic	Cross sectional	451	30+	81%	√	X	√	X	X	√	√	√	X	√
Sarfo 2019b	Ghana	HIV clinic	Cross sectional	451	30+	81%	√	X	X	X	X	√	X	X	√	X
Sarfo 2020	Ghana	HIV clinic	Cross sectional	502	30+	75%	X	X	√	X	X	X	X	X	X	X
Ayisi-Boateng 2022	Ghana	HIV clinic	Cohort	491	30+	81%	X	√	X	X	X	X	√	X	X	X
Dzudzor 2023	Ghana	HIV clinic	Case control	308	25-52	67%	√	X	X	X	X	√	√	√	√	√
Kotey 2022	Ghana	HIV clinic	Cohort	222	16+	65%	√	X	X	X	X	√	X	X	X	X
Nutor 2023	Ghana	HIV clinic	Cross sectional	159	18+	20%	X	√	X	X	X	X	X	X	X	X
Steiniche 2016	Guinea Bissau	HIV clinic	Cross sectional	893	15+	63%	X	X	√	X	X	X	X	X	X	X
Achwoka 2019	Kenya	Database	Cohort	3170	15+	67%	√	X	√	X	√	X	X	X	X	X
Achwoka 2020	Kenya	Database	Cohort	1478	15+	94%	√	X	√	√	√	X	X	√	X	X
Juma 2019	Kenya	Database	Cross sectional	1502	18+	69%	√	X	√	X	X	√	X	√	√	X
Manuthu 2008	Kenya	HIV clinic	Cross sectional	295	20+	58%	√	X	X	X	X	√	X	X	√	X
Masyuko 2020	Kenya	HIV clinic	Cross sectional	300	30+	50%	√	X	√	X	X	√	√	√	X	√
Mbuthia 2021	Kenya	HIV clinic	Cross sectional	939	18-84	69%	√	X	X	X	X	X	X	√	X	X
Memiah 2012	Kenya	HIV clinic	Cross sectional	191	18-69	100%	X	X	X	√	X	X	X	X	X	X
Memiah 2015	Kenya	HIV clinic	Cross sectional	614	18-69	100%	X	X	X	√	X	X	X	X	X	X
Menon 2018	Kenya	HIV clinic	cross sectiona	74	18+	100%	X	X	X	√	X	X	X	X	X	X
Mungo 2013	Kenya	HIV clinic	cross sectional	4308	22-50	100%	X	X	X	√	X	X	X	X	X	X
Njue 2021	Kenya	HIV clinic	Cross sectional	73	18-46	100%	X	X	X	√	X	X	X	X	X	X
Nyongesa 2019	Kenya	HIV clinic	Cross sectional	450	18-60	79%	√	√	X	X	X	√	√	X	X	X
Nyongesa 2021	Kenya	HIV clinic	Cross sectional	406	18-24	57%	X	X	X	X	X	√	√	X	X	X
Osoti 2018	Kenya	HIV clinic	Cross sectional	300	18+	64%	X	X	√	X	X	√	√	√	X	√
Temu 2015	Kenya	HIV clinic	Cross sectional	300	18-80	64%	X	X	X	X	X	√	X	√	√	X
Tilahun 2021	Kenya	HIV clinic	Cross sectional	287	30+	50%	X	X	X	X	X	√	√	√	√	X

(Table 1 continues on next page)

Study ID	Country	Study setting	Study design	Number of PLHIV	Age in years/age range	Female Sex	Hypertension	Depression	Diabetes	Cervical Cancer	CRD	Smoking	Alcohol	Overweight/ obese	Hypercholesterolemia	Metabolic syndrome
(Continued from previous page)																
Ahmed 2022	Kenya	HIV clinic	Cross sectional	200	30+	60%	√	X	√	X	X	√	X	√	√	X
Farrant 2022	Kenya	HIV clinic	Cross sectional	145	30+	56%	X	X	√	X	X	√	X	√	√	X
Mogaka 2022	Kenya	HIV clinic	Cross sectional	300	30+	50%	√	X	X	X	X	√	√	√	√	X
Oyawa 2022	Kenya	HIV clinic	Cross sectional	280	21–80	69%	√	X	X	X	X	X	√	√	X	X
Monroe 2022	Kenya,Nigeria, Tanzania & Uganda	HIV clinic	Cohort	2774	18+	59%	X	X	X	X	X	√	√	√	√	X
Chang 2022	Kenya,Nigeria, Tanzania & Uganda	HIV clinic	Cohort	3099	15+	59%	X	X	√	X	X	X	X	X	X	X
Sebilo 2021	Lesotho	Database	Cohort	785	18+	60%	√	X	√	X	X	X	X	X	X	X
Amberbir 2019	Malawi	HIV clinic	Cohort	820	18+	72%	√	X	√	X	X	√	X	√	√	X
Divala 2016	Malawi	HIV clinic	Cross sectional	952	18+	72%	√	X	√	X	X	√	√	√	√	X
Kohler 2016	Malawi	Database	Cross sectional	226	18+	100%	X	X	X	√	X	X	X	X	X	X
Malava 2018	Malawi	HIV clinic	Cross sectional	206	18+	59%	X	√	X	X	X	X	X	X	X	X
Rucker 2018	Malawi	HIV clinic	Cross sectional	379	30+	73%	√	X	√	X	X	√	X	X	√	X
Stockton 2021	Malawi	HIV clinic	Cross sectional	1091	18+	53%	X	√	X	X	X	X	X	X	X	X
Moucheraud 2022	Malawi	HIV clinic	Cross sectional	134	30–88	49%	X	X	X	X	X	X	√	√	X	X
Steffen 2023	Malawi	HIV clinic	Cohort	1288	18+	58%	√	X	√	X	X	X	X	√	X	X
Mocumbi 2019	Mozambique	HIV clinic	Cohort	70	18+	59%	√	X	√	X	X	√	X	√	√	X
Dakum 2021	Nigeria	HIV clinic	Cross sectional	19,566	50+	47%	X	X	X	X	X	X	X	√	X	X
Egbe 2017	Nigeria	HIV clinic	Cross sectional	1187	18+	67%	X	√	X	X	X	√	X	X	X	X
Ekrikpo 2018	Nigeria	HIV clinic	Cross Sectional	12,167	18+	60%	√	X	√	X	X	X	X	√	√	X
Ekun 2021	Nigeria	HIV clinic	Cross sectional	196	25–84	64%	√	X	X	X	X	X	X	√	X	X
Isa 2016	Nigeria	HIV clinic	Cross sectional	2632	18+	65%	X	X	√	X	X	X	X	X	X	X
Muhammad 2017	Nigeria	HIV clinic	Cross sectional	300	18+	64%	X	X	X	X	X	√	√	X	X	√
Obadeji 2014	Nigeria	HIV clinic	Cross sectional	130	18+	69%	X	√	X	X	X	X	X	X	X	X
Ogunmola 2014	Nigeria	HIV clinic	Cross sectional	250	13–52	62%	√	X	X	X	X	X	X	X	X	X
Ojong 2022	Nigeria	HIV clinic	Cross sectional	150	30+	51%	√	X	√	X	X	X	X	X	X	√
Olagunju 2012	Nigeria	HIV clinic	Cross sectional	300	28+	62%	X	√	X	X	X	X	X	X	X	X

(Table 1 continues on next page)

Study ID	Country	Study setting	Study design	Number of PLHIV	Age in years/age range	Female Sex	Hypertension	Depression	Diabetes	Cervical Cancer	CRD	Smoking	Alcohol	Overweight/ obese	Hypercholesterolemia	Metabolic syndrome
(Continued from previous page)																
Olagunju 2013	Nigeria	HIV clinic	Cross sectional	295	31-40	61%	X	√	X	X	X	X	X	X	X	X
Olisah 2015	Nigeria	HIV clinic	Cross sectional	310	18+	68%	X	√	X	X	X	X	X	X	X	X
Abiodun 2022	Nigeria	HIV clinic	Cross sectional	458	18+	100%	X	√	X	X	X	X	X	X	X	X
Adebajo 2023	Nigeria	HIV clinic	Cross sectional	761	16+	0%	√	√	X	X	X	X	X	√	√	X
Adedokun 2023	Nigeria	HIV clinic	Cross sectional	277	20+	64%	X	X	X	X	X	√	√	√	√	X
Badru 2022	Nigeria	HIV clinic	Cross sectional	301	18+	69%	√	X	X	X	X	X	√	√	X	X
Fink 2022	Nigeria	HIV clinic	Cross sectional	170	18+	77%	X	X	X	X	√	√	X	X	X	X
Jackson 2022	Nigeria	HIV clinic	Cross sectional	417	18+	69%	√	X	X	X	X	X	X	√	X	X
Brennan 2018	South Africa	HIV clinic	cohort	77,696	18+	61%	√	X	X	X	X	X	X	√	X	X
Chiwandire 2021	South Africa	Database	Cross sectional	4484	25+	66%	√	X	√	X	X	X	X	X	X	X
Dave 2011	South Africa	HIV clinic	Cross sectional	849	28-44	77%	X	X	√	X	X	X	X	X	X	X
Dhokotera 2021	South Africa	Database	Cross sectional	8479	20-24	54%	X	X	X	√	X	X	X	X	X	X
Freeman 2007	South Africa	HIV clinic	Cross sectional	900	18+	74%	X	√	X	X	X	X	X	X	X	X
Hopkins 2021	South Africa	HIV clinic	Cross sectional	149	18+	73%	X	X	√	X	X	X	X	√	√	X
Hyle 2019	South Africa	HIV clinic	Cross sectional	458	21+	78%	√	X	√	X	X	√	X	√	X	X
Julius 2011	South Africa	HIV clinic	Cross sectional	304	18-45	78%	√	X	√	X	X	X	X	√	√	√
Kubiak 2021	South Africa	HIV clinic	Cross sectional	1207	18+	56%	√	X	√	X	X	√	√	√	X	X
Kummerow 2019	South Africa	Community	Cross sectional	394	18+	68%	X	X	X	X	√	√	X	√	X	X
Magodoro 2022	South Africa	Database	Cross sectional	1213	15+	68%	√	X	√	X	X	√	X	√	X	X
Manne-Goehler 2018	South Africa	Community	longitudinal study	1035	40+	54%	√	X	√	X	X	X	X	√	X	X
Mashinya 2015	South Africa	HIV clinic	Cross sectional	214	15+	80%	√	X	√	X	X	√	√	X	√	√
Myer 2008	South Africa	HIV clinic	Cross sectional	443	18-65	75%	X	√	X	X	X	X	X	X	X	X
Nguyen 2017	South Africa	HIV clinic	Cross sectional	748	18+	79%	X	X	X	X	X	X	X	X	X	√
Olley 2006	South Africa	HIV clinic	Cohort	105	18-55	100%	X	√	X	X	X	X	X	X	X	X
Rabkin 2015	South Africa	HIV clinic	Cross sectional	175	30+	74%	√	X	√	X	X	√	X	√	√	X

(Table 1 continues on next page)

Study ID	Country	Study setting	Study design	Number of PLHIV	Age in years/age range	Female Sex	Hypertension	Depression	Diabetes	Cervical Cancer	CRD	Smoking	Alcohol	Overweight/ obese	Hypercholesterolemia	Metabolic syndrome
(Continued from previous page)																
Rajagopaul 2021	South Africa	HIV clinic	Cross sectional	301	18+	63%	√	X	√	X	X	X	X	X	X	X
Rohner 2017	South Africa	HIV clinic	Cohort	10,640	18+	100%	X	X	X	√	X	X	X	X	X	X
Ruffieux 2021	South Africa	Database	Cohort	2,507,909	18+	100%	X	X	X	√	X	X	X	X	X	X
Sobieszczyk 2016	South Africa	HIV clinic	Cohort	160	18+	100%	X	X	X	X	X	X	X	X	X	√
Umar 2021	South Africa	HIV clinic	Cohort	1203	18+	66%	√	X	√	X	X	X	X	X	X	X
Brennan 2023	South Africa	HIV clinic	Cohort	6948	18+	60%	√	X	X	X	X	X	X	√	X	X
de Vries 2023	South Africa	HIV clinic	Cross sectional	356	18+	72%	X	X	√	X	X	X	X	X	X	X
Haas 2023	South Africa	Database	Cross sectional	54,378	15+	55%	X	√	X	X	X	X	X	X	X	X
Kamkuemah 2023	South Africa	HIV clinic	Cross sectional	87	15–24	76%	√	X	X	X	X	X	X	√	X	X
Okyere 2022	South Africa	Database	Cross sectional	517	50+	77%	√	X	X	X	X	√	√	√	X	X
Tsuro 2022	South Africa	HIV clinic	Cohort	361	15+	89%	√	X	X	X	X	√	√	√	X	X
Albrecht 2019	Tanzania	HIV clinic	Cohort	1622	15+	65%	√	X	X	X	X	√	√	X	X	X
Hertz 2022	Tanzania	HIV clinic	Cross sectional	500	18+	72%	√	X	√	X	X	X	X	X	X	X
Jeremiah 2020	Tanzania	Database	Cross sectional	1292	18+	61%	X	X	√	X	X	√	X	√	X	X
Kafuruki 2013	Tanzania	HIV clinic	Cross sectional	355	18–63	100%	X	X	X	√	X	X	X	X	X	X
Kagaruki 2014	Tanzania	HIV clinic	Cross sectional	671	18+	71%	√	X	√	X	X	√	√	√	√	X
Maganga 2015	Tanzania	HIV clinic	Cross sectional	301	18+	68%	X	X	√	X	X	√	√	√	X	X
Manavalan 2020	Tanzania	HIV clinic	Cohort	555	18+	79%	√	X	X	X	X	X	X	X	X	X
Marwick 2010	Tanzania	HIV clinic	Cross sectional	220	16–75	74%	X	√	X	X	X	X	X	X	X	X
Memiah 2021	Tanzania	HIV clinic	Cross sectional	261	18+	76%	√	X	X	X	X	X	√	√	X	X
Msoka 2018	Tanzania	HIV clinic	Cross sectional	102	30+	74%	X	X	X	X	X	X	X	X	X	√
Peck 2014	Tanzania	HIV clinic	Cross sectional	301	18+	68%	√	X	√	X	X	√	√	√	X	X
Kavishe 2022	Tanzania	HIV clinic	Cohort	640	18+	67%	√	X	X	X	X	√	√	√	X	X
Malindisa 2023	Tanzania	HIV clinic	Cross sectional	223	18+	80%	√	X	√	X	X	√	√	√	√	√
Mwakyandile 2023	Tanzania	HIV clinic	Cross sectional	430	18+	65%	√	X	√	X	X	X	X	√	√	X
Prattipati 2022	Tanzania	HIV clinic	Cross sectional	497	18+	73%	√	X	√	X	X	√	√	X	X	X
Akena 2013	Uganda	HIV clinic	Cross sectional	735	18+	71%	X	√	X	X	X	X	X	X	X	X

(Table 1 continues on next page)

Study ID	Country	Study setting	Study design	Number of PLHIV	Age in years/age range	Female Sex	Hypertension	Depression	Diabetes	Cervical Cancer	CRD	Smoking	Alcohol	Overweight/ obese	Hypercholesterolemia	Metabolic syndrome
(Continued from previous page)																
Enriquez 2022	Uganda	Database	Cross sectional	960	35-49	64%	√	X	√	X	X	√	√	√	√	X
Kansiime 2019	Uganda	Database	Cross sectional	387	18+	66%	√	X	√	X	√	√	√	X	X	X
Kayongo 2020	Uganda	HIV clinic	Cross sectional	722	35+	62%	X	X	X	X	√	√	X	√	X	X
Kinyanda 2017	Uganda	HIV clinic	Cross sectional	899	18+	78%	X	√	X	X	X	X	X	X	X	X
Kwarisiima 2019	Uganda	Community	Intervention	2071	18+	58%	√	X	X	X	X	X	X	X	X	X
Lubega 2021	Uganda	HIV clinic	Intervention	2026	18-59	74%	√	X	X	X	X	X	X	√	X	X
Mateen 2013	Uganda	HIV clinic	Cohort	5563	13+	67%	√	X	X	X	X	X	X	X	X	X
Muyanja 2016	Uganda	HIV clinic	Cross sectional	250	20+	68%	√	X	√	X	X	√	X	√	√	√
Nakimuli-Mpungu 2011	Uganda	HIV clinic	Cross sectional	500	18-80	70%	X	√	X	X	X	X	√	X	X	X
Niwaha 2021	Uganda	HIV clinic	Cross sectional	721	35+	60%	√	X	X	X	X	√	X	√	X	X
North 2018	Uganda	HIV clinic	Cross sectional	143	40+	46%	X	X	X	X	√	√	X	√	X	X
Okello 2015	Uganda	HIV clinic	Cohort	3389	18+	67%	√	X	X	X	X	X	X	√	X	X
Sander 2015	Uganda	HIV clinic	Cross sectional	426	18+	71%	√	X	X	X	X	X	X	√	X	X
Amutuhaire 2023	Uganda	HIV clinic	Cross sectional	309	18+	59%	√	X	√	X	X	√	X	√	√	√
Buzaalirwa 2022	Uganda	HIV clinic	Cross sectional	1426	18+	65%	√	X	X	X	X	X	X	√	X	X
Byonanebye 2023	Uganda	HIV clinic	Cohort	970	40-51	62%	√	X	√	X	X	√	√	X	X	X
Gilbert 2022	Uganda	HIV clinic	Cross sectional	140	40+	46%	√	X	√	X	√	X	X	√	√	X
Kayongo 2023	Uganda	HIV clinic	Cross sectional	100	35-80	44%	X	X	X	X	√	√	X	√	X	X
Kiyimba 2022	Uganda	Community	Cross sectional	254	18+	71%	X	X	X	X	X	√	√	X	X	√
Mugisha 2016	Uganda	HIV Clinic	Cross sectional	244	50+	60%	√	√	√	X	√	√	√	X	X	X
Migisha 2023	Uganda	HIV clinic	Cross sectional	1045	13-25	68%	√	X	X	X	X	√	√	√	X	X
Mulindwa 2023	Uganda	HIV clinic	Cross sectional	243	18+	58%	√	X	X	X	X	√	√	√	X	X
Mutebi 2023	Uganda	HIV clinic	Cross sectional	430	18+	71%	√	X	X	X	X	X	X	√	√	X
Niwaha 2022	Uganda	HIV clinic	Cross sectional	140	18+	70%	√	X	X	X	X	√	X	√	X	X
Bauer 2017	Zambia	HIV clinic	Cohort	896	18+	52%	√	X	X	X	X	√	X	√	X	X
Hamooya 2021	Zambia	HIV clinic	Cross sectional	1108	18+	60%	X	X	X	X	X	√	√	X	X	√

(Table 1 continues on next page)

Study ID	Country	Study setting	Study design	Number of PLHIV	Age in years/age range	Female Sex	Hypertension	Depression	Diabetes	Cervical Cancer	CRD	Smoking	Alcohol	Overweight/ obese	Hypercholesterolemia	Metabolic syndrome
(Continued from previous page)																
Shankalala 2017	Zambia	HIV clinic	Cross sectional	270	20–70	69%	x	x	√	x	x	√	x	√	x	x
van den Heuvel 2013	Zambia	HIV clinic	Cross sectional	418	16–92	53%	x	√	x	x	x	x	x	x	x	√
Chipanta 2021	Zambia	Community	Cross sectional	153	16+	87%	x	√	x	x	x	x	x	x	x	x
Kaluba 2023	Zambia	HIV clinic	Cross sectional	91	30+	58%	x	x	x	x	x	√	√	x	x	x
Chihota 2022	Zambia, Zimbabwe	HIV clinic	Cross sectional	420	30+	52%	√	x	√	x	x	√	x	√	x	√
Chibanda 2016	Zimbabwe	HIV clinic	Cross sectional	165	18+	75%	x	√	x	x	x	x	x	x	x	x
Chimbetete 2017	Zimbabwe	HIV clinic	Cohort	4110	16+	67%	√	x	√	x	x	x	x	√	x	x
Shamu 2021	Zimbabwe	HIV clinic	Cohort	420	50+	57%	√	x	√	x	x	x	x	x	x	x
Cheza 2022	Zimbabwe	HIV clinic	Cross sectional	324	18+	60%	√	x	√	x	x	x	x	x	x	x

CRD = Chronic respiratory diseases; DRC = Democratic Republic of Congo; PLHIV = People living with HIV. √ = prevalence data extracted for condition; X = prevalence data not available for this condition.

Table 1: **Characteristics of 188 included studies grouped by country.**

had four studies each. The DRC[36,37] and Zambia[192,194] each had two studies. Benin,[16] Burkina Faso,[19] Burundi,[21] Guinea Bissau,[74] Lesotho,[96] and Mozambique,[105] each had one study reporting diabetes prevalence. In 2021, Chiwandire[126] reported the prevalence of diabetes over three time points (2005, 2008 and 2017) in South Africa and hence appears three times on the forest plot. Heterogeneity was relatively high (I^2 = 81.1) as the prevalence of diabetes ranged widely from 0.3% in Kenya[76] to 41% in Zimbabwe[197] (Fig. 7). The LFK index (5.05) and the corresponding Doi plot (Supplementary material; Appendix III: Fig. C) suggested potential for major upward publication bias.

Cervical cancer

We reviewed 12 studies reporting the burden of cervical cancer among PLHIV in SSA with a pooled prevalence of 1.5% (95% CI: 0.1–2.9). Five studies described the burden of cervical cancer in Kenya,[80–84] three studies from South Africa,[128,142,143] a study each from Burundi,[20] Cote d'Ivoire,[35] Malawi,[99] and Uganda.[166] The prevalence of cervical cancer ranged from 0.1% in Cote d'Ivoire[35] to 28.8% in Malawi.[99] Heterogeneity was moderate (I^2 = 66.6%) (Fig. 8). The LFK index (10.07) and the corresponding Doi plot (Supplementary material; Appendix III: Fig. D) suggested potential for major upward publication bias.

Chronic respiratory diseases (CRDs)

We reviewed 11 studies reporting the prevalence of CRDs among PLHIV, with a pooled prevalence of 7.1% (95% CI: 4.0%–10.3%). The burden of asthma,[42,75,76,134,167] and that of chronic obstructive pulmonary diseases (COPD)[122,168,173,177,184] were each reported by five studies. We reviewed one study that described both asthma and COPD.[183] Most of the studies (n = 6) describing CRD were conducted in Uganda,[167,168,173,177,183,184] two studies in Kenya,[75,76] and a study each from Ethiopia,[42] Nigeria,[122] and South Africa.[134] The prevalence of CRD ranged from 0.3% in Kenya[75] to 50% in Uganda[184] and there was very high heterogeneity (I^2 = 90.7%) (Fig. 9). The LFK index (7.5) and the corresponding Doi plot (Supplementary material; Appendix III: Fig. E) suggested potential for major upward publication bias.

Overweight/obesity

We found 85 studies reporting the prevalence of being overweight or obese among PLHIV in SSA with a pooled prevalence of 32.2% (95% CI: 29.7–34.7). This was the highest burden among PLHIV in SSA. Most of the studies (n = 15) were conducted in Uganda[94,165,168,171,174,177,179–181,183,184,186–189] followed by South Africa (n = 13),[8,125,130–136,140,148–150] Kenya[4,75,78,79,87–94] with 12 studies, and Tanzania[10,94,153,154,157,159–162] had nine studies. Ethiopia[40,42,47,50,53,55,59,61] and Nigeria[94,107–109,119–121,123] each had eight studies. Cameroon[22,23,27,29–31,33] had seven

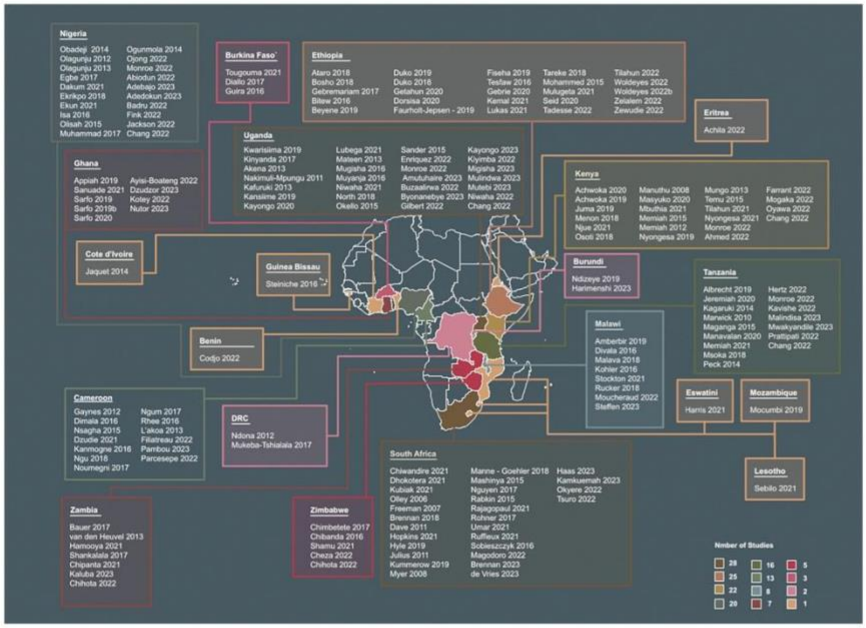

Fig. 2: Map showing countries where included studies on the burden of NCD/risk factors among PLHIV in SSA were conducted.

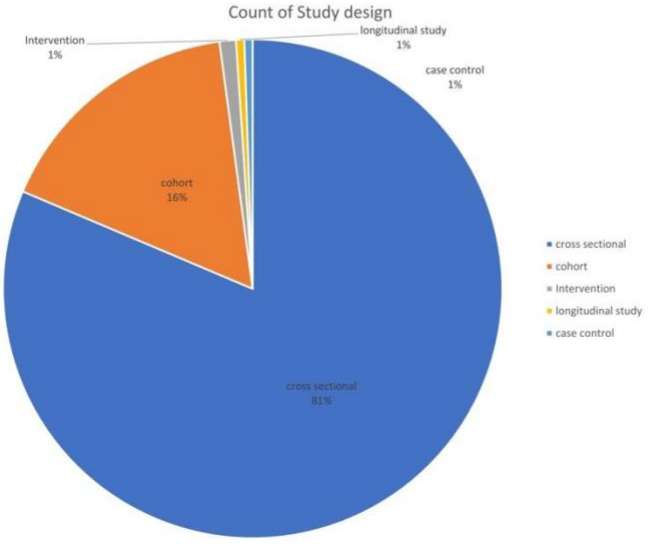

Fig. 3: Pie chart showing study designs for the burden of NCD/risk factors among PLHIV in SSA.

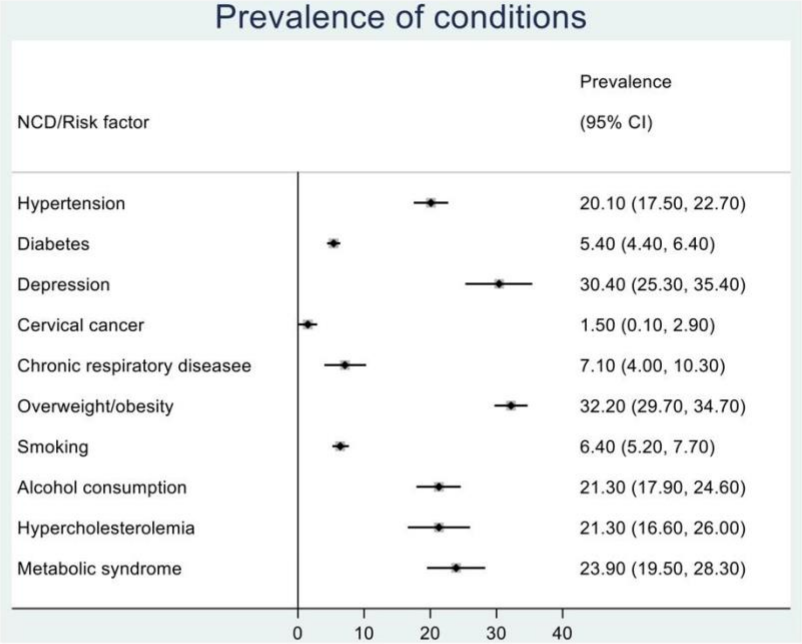

Fig. 4: Forest plot of pooled estimates generated by meta-analyses for prevalence of selected conditions among PLHIV in SSA.

studies, while Malawi,[97,98,103,104] had four studies. Ghana[66,67,71] and Zambia[190,192,194] each had three studies. Burkina Faso[18,19] and Zimbabwe[194,199] each had two studies, while Burundi,[21] Eritrea,[38] and Mozambique,[105] each had one study. The prevalence of overweight/obese ranged from 1.4% in Ethiopia[53] to 64.5% in Kenya[90] and heterogeneity was very high (I^2 = 96.1%) (Supplementary material; Appendix II: Fig. I). The LFK index (3.36) and the corresponding Doi plot (Supplementary material; Appendix III: Fig. F) suggested evidence of major upward potential for publication bias.

Hypercholesterolemia

We found 40 studies reporting hypercholesterolemia among PLHIV in SSA with a pooled prevalence of 21.3% (95% CI: 16.6–26.0). Kenya[4,77,88,90–92,94] had seven studies, while Ethiopia,[42,52,60,61,89] Tanzania[10,94,161,162,183] and Uganda[94,165,174,180,188] each had five studies. Ghana,[65,66,68,71] Nigeria,[94,108,119,120] and South Africa[130,132,137,140] had four studies each followed by Cameroon,[29,30,33] and Malawi[97,98,100] each with three studies. Eritrea,[38] Burkina Faso,[17] DRC,[36] and Mozambique[105] each had one study. The prevalence of hypercholesterolemia ranged from 4.1% in Nigeria[108] to 60.4% in Ethiopia[61] and heterogeneity was quite high (I^2 = 95.4%) (Supplementary material; Appendix II: Fig. II). The LFK index (3.36) and the corresponding Doi plot (Supplementary material; Appendix III: Fig. G) suggested evidence of major upward potential for publication bias.

Metabolic syndrome

We found 22 studies reporting the prevalence of metabolic syndrome among PLHIV in SSA with a pooled prevalence of 23.3% (95% CI: 18.8–27.8). Most of the studies (n = 4) were conducted in South Africa[132,137,139,144] followed by Uganda[174,180,185] with three studies. Ethiopia,[42,61] Ghana,[67,71] Kenya,[78,87] Nigeria,[111,114] Tanzania,[158,161] and Zambia[191,194] each had two studies. Benin,[16] Burkina Faso,[18] Cameroon,[29] and Zimbabwe[194] each had one study. The prevalence ranged from 6.3% in Kenya[78] to 58% in Uganda,[174] and heterogeneity was quite high (I^2 = 86.1%) (Supplementary material; Appendix II: Fig. III). The LFK index (1.38) and the corresponding Doi plot (Supplementary material; Appendix III: Fig. H) indicated evidence of minor upward potential for publication bias.

Alcohol consumption

We found 61 studies reporting current alcohol consumption among PLHIV in SSA with a pooled prevalence of 19.4% (95% CI: 14.4–24.4). Most of the studies (n = 15) were conducted in Ethiopia[40–43,47,49,50,52,55,59,61–64,89] followed by Tanzania[10,94,151,157,159–161,163] with nine studies. Kenya[78,85–88,92–94] and Uganda[94,167,173,175,182,185–187] each had eight studies while Ghana,[66,67,70,71] Nigeria[94,111,120,121] and South Africa[133,137,149,150] had four studies each. Burundi,[20,21] Malawi[98,103] and Zambia[191,196] had two studies each, while Burkina Faso,[18] and DRC,[37] had one study each. The prevalence of alcohol consumption ranged from 1.3% in Nigeria[121] to 66.1% in Cameroon,[33] and heterogeneity was quite high (I^2 = 93%), (Supplementary material; Appendix II: Fig. IV). The LFK index (2.44) and the corresponding Doi plot (Supplementary material; Appendix III: Fig. I) indicated evidence of major upward potential for publication bias.

Smoking

We included 84 studies describing the prevalence of current smoking among PLHIV in SSA with a pooled prevalence of 6.2% (95% CI: 5.0–7.4). Most of the studies (n = 14) were conducted in Ethiopia,[40–43,47,49,52,55,59–64] and Uganda.[165,167,173,174,176,177,180,182,184–187,189] followed by Kenya[4,77,78,85–92,94] with 12 studies and Tanzania[10,94,151,153,154,159–161,163] with nine studies. South Africa[131,133–135,137,140,149,150] had eight studies while Cameroon[22,23,27,30,33,34] had six studies. Ghana,[65–67,71,72] Nigeria[94,106,111,120,122] and Zambia[190–192,194,196] followed, each with five studies. Burundi[20,21] and Malawi[97,98] had two studies each, while Benin,[16] Burkina Faso,[19] DRC,[37] Eswatini,[39] Mozambique[105] and Zimbabwe[194] followed, each with one study. There were two multi-country studies[94,194] that included current alcohol use among PLHIV. The pooled prevalence of current smoking ranged from 0.8% in Burkina Faso[19] to 40% in Uganda[168] and the heterogeneity was moderate (I^2 = 64.7%) (Supplementary material; Appendix II: Fig. V). The LFK index (3.08) and its corresponding Doi plot (Supplementary material; Appendix III: Fig. J) showed evidence of major upward potential for publication bias.

Discussion

We estimated the prevalence of the major NCDs and their risk factors among PLHIV in SSA from 188 studies compared to 57 articles (in LMICs) from the previous review. Among the NCDs considered, depression had the highest prevalence at 31.4% (95% CI: 24.4–38.3) confirming the common occurrence of depression among PLHIV. However, it is important to note that other systematic reviews have reported varied estimates for the prevalence of depression at 36.3% (95% CI: 28.4%–44.2%) in Ethiopia[201] and 24.4% (95%

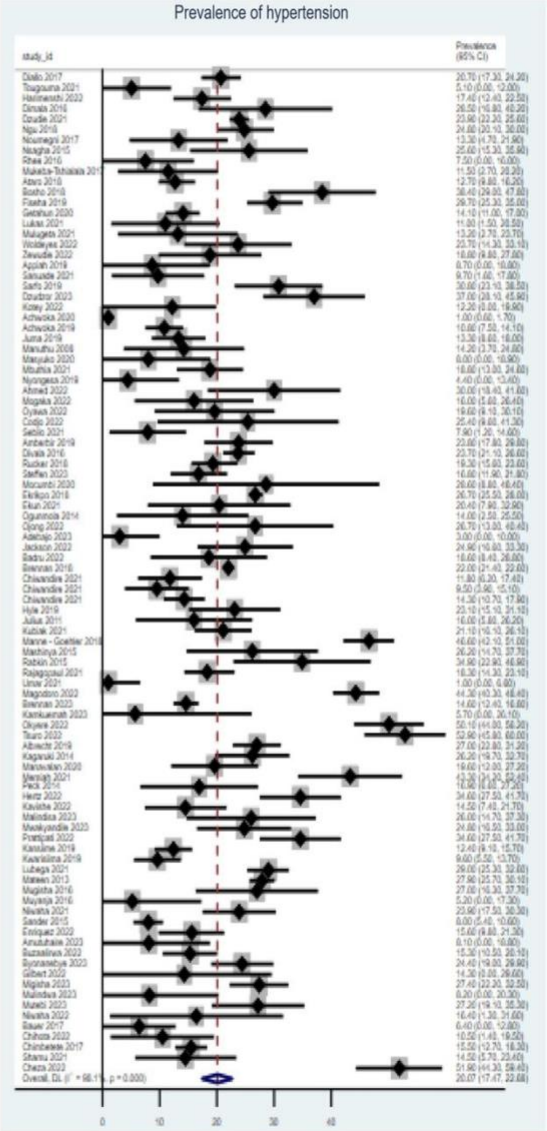

Fig. 5: Forest plot of pooled estimates generated by meta-analyses for prevalence of hypertension among PLHIV in SSA.

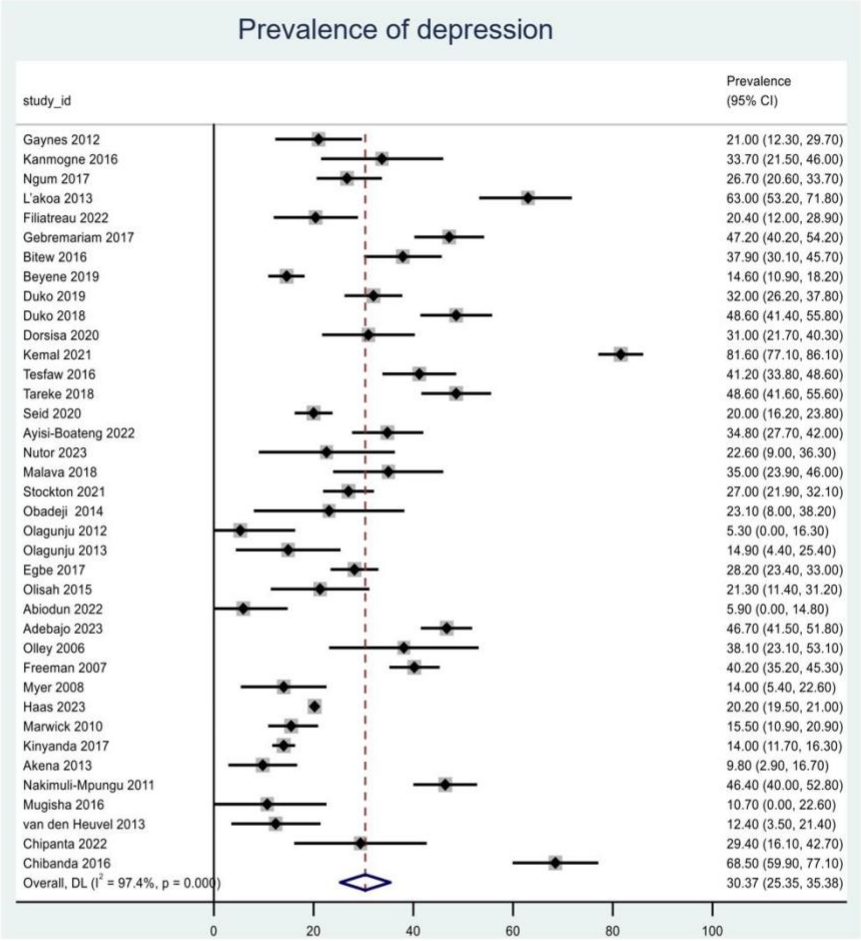

Fig. 6: Forest plot of pooled estimates generated by meta-analyses for prevalence of depression among PLHIV in SSA.

CI: 12.5–42.1) in LMICs.[12] The variation in prevalence may be due to different tools used to diagnose depression and study settings, in addition to potential publication bias.

The most common CVD risk factor, hypertension, reported a relatively high prevalence of 20.1% (95% CI: 17.5–22.7), among PLHIV in SSA. This prevalence estimate was slightly lower than the previously reported prevalence of 21.2% (95% CI: 16.3–17.1)in LMICs,[12] 19.9% (95% CI: 17.2–22.8) in Eastern and Southern Africa,[202] and 23.5% (95% CI: 16.6–31.0) in West and Central Africa.[202] The slight variation in estimates may be attributed to variations in the measurement process of blood pressure.[203] Although most studies used the same definition of hypertension, the measurement process may have varied. Factors such as whether resting blood pressure was measured, and the frequency of blood pressure measurements before confirming hypertension and perhaps differences in the type of sphygmomanometer used might have

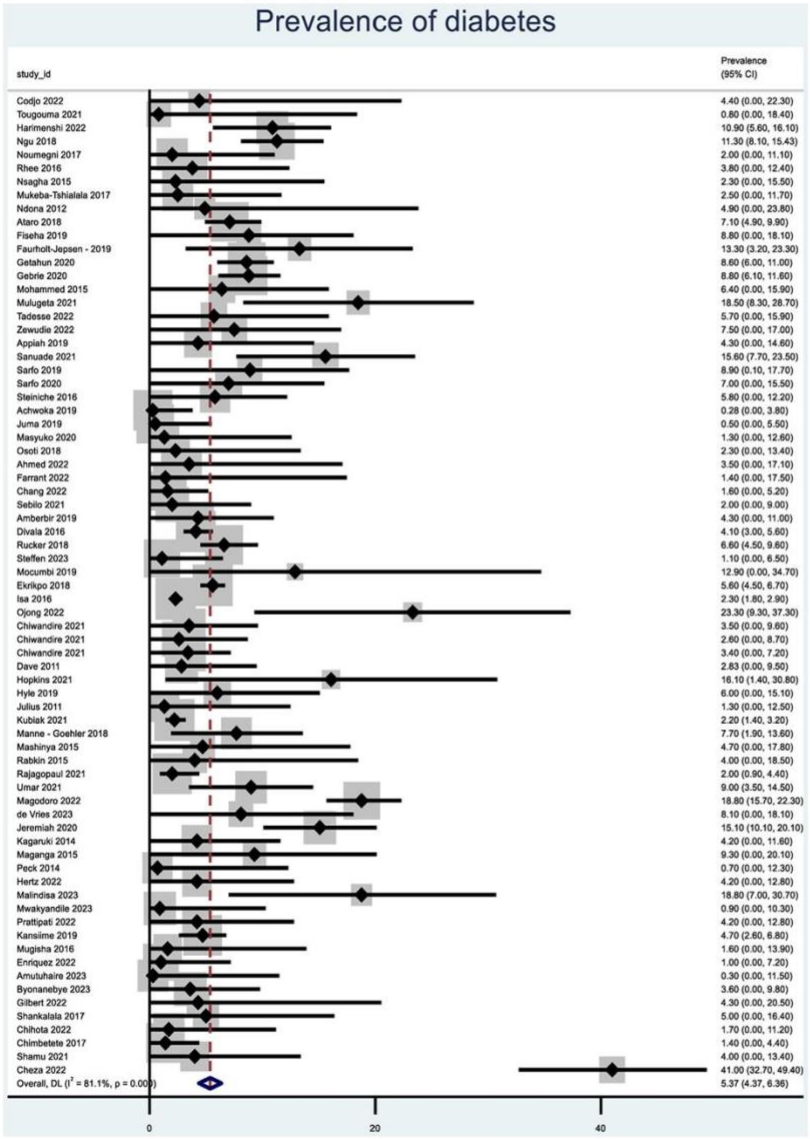

Fig. 7: Forest plot of pooled estimates generated by meta-analyses for prevalence of diabetes among PLHIV in SSA.

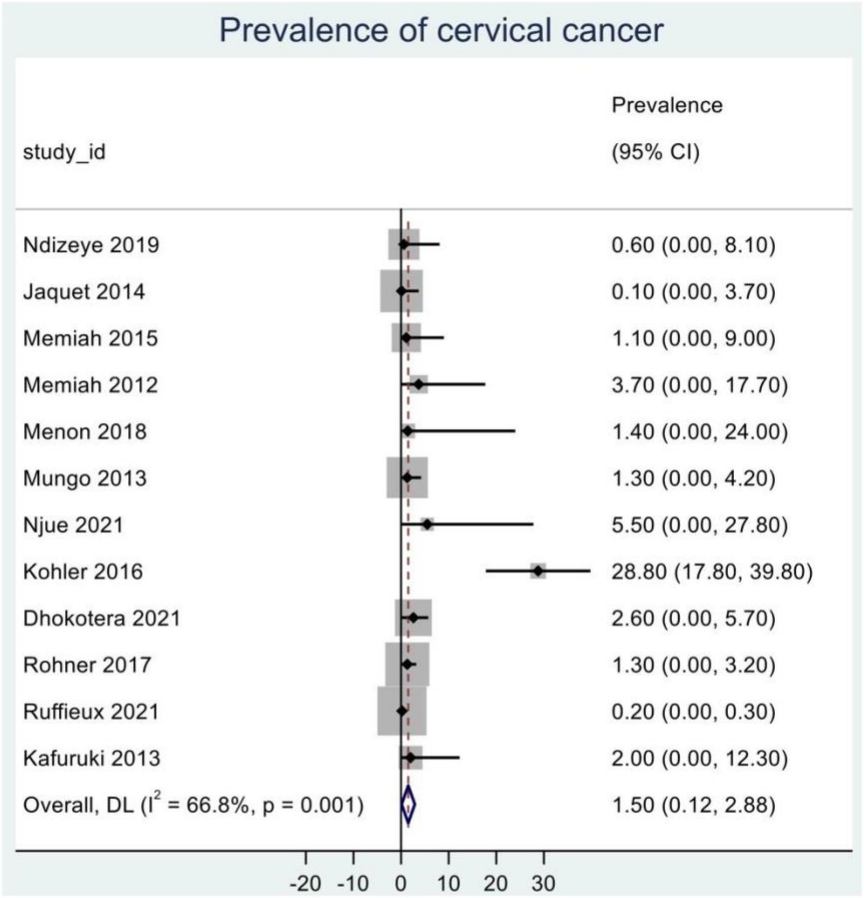

Fig. 8: Forest plot of pooled estimates generated by meta-analyses for prevalence of cervical cancer among PLHIV in SSA.

contributed to these differences,[203] including potential publication bias.

We estimated the prevalence of diabetes to be 5.4% (95% CI: 4.4–6.4, min = 0.3%; max = 41%) which was a wider range than previous findings in SSA, that reported diabetes prevalence rates ranging from 1% to 26%.[204] The high heterogeneity in diabetes prevalence could be attributed to variations in testing methods used across studies (Fig. 4). Most of the studies used the point of care glucometers and chemistry analyzer platforms or both. Additionally, some studies did not explicitly mention the method of diabetes testing employed. Potential publication bias and other factors such as diet and physical activity of various study populations should be explored as a means of explaining the variation in diabetes prevalence across populations. Implementing regular screening for diabetes among PLHIV during their routine health facility visits can help identify cases early and facilitate timely and appropriate care to mitigate the impact of diabetes in this population.

In our study, we obtained relatively lower prevalence estimates for cervical cancer and CRDs among PLHIV in SSA. The prevalence of cervical cancer was estimated to be 1.5%, which is consistent with previous reports of (1.3%–1.7%) by Patel et al.[12] However, our prevalence of

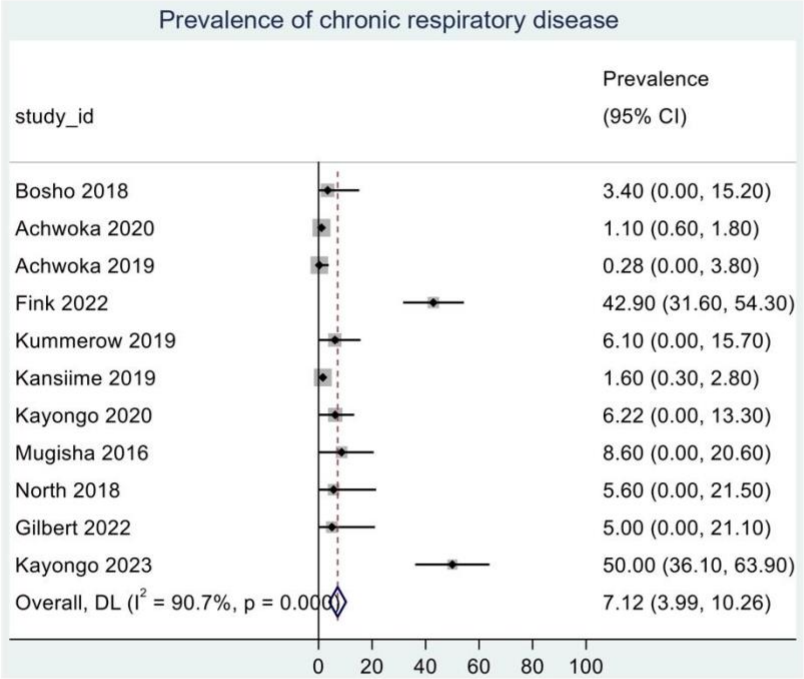

Fig. 9: Forest plot of pooled estimates generated by meta-analyses for prevalence of chronic respiratory diseases among PLHIV in SSA.

CRD (7.1%) was lower than the global estimate of 10.4%, that was previously reported in a systematic review that mainly included studies from Europe, with only four studies from Africa.[205] Potential publication bias may have contributed to the variation in our findings. The limited number of studies for meta-analysis of CRDs in SSA might explain the high heterogeneity observed.

Given the scarcity of studies on cervical cancer and CRDs among PLHIV in SSA, further research is warranted to investigate the burden of these conditions in this population. Screening for cervical cancer among adult women living with HIV remains essential as they face a six-fold higher risk[206] compared to HIV negative women.

We found a high prevalence of being overweight/obese among PLHIV in SSA at 32.2% (95% CI: 29.7–34.7), which is consistent with previous reports in LMICs.[13] Despite using similar definitions across studies, there was wide variation in the prevalence of overweight/obesity among PLHIV. This variation may be attributed to differences in diet and levels of activity among the study populations, in addition to potential publication bias.

The prevalence of hypercholesterolemia among PLHIV in SSA was found to be high at 24.3% (95% CI: 19.1–29.6), comparable to previous findings in LMICs at 22.2% (95% CI:14.7–32.1).[13] Among PLHIV in SSA, alcohol consumption (19.7%) was more prevalent than smoking (7.7%), indicating that interventions should target reducing alcohol consumption in this population. Both hypercholesterolemia and alcohol consumption showed high heterogeneity (I^2 > 90%) which could be attributed to differences in study populations. The prevalence of smoking varied moderately (I^2 = 53.8%).

We also reported a high prevalence of metabolic syndrome (23.9% [95% CI: 19.5–28.3]) among PLHIV that was slightly higher than previously reported rates at 21.5% (95% CI: 15.09–26.86).[207] This was not reported in the previous systematic review.[12] The heterogeneity observed may be due to variations in definitions of metabolic syndrome across studies.

Our systematic review has several limitations that should be acknowledged: Firstly, the generalizability of

our findings may be limited as our review focused on studies conducted in SSA, which may not fully reflect the global burden of NCDs among PLHIV. Additionally, the majority of the studies included in our review were conducted in only three countries within SSA, potentially introducing bias and limiting the representativeness of the findings.

We did not perform an analysis stratified by age, which could have provided valuable insights into variations in NCD prevalence among different adult age groups of PLHIV. Furthermore, comparisons between NCD prevalence among PLHIV and the general population were not explored, potentially missing out on important insights.

We also did not investigate gender differences, distinctions between urban and rural settings or differentiate between PLHIV on ART and those not on ART. These factors could have contributed to heterogeneity in our findings. Urban and rural environments may have distinct healthcare access, lifestyle patterns and sociodemographic characteristics that can influence NCD prevalence. Additionally, the use of ART might impact the development and management of NCDs among PLHIV.

Furthermore, there may be potential publication bias affecting the prevalence estimates of all selected NCDs/risk factors in our study, although it was minor for hypertension and metabolic syndrome. Previous studies used the Egger test and funnel plots to test for publication bias while we have used the Doi plots and LFK index[15] which is a more appropriate method of assessing the potential of publication bias in proportion studies. Therefore, although we compare with previous findings, we are uncertain on the impact of publication bias on previous findings. Considering these limitations, future studies should aim to address these factors to enhance the precision of prevalence estimates and enable more targeted interventions.

We had a few deviations from our protocol. To begin with, our systematic review only included SSA while Patel et al.[12] included LMICs. Therefore our study only updated data for the SSA region. We provided estimates for CRD, alcohol intake, and smoking that the previous systematic review did not report on. We only reported hypercholesterolemia for lipids.

We did not utilise the Grading of Recommendations, Assessment, Development and Evaluations Framework (GRADE) because we were reporting prevalence from observational studies. The GRADE is mainly used for intervention studies.

In this review, the determination of associations between being on ART and NCDs and/or NCD risk factors among PLHIV in SSA was not done due to large numbers of articles which warrants a separate article on it.

We used the Doi plots and LFK index (a newer method) to test for publication bias instead of the Egger test and funnel plots.

The burden of NCDs among PLHIV is a public health emergency. The heterogeneity of the estimated burden of NCDs among PLHIV may be due to differences in definitions of disease, measurement methods, variations in modifiable risk factors across populations and potential publication bias. Our review still provides sufficient evidence that NCDs are a public health problem that should be addressed among PLHIV and the general population.

Our findings should encourage researchers in SSA to conduct studies on the burden of NCDs and NCD risk factors in the many under represented countries and NCDs, such as cervical cancer and CRDs in SSA. Furthermore, health policy makers should strengthen the promotion of integrated health care for PLHIV in poorly resourced settings, as a step towards promoting universal access to health care. As PLHIV visit primary health care facilities for regular care, screening for NCDs/risk factors should be considered with the aim of preventing disease as much as possible. The health systems in SSA are faced with an emergent need to provide NCD care among the general population but particularly for PLHIV, as the gains achieved by the well-established HIV care programs may be lost due to NCD-related mortality.

Contributors

MMC-Co-ordination of the review, search and selection of studies for inclusion in the review, accessed and verified the data (collection, analysis, and interpretation of data), writing of the review.

KM-Selection of studies for inclusion in the review, accessed and verified the data (collection and interpretation of data), and writing of the review.

MM-Selection of studies for inclusion in the review, interpretation of data, writing of the review.

KK-Adapting of search strategy for the three databases and search of studies for inclusion in the review, writing of the review.

CH-Interpretation of data, writing of the review.

AM-Conception of review, design of the review, selection of studies for inclusion in the review, accessed and verified the data (analysis and interpretation of data), writing of the review, supervision.

All the authors agreed to submit the manuscript for publication.

Data sharing statement

Data will be made available upon reasonable request.

Declaration of interests

The authors declare that they have no competing interests both financial and non-financial.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.eclinm.2023.102255.

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Supplementary Materials

Table of Contents

APPENDIX I: SEARCH STRATEGY 2

APPENDIX II: FOREST PLOTS FOR THE PREVALENCE OF NCD RISK FACTORS AMONG PEOPLE LIVING WITH HIV (PLHIV) IN SUB SAHARAN AFRICA (SSA) 5

APPENDIX III: DOI PLOTS AND LFK INDICES FOR INVESTIGATING PUBLICATION AND OTHER BIAS IN THE META-ANALYSIS OF PREVALENCE OF NCDS/ NCD RISK FACTORS AMONG PLHIV IN SSA 11

Appendix I: Search Strategy

((PLWH* OR PLWHA* OR "people living with HIV" OR "people living with HIV/AIDS" OR "people living with" OR "people living with aids" OR "people living with hiv" OR "people living with hiv/aids" OR "people living with hiv/aids plwha" OR "people living with hiv/aids plwhas" OR "people living with hiv aids" OR "people living with hiv aids plwha" OR "people living with hiv aids plwhas" OR "people living with hiv and aids" OR "people living with hiv infection" OR "people living with hivs" OR "people living with human immunodeficiency virus" OR "people living with human immunodeficiency virus/acquired immunodeficiency syndrome" OR "people living with human immunodeficiency virus acquired immunodeficiency syndrome" OR "people living with hiv" OR "HIV Infections"[mesh] OR "HIV infection" OR "HIV infections" OR PLWHIV OR "HIV positive" OR "HIV-positive" OR "HIV+" OR "HIV infected" OR "HIV-infected" OR "HIV seropositivity"[mesh] OR "HIV seropositivity"

) AND ((((("cervical cancer" OR uterine cervical neoplasms[mesh] OR "uterine cervical cancers" OR "uterine cervical cancer" OR "cervix neoplasms" OR "cervix neoplasm" OR "cervical neoplasms" OR "cervical neoplasm" OR "uterine cervical neoplasm" OR "uterine cervical neoplasms") OR ("Diabetes Mellitus"[Mesh] OR diabetes[tiab] OR "Type 1 diabetes" OR "Type 2 diabetes" OR hyperglycaemia OR gestational diabetes OR "fasting blood sugar" OR "endocrine disorder" OR A1C OR "A1C test" OR "hemoglobin A1C" OR "glycohemoglobin test" OR HbA1c OR "Endocrine System Diseases"[Mesh] OR "Metabolic Syndrome"[Mesh] OR "metabolic cardiovascular syndrome" OR "metabolic syndrome" OR "metabolic syndrome" OR "insulin resistance syndrome X" OR "metabolic X syndrome")) OR (mental health[mesh] OR "mental health" OR "mental illness" OR mental disorders[mesh] OR "mental disorders" OR "mental disorder" OR depression OR depression[mesh] OR "depressive disorder"[mesh] OR depressed

OR "psychiatric illness" OR "psychiatric disorder" OR "mood disorder" OR "mood disorders" OR "psychosocial stress" OR Schizophrenia OR "psychiatric illness" OR "neuropsychiatric disorder" OR "neurospsychiatric disorders" OR "common mental disorders" OR psychosis OR "psychotic disorder" OR "HIV dementia" OR "HIV encephalopathy" OR "mental hospital" OR "psychiatric hospital" OR "Trauma and Stressor Related Disorders"[Mesh] OR "Mood Disorders"[Mesh] OR "Anxiety"[Mesh] OR "Suicide"[Mesh] OR "Suicidal Ideation"[Mesh] OR "Schizophrenia Spectrum and Other Psychotic Disorders"[Mesh] OR "Schizophrenia"[Mesh] OR "Anxiety Disorders"[Mesh] OR "Adjustment Disorders"[Mesh] OR "Psychotic Disorders"[Mesh] OR "AIDS Dementia Complex"[Mesh] OR "Mental Health Services"[Mesh] OR "Community Mental Health Services"[Mesh] OR "Hospitals, Psychiatric"[Mesh] OR "Substance-Related Disorders"[Mesh] OR "substance abuse" OR "drug abuse" OR "drug dependence" OR "substance addiction" OR MINI OR CIDI OR PHQ-9 OR "Mini International Neuropsychiatric Interview" OR "Composite International Diagnostic Interview" OR "Beck Depression Inventory" OR "bdi depression scores" OR "bdi depression" OR "Patient Health Questionnaire" OR "Patient Health Questionnaire 9" OR "drug addiction" OR anxiety OR suicide OR "suicide ideation" OR "adjustment disorder" OR "adjustment disorders" OR "psychiatric disorder" OR "psychiatric disorders" OR "AIDS dementia complex" OR "mental health services" OR "substance related disorder" OR "substance related disorders" OR "community mental health services" OR "counseling" OR "medication adherence" OR "medication compliance" OR "Medication Adherence"[Mesh] OR "Counseling"[Mesh])) OR (Cardiovascular Diseases[mesh] OR Heart Diseases[mesh] OR hypertension[mesh] OR stroke[mesh] OR cardiovascular OR "heart disease" OR hypertension OR "high blood pressure" OR stroke OR "heart attack" OR "Coronary Disease"[Mesh] OR "Cerebrovascular Disorders"[Mesh] OR "Pulmonary Embolism"[Mesh] OR "Peripheral Arterial Disease"[Mesh] OR

"Peripheral Vascular Diseases"[Mesh] OR "Rheumatic Heart Disease"[Mesh] OR "Venous Thrombosis"[Mesh] OR "coronary disease" OR "pulmonary embolism" OR "cerebrovascular disorder" OR "cerebrovascular disease" OR "peripheral arterial disease" OR "rheumatic heart disease" OR "deep vein thrombosis" OR "ischemic heart disease" OR "heart failure" OR "coronary heart disease" OR "cardiovascular disease" OR "Inflammation"[Mesh] OR inflammation OR inflame* OR "Atherosclerosis"[Mesh] OR atherosclerosis OR "Metabolic Syndrome"[Mesh] OR "metabolic cardiovascular syndrome" OR "metabolic syndrome" OR "insulin resistance syndrome X" OR "metabolic X syndrome" OR "cardiovascular biomarker" OR "inflammation biomarker" OR "endothelial function" OR "Interleukin-6"[Mesh] OR IL-6 OR "C-Reactive Protein"[Mesh] OR "C Reactive Protein" OR "C-Reactive Protein" OR "Carotid Intima-Media Thickness"[Mesh] OR "carotid intima media thickness" OR "carotid intima-media thickness" OR "Cholesterol"[Mesh] OR cholesterol OR "Angiography"[Mesh] OR angiography OR "Hydroxymethylglutaryl- CoA Reductase Inhibitors"[Mesh] OR "Hydroxymethylglutaryl CoA Reductase Inhibitors" OR "HMG-CoA Statins" OR "HMG-CoA Reductase Inhibitors" OR "Fluorodeoxyglucose F18"[Mesh] OR 18F-FDG OR "18F FDG" OR "Fluorodeoxyglucose F 18" OR "2-Fluoro-2-deoxy-D-glucose" OR "Venous Thromboembolism"[Mesh] OR "venous thromboembolism" OR cardiometabolic OR "Myocardial Infarction"[Mesh] OR "myocardial infarction" OR "myocardial infarct" OR "Vascular Diseases"[Mesh] OR "vascular disease" OR "Coronary Artery Disease"[Mesh] OR "coronary artery disease" OR "Myocarditis"[Mesh] OR myocarditis OR "Cardiomyopathies"[Mesh] OR cardiomyopathy OR cardiomyopathies OR "cardiac disease" OR "cardiac arrhythmias" OR "Arrhythmias, Cardiac"[Mesh] OR arrhythmia* OR "myocardial disease" OR "myocardial diseases" OR myocardiopathy OR myocardiopathies OR carditis OR "dyslipidemias"[MeSH] OR dyslipidemia OR hyperlipidemia OR hypercholesterolemia OR hypertriglyceridemia OR

triglyceride OR triglycerides OR HDL OR LDL OR VLDL OR "Lipoproteins, HDL"[Mesh] OR "Lipoproteins, LDL"[Mesh] OR "Lipoproteins, VLDL"[Mesh] OR hyperlipoproteinemia OR lipoprotein(a) OR hyperlipidaemia OR hypercholesterolaemia OR hypertriglyceridaemia OR "Blood Pressure"[MeSH] OR "blood pressure" OR "systolic blood pressure" OR "diastolic blood pressure" OR SBP[tiab] OR DBP[tiab]))) “Chronic lung disease” OR "Lung Diseases"[Mesh] OR "Respiratory Tract Diseases"[Mesh] OR "Respiration Disorders"[Mesh] OR “Chronic respiratory diseases” OR “respiratory diseases” OR "asthma"[MeSH] OR Asthma Or "Asthma-Chronic Obstructive Pulmonary Disease Overlap Syndrome"[Mesh] OR "chronic obstructive pulmonary disease" OR "Pulmonary Disease, Chronic Obstructive"[Mesh] AND ("Africa South of the Sahara"[Mesh] OR "sub Saharan Africa "OR "sub-Saharan Africa" OR "sub-Sahara" OR sub-Sahara OR SSA OR "Africa south of the Sahara" OR Angola OR Benin OR Botswana OR "Burkina Faso" OR Burundi OR "Cabo Verde" OR Cameroon OR "Central African Republic" OR Chad OR Comoros OR Congo OR "Cote d'ivoire" OR "Equatorial Guinea" OR Eritrea OR Eswatini OR Ethiopia OR Gabon OR "Gambia, the" OR Ghana OR Guinea OR "Guinea-Bissau" OR Kenya OR Lesotho OR Liberia OR Madagascar OR malawi OR Mali OR Mauritania OR Mauritius OR Mozambique OR Namibia OR Niger OR Nigeria OR Rwanda OR "Sao tome and Principe" OR Senegal OR Seychelles OR "Sierra Leone" OR Somalia OR "South Africa" OR "South Sudan" OR Sudan OR Tanzania OR Togo OR Uganda OR Zambia OR Zimbabwe)

Appendix II: Forest plots for the prevalence of NCD risk factors among people living with HIV (PLHIV) in Sub Saharan Africa (SSA)

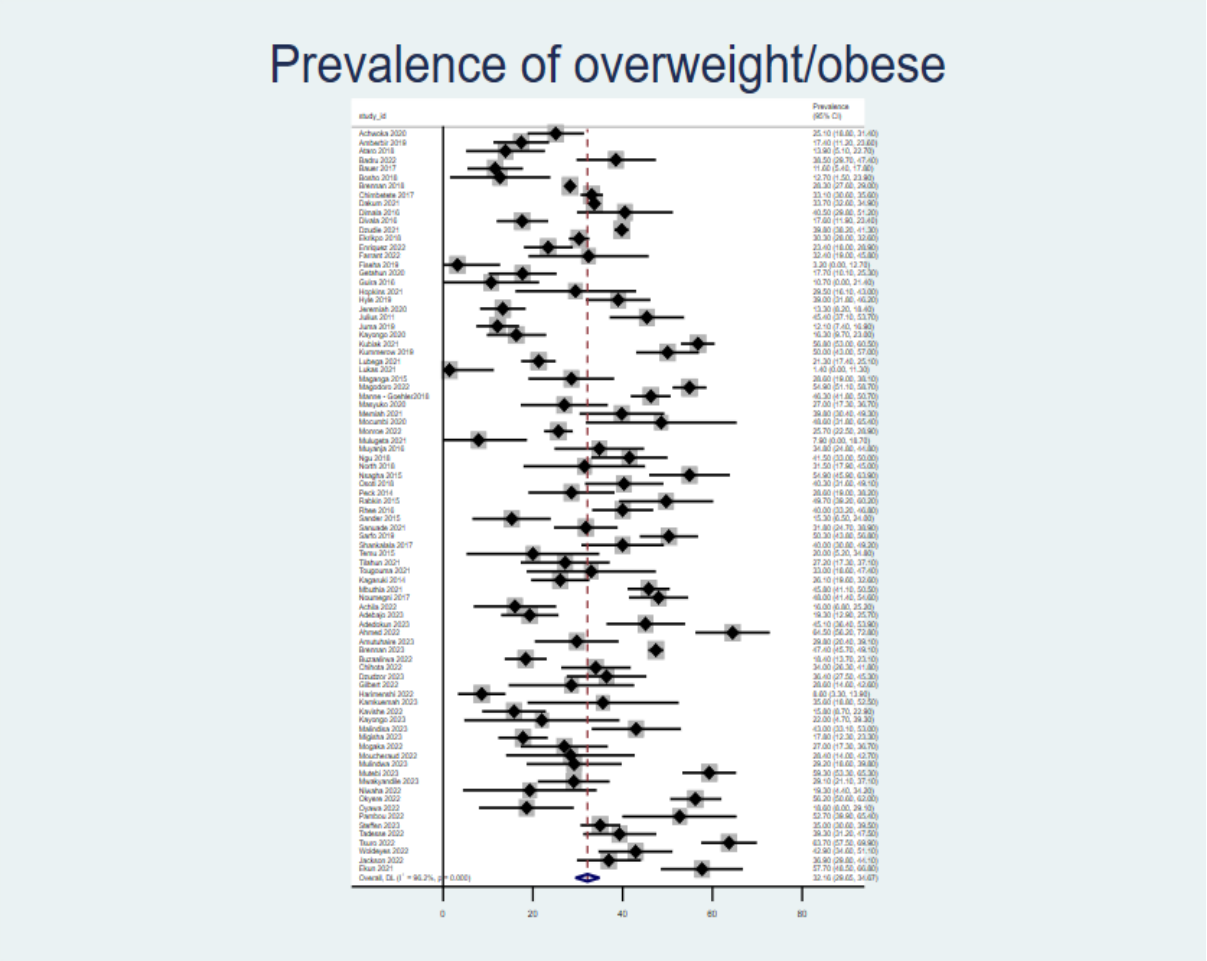

Figure I: Forest plot of pooled estimates generated by meta-analyses for prevalence of overweight/obesity among PLHIV in SSA.

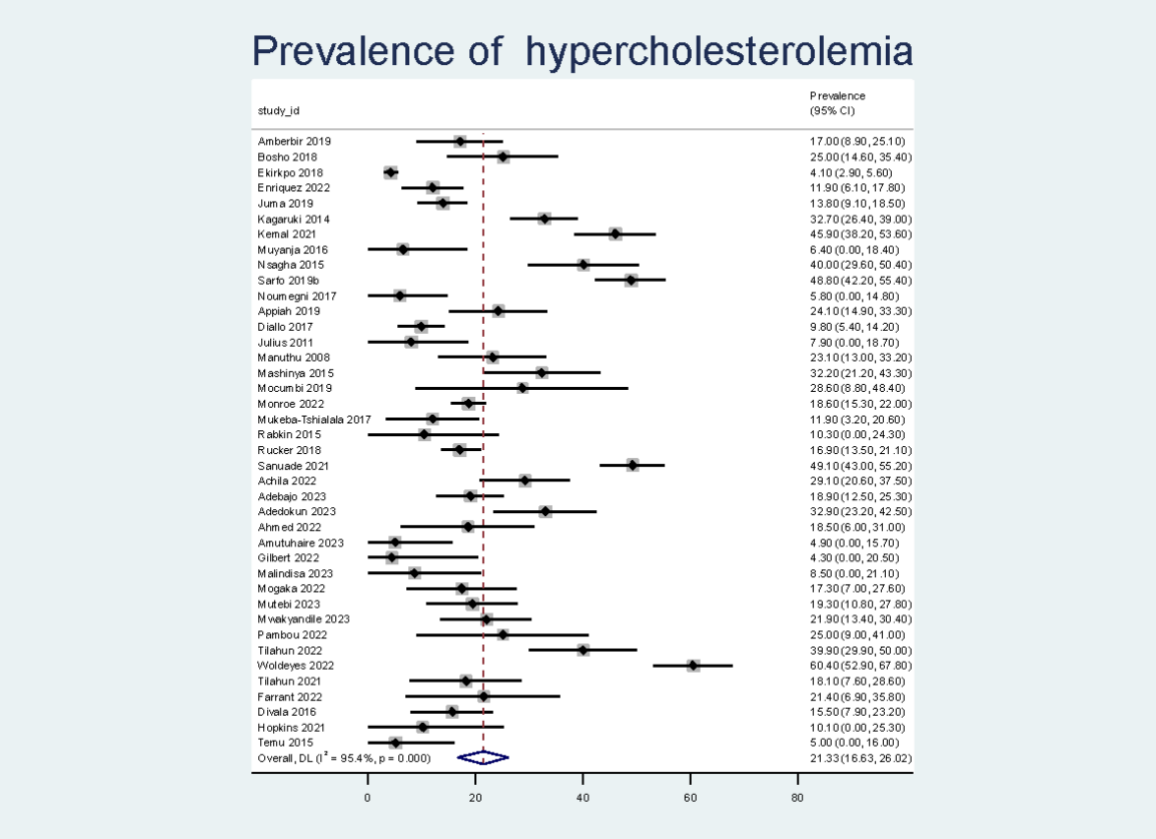

Figure II: Forest plot of pooled estimates generated by meta-analyses for prevalence of hypercholesterolemia among PLHIV in SSA.

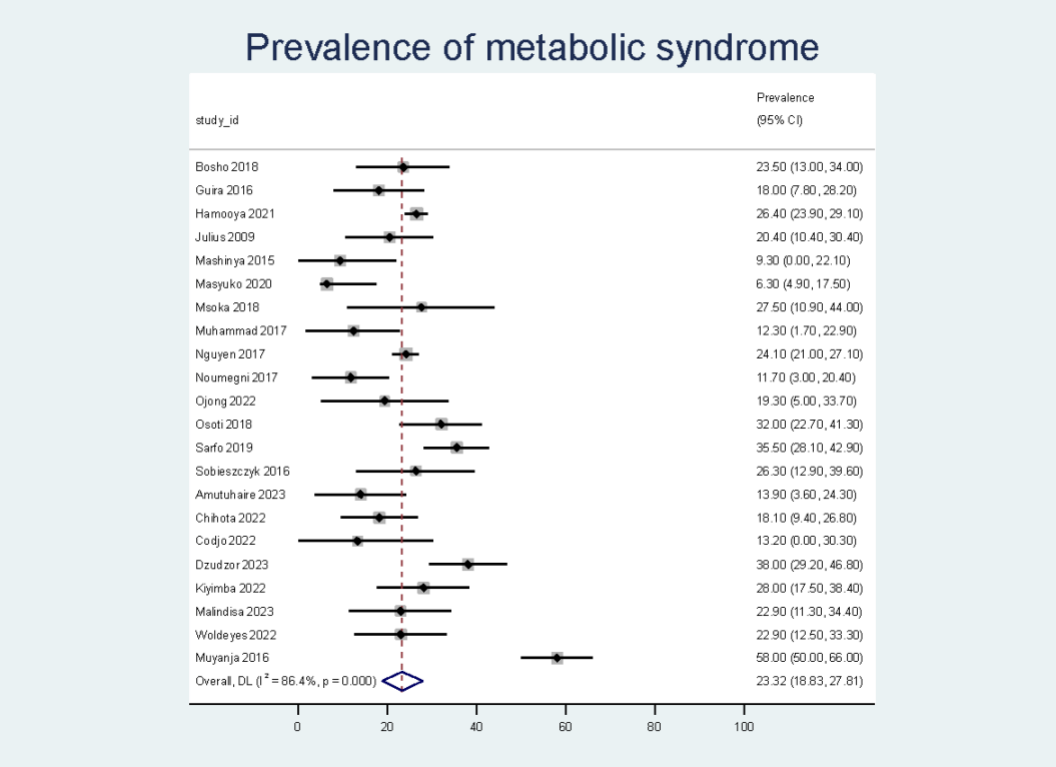

Figure III: Forest plot of pooled estimates generated by meta-analyses for prevalence of metabolic syndrome among PLHIV in SSA.

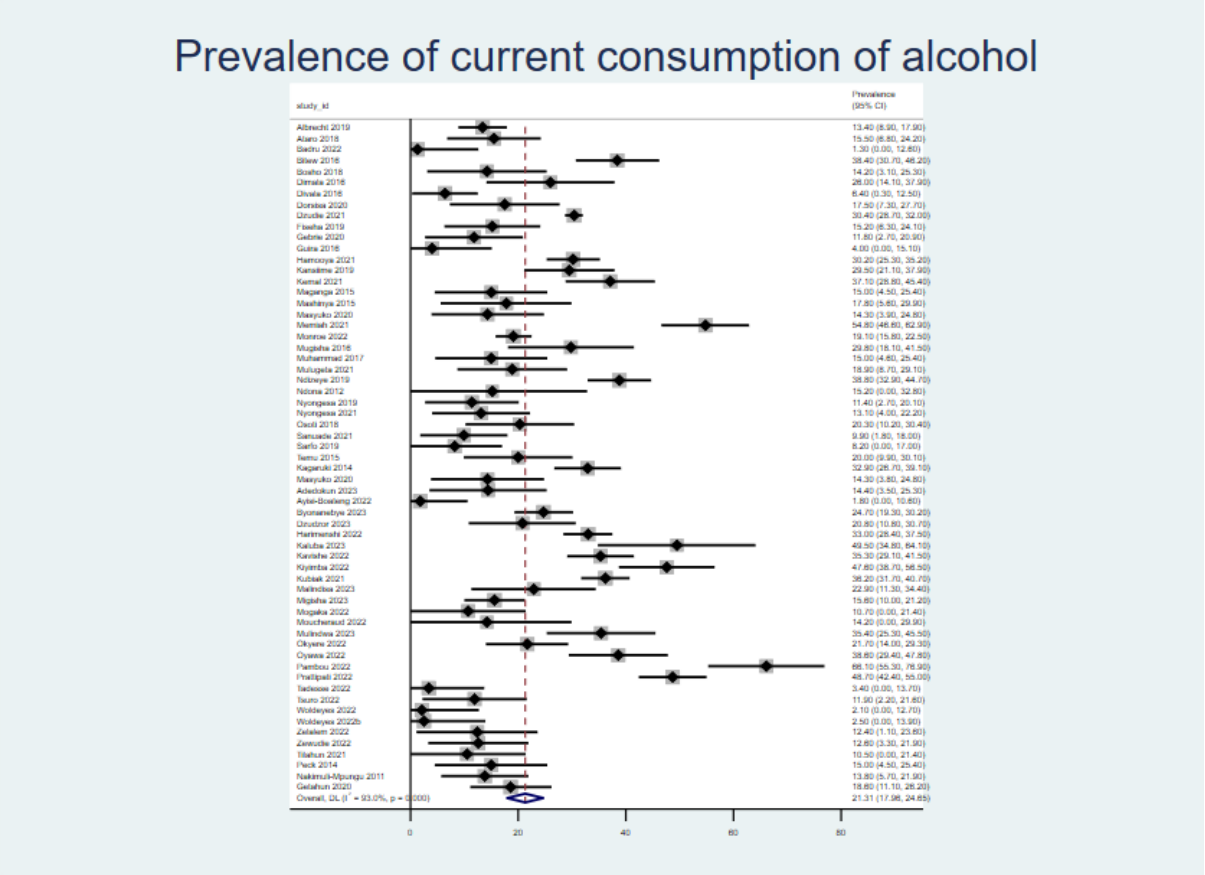

Figure IV: Forest plot of pooled estimates generated by meta-analyses for prevalence of consumption of alcohol among PLHIV in SSA.

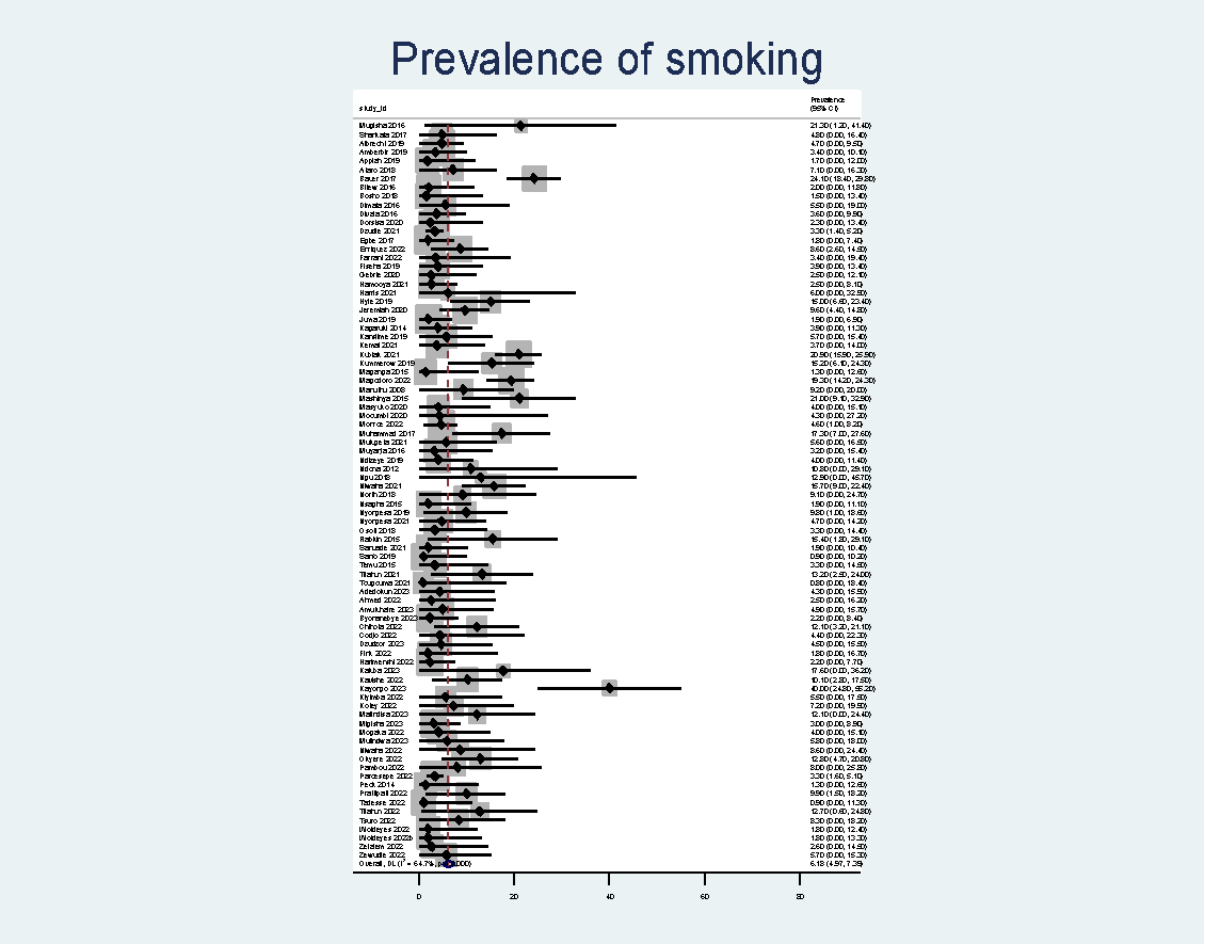

Figure V: Forest plot of pooled estimates generated by meta-analyses for prevalence of smoking among PLHIV in SSA.

Appendix III: Doi plots and LFK indices for investigating publication and other bias in the meta-analysis of prevalence of NCDs/ NCD risk factors among PLHIV in SSA

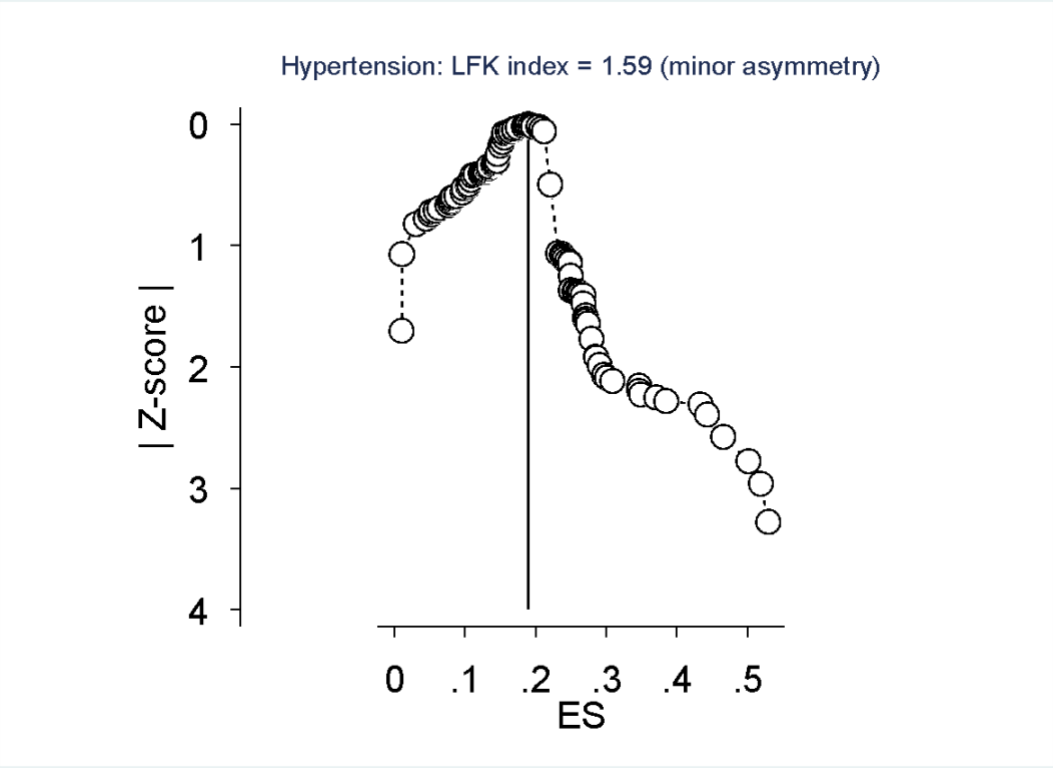

Figure A: Doi plot of pooled estimates generated by meta-analyses for prevalence of hypertension among PLHIV in SSA (LFK index=1.59)

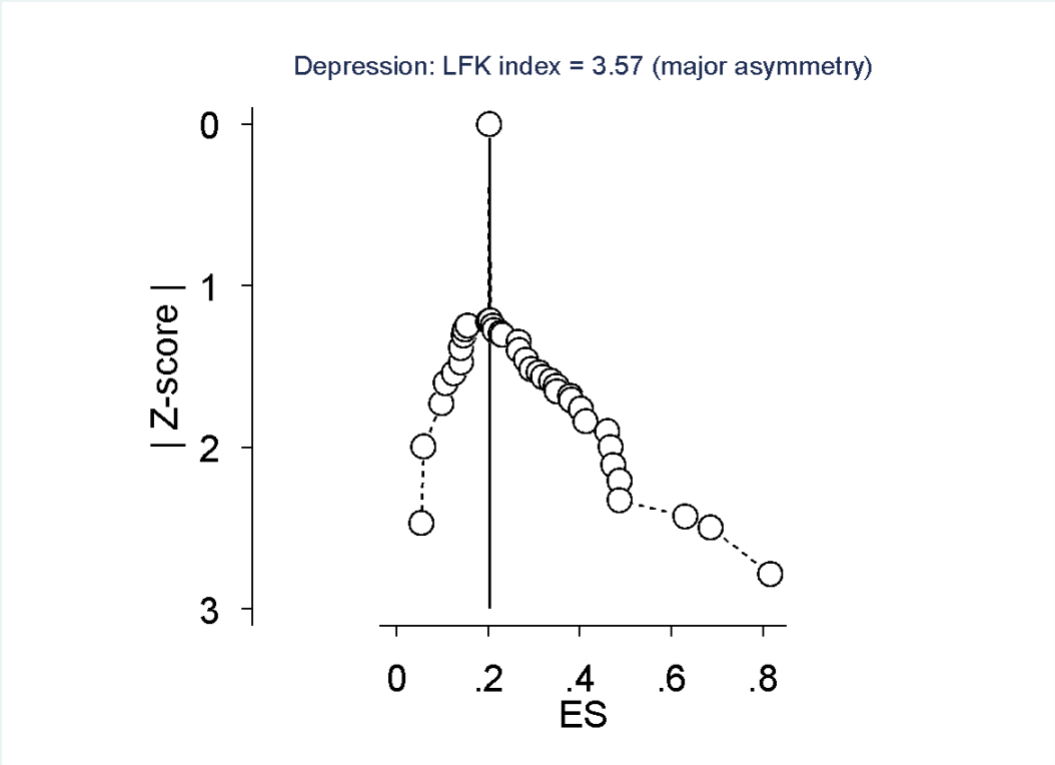

Figure B: Doi plot of pooled estimates generated by meta-analyses for prevalence of depression among PLHIV in SSA (LFK index=3.57).

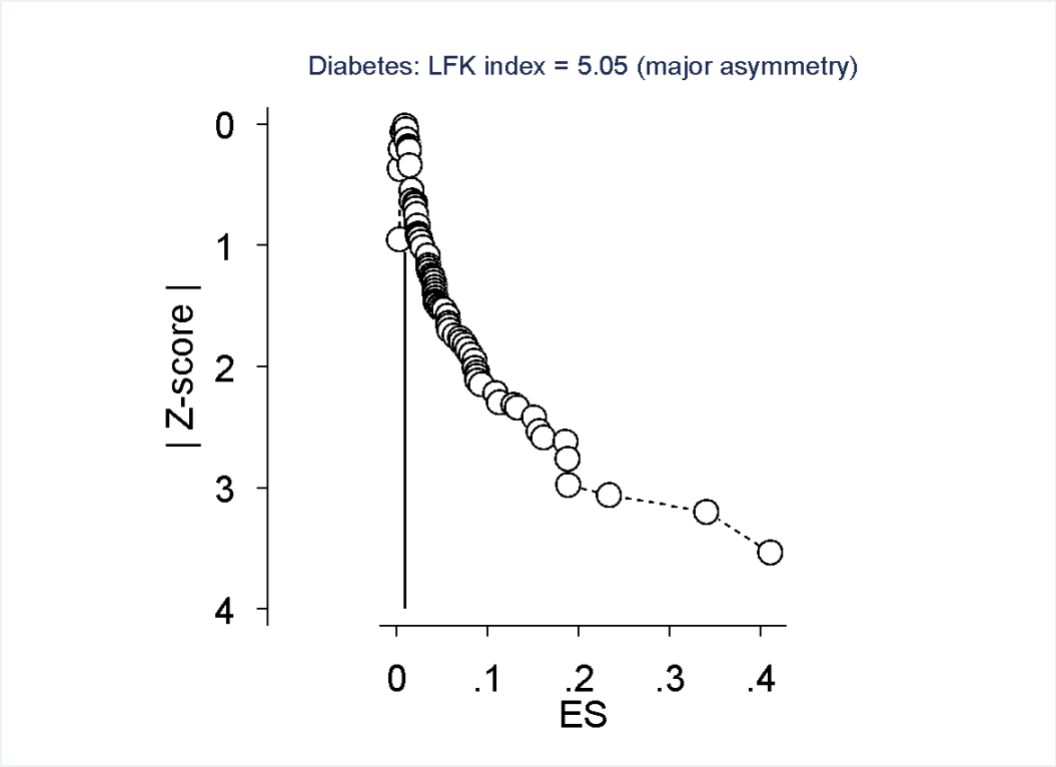

Figure C: Doi plot of pooled estimates generated by meta-analyses for prevalence of diabetes among PLHIV in SSA (LFK Index=5.05).

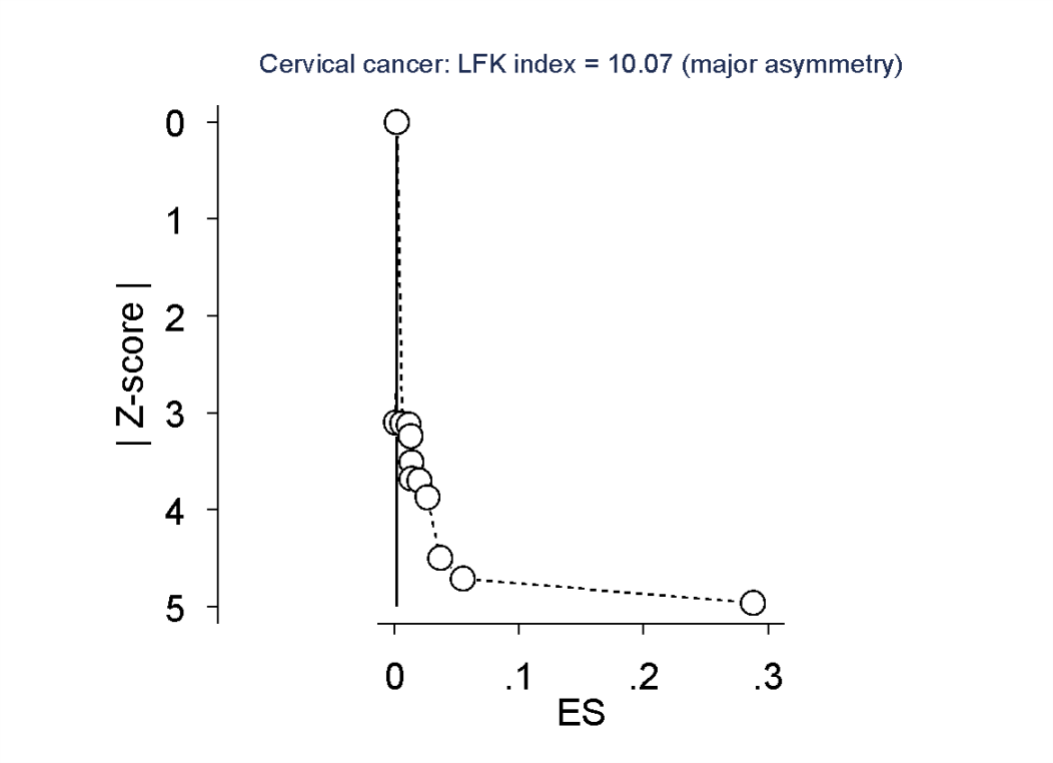

Figure D: Doi plot of pooled estimates generated by meta-analyses for prevalence of cervical cancer among PLHIV in SSA (LFK index=10.07).

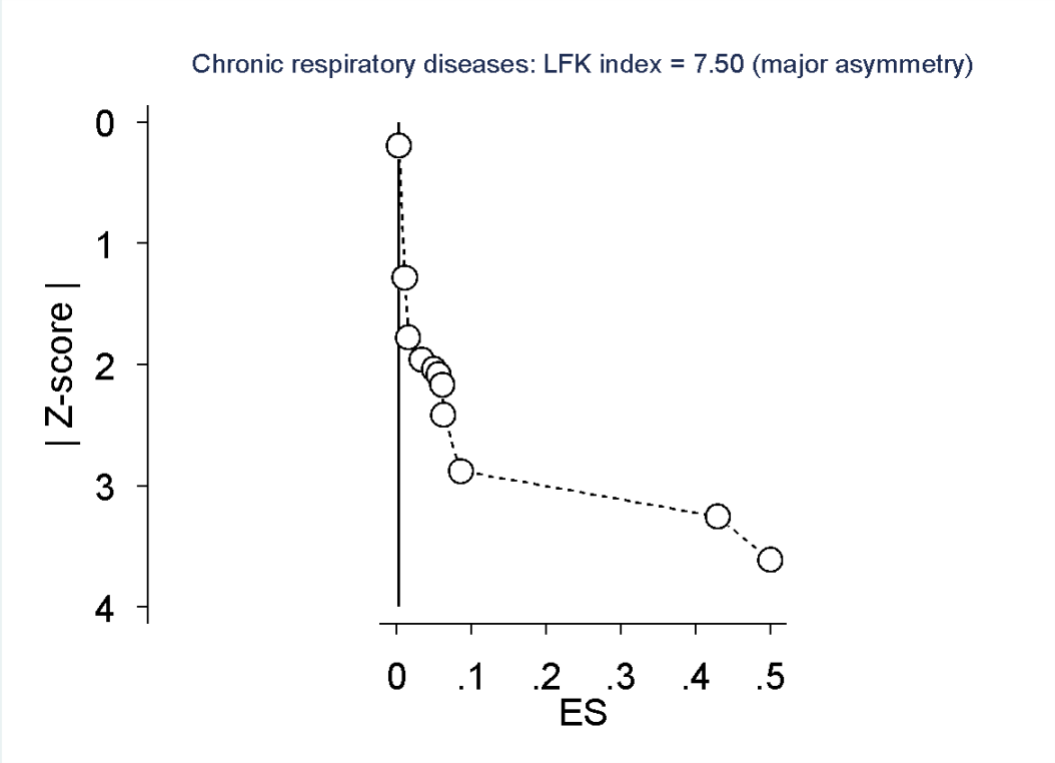

Figure E: Doi plot of pooled estimates generated by meta-analyses for prevalence of chronic respiratory diseases among PLHIV in SSA (LFK index=7.50).

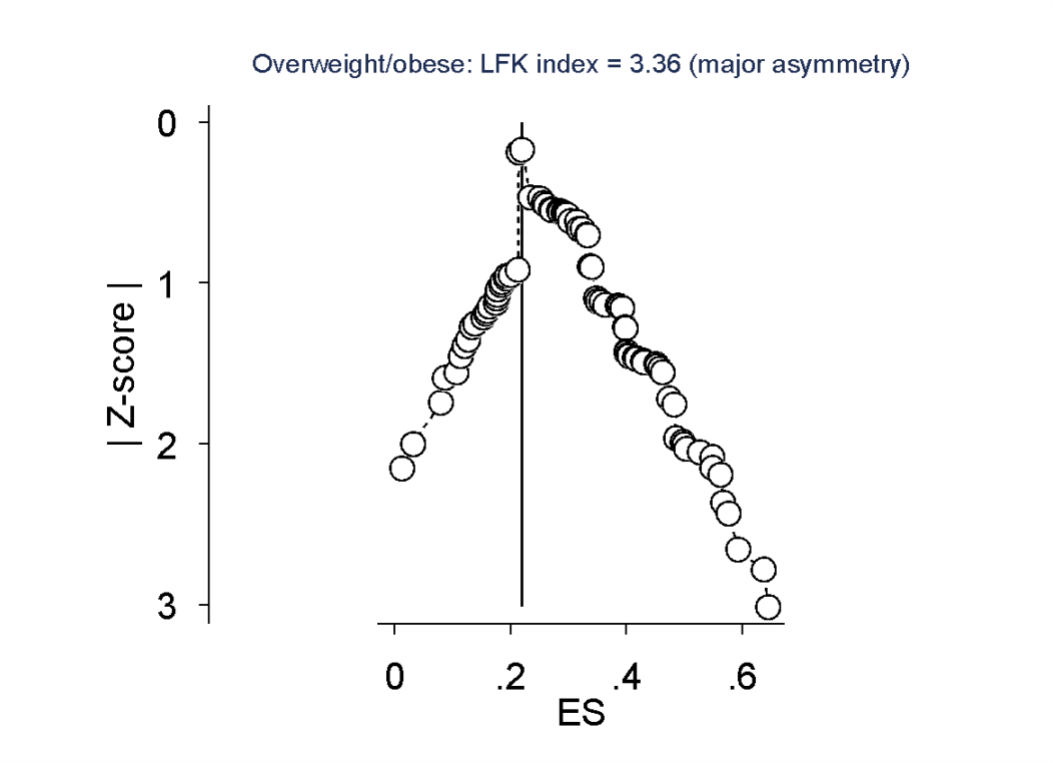

Figure F: Doi plot of pooled estimates generated by meta-analyses for prevalence of overweight/obese among PLHIV in SSA (LFK index=3.36).

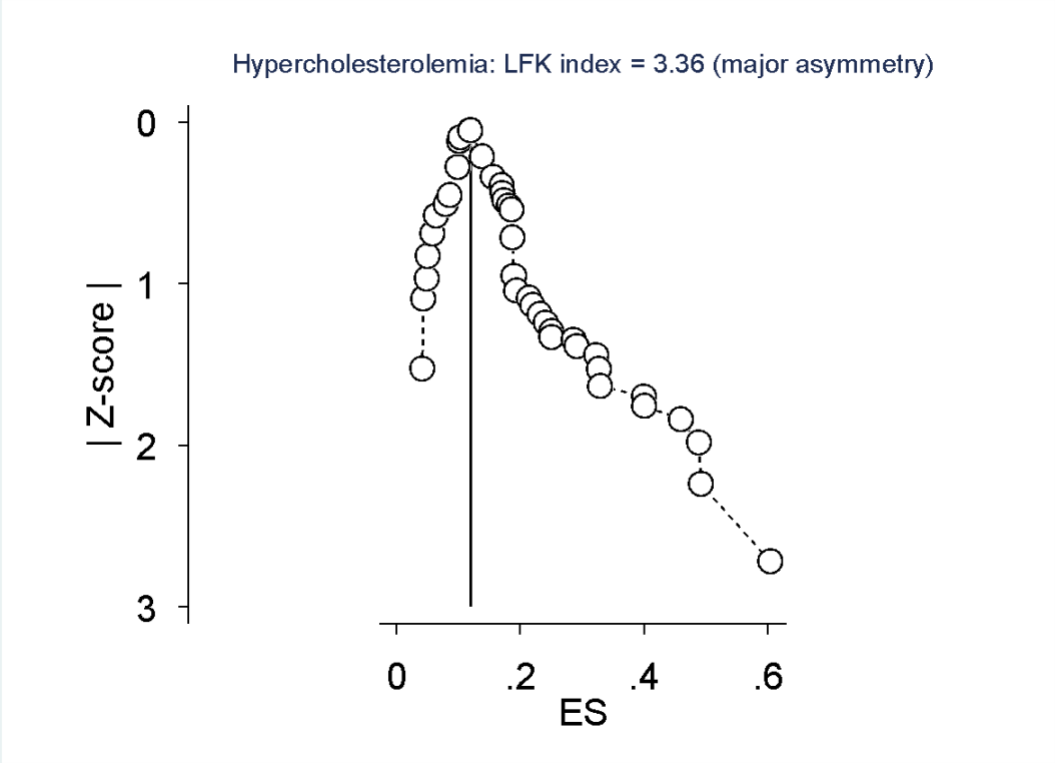

Figure G: Doi plot of pooled estimates generated by meta-analyses for prevalence of hypercholesterolemia among PLHIV in SSA (LFK index=3.36).

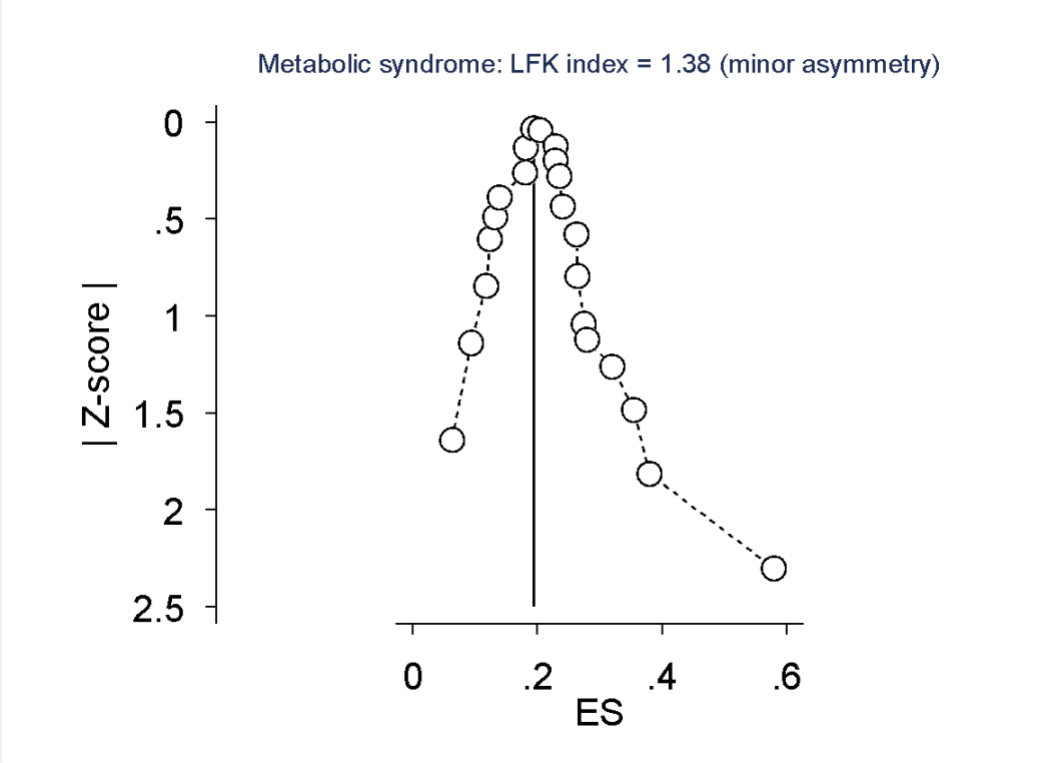

Figure H: Doi plot of pooled estimates generated by meta-analyses for prevalence of metabolic syndrome among PLHIV in SSA (LFK index=1.38).

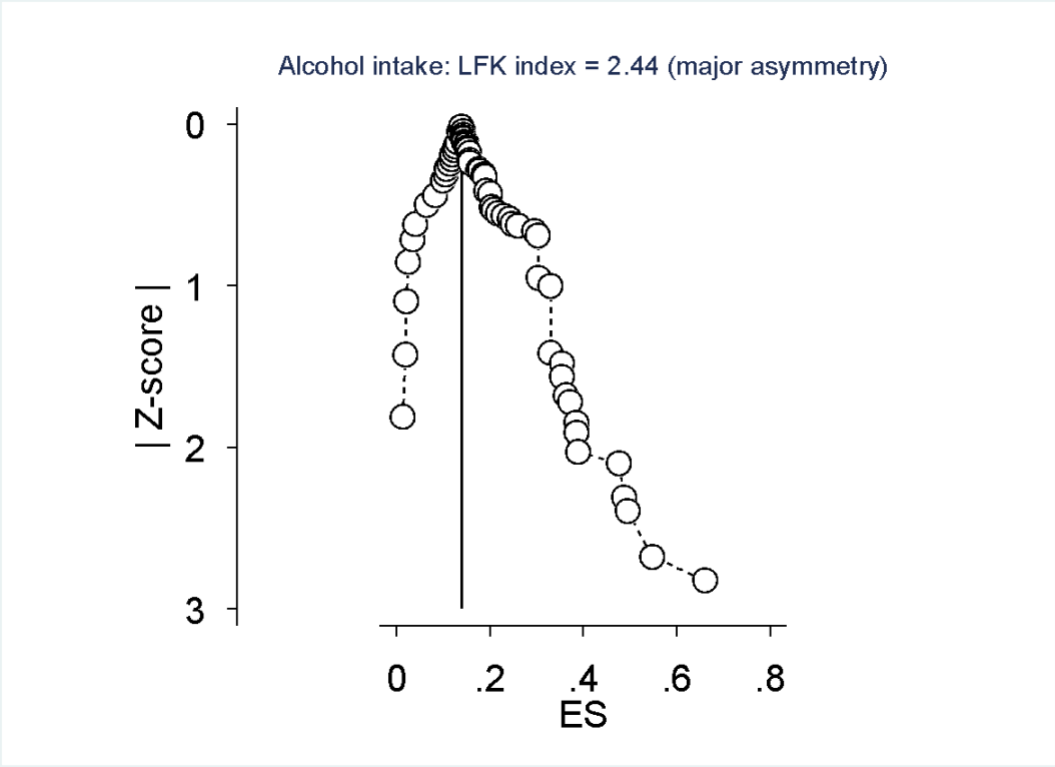

Figure I: Doi plot of pooled estimates generated by meta-analyses for prevalence of alcohol use among PLHIV in SSA (LFK index=2.44).

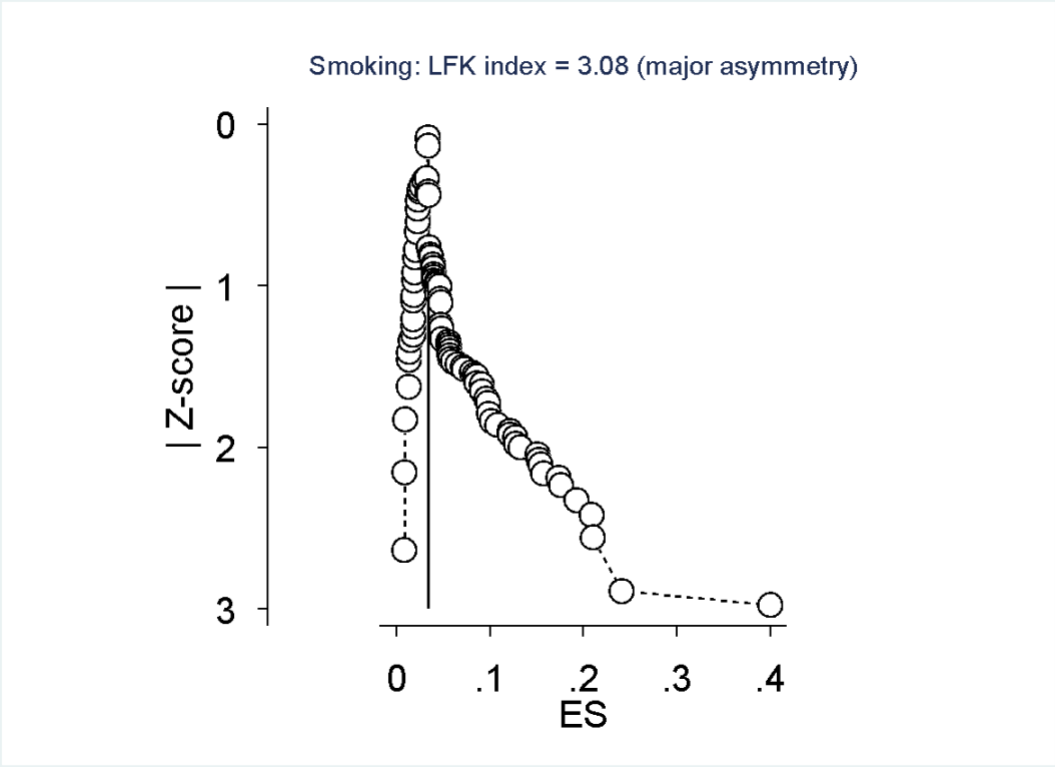

Figure J: Doi plot of pooled estimates generated by meta-analyses for prevalence of smoking among PLHIV in SSA (LFK index=3.08).

Chapter 4: The extent of HIV/NCD Integration

After determining the burden of NCDs among PLHIV in SSA, the study proceeded to address the second objective of determining the extent of HIV/NCD integration in Southern Africa from the perspectives of the national HIV program managers. This was a qualitative study that utilised semi structured interviews and a documentary data collection instrument. The findings are reported in a manuscript format in line with the targeted journal. The manuscript has been submitted to the Pan African Medical Journal and is currently under peer review. The manuscript is titled *"The perspectives of HIV Program Managers on the extent of integration of HIV and non-communicable disease care for people living with HIV in Southern Africa – a qualitative study"*.

This chapter provided insights from the perspectives of HIV program Managers on the extent of integration in Southern African countries. Key findings from this chapter include the lack of funding for integrated HIV/NCD care and the need to strengthen health systems to include mental health care for PLHIV at PHC level.

The perspectives of HIV Program Managers on the extent of integration of HIV and non-communicable disease care for people living with HIV in Southern Africa – a qualitative study

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Abstract

Background: Global prevalence studies confirm the comorbid presentation of HIV and non-communicable diseases (NCDs) such as cardiovascular diseases, diabetes, and cancers, existing to even above 30% of all individuals affected with HIV. Best practice indicates a need for the implementation of an integrated health service for PLHIV. The paucity of empirical work on the progress and extent of this integration in the region serves as an important motivation for the conceptualisation of the current study.

Methods: A qualitative study based on data collected from semi-structured interviews (n=5) and a documentary data collection instrument of national HIV program managers in four Southern African countries (Eswatini, Mozambique, Zambia and Zimbabwe) was conducted. Emergent data was analysed using thematic data analysis.

Results: Findings revealed varied levels of integration. Additionally, data from interviewees highlighted that individuals presenting with specific comorbidities such as HIV/ mental illness had the lowest levels of reported access to integrated care, relative to other medical conditions such as hypertension and diabetes. Implementation success was significantly impacted by challenges related to drug stockouts, availability of laboratory tests, scarcity of funding for NCDs, and the impact of COVID-19, on primary health care (PHC) services.

Conclusion: Despite some evidence of noteworthy efforts to integrate HIV/NCD services, findings, showed services across the four countries to be relatively limited:- an

observation that supports the assertion that health systems still require strengthening to maximally facilitate the development of adequately integrated HIV/NCD care services at PHC level in these countries. Measuring extent of integration requires further standardisation.

Keywords: Integration; Noncommunicable Diseases; People Living with HIV/AIDS; Southern African Development Community; Qualitative

Introduction

The implementation of the universal test and treat approach for human immunodeficiency virus infection and acquired immunodeficiency syndrome (HIV/AIDS) care in Sub–Saharan Africa(SSA) has improved the life expectancy for people living with HIV (PLHIV) comparable to individuals without HIV infection[1]. As a result, PLHIV now face challenges of non-communicable diseases (NCDs) in addition to potential adverse effects from anti-retroviral therapy, drug interactions, and the impact of HIV infection itself[2]. The joint United Nations programme on HIV/AIDS (UNAIDS) global update[3] highlights the growing burden of NCDs among PLHIV, and within this, they specifically note the hindered progress of HIV programmes, particularly in low- and middle-income countries (LMICs) such as SSA.

The rising trend of urbanization and shifting lifestyles, characterized by reduced physical activity, and a higher consumption of unhealthy diets, rich in salt and sugar content, has led to a significant surge in NCDs within numerous LMICs[4] . If timely interventions are not promptly implemented, this public health concern is projected to exacerbate, especially given that NCDs are currently the leading cause of death globally[5].

The World Health Organization (WHO) recently reported an increase in premature NCD-related mortality in over 20 countries, primarily LMICs[6]. Given that SSA already has well established platforms for HIV care, integrating NCD care within these systems is seen as highly beneficial. Africa has a rich history of effectively combating infectious diseases that

has traditionally placed less emphasis on addressing NCDs. Therefore, it is crucial for LMICs to strengthen their health systems to effectively manage and provide healthcare for individuals with NCDs.

The WHO global report on NCDs sets specific goals to reduce NCD deaths for its 194 member states including countries in SSA[7]. These objectives encompass various areas, such as formulating government policies to tackle NCDs, implementing effective measures to reduce tobacco consumption, combating detrimental effects of alcohol abuse and unhealthy eating habits, promoting physical activity and enhancing health systems through primary health care and universal health coverage[8].

In resource constrained settings like SSA, where the largest number of PLHIV (20.6 million) is concentrated globally[3], there has been a growing focus on integrated care for patients at primary health care (PHC) facilities. While numerous publications have addressed integrated health services in several African countries[9-11], limited information is available regarding the implementation of integrated HIV/NCD care and its impact on healthcare service delivery and the reduction of NCD-related deaths. Article 13 of the SADC protocol on health alludes to adopting appropriate strategies for the prevention and control of NCDs, and this is well aligned to sustainable development goals (SDG) - 3, target v3.4 that addresses reduction of mortality from NCDs among PLHIV, through prevention, treatment and promotion of mental health and wellbeing by 2030. This study aimed to contribute to meeting this target by determining the extent of

integration of HIV/NCD health care in Southern African countries from the perspective of the provider, in order to inform health policy makers and encourage further research in the region. While recognizing that the concept of integrated care for NCDs and HIV encompasses various dimensions, leading to complex definitions, this study examined the extent of integration between the five major NCDs (cardiovascular diseases, cancers, diabetes, mental illnesses, and chronic respiratory diseases)[6] and HIV care programmes. The findings of this study will provide valuable insights into the level of integration across various countries and identify areas that require improvement to enhance NCD care in SSA countries.

Methods

Study Approach

The study employed a multi-approach qualitative study in which a combination of semi-structured interviews of HIV program managers (n=5) and a data template were used as the basis for the collection of data on the existence and success of the integration of NCDs into HIV care in Southern African countries. In-depth qualitative data from the key informant semi-structured interviews was analysed via thematic analysis[12]. In identifying study participants to take part in the interviews, purposive sampling was utilised to identify national HIV programme managers of Southern African countries, who met the inclusion criteria. By focusing on this specific group, the study aimed to gather valuable insights into the extent of NCD integration within HIV care and provide relevant

information that could guide policy development in the region. We sought to determine the level of integration by considering the inclusion of five major NCDs within the HIV care programme in SSA. Integration was defined as availability of screening and /or care of any of the five main NCDs among PLHIV at a primary health care facility. The extent of integration was described as fully segregated, if none of NCD screening is available among PLHIV, low integration if one or two NCDs screening/care is available, moderate integration if up to three NCDs are screened/cared for, high integration for four and complete service-level integration if all five NCD screening and/or treatment services were available within the same facility as the HIV care programme. This could be carried out by either a single healthcare worker or multiple professionals, depending on the availability of human resources at a particular health facility.

Study setting and participants

The study focused on engaging national HIV and/or NCD programme officials in four Southern African countries, namely Eswatini, Mozambique, Zambia and Zimbabwe.

Eswatini, despite its small population of approximately 1.2 million[13], bears the highest global prevalence of HIV at 27.9 %[14]. The country also experiences a significant percentage of deaths attributable to NCDs, amounting to 46%[6].

Mozambique, with a population of around 32 million (2021)[15] has an HIV prevalence of 11.5%[16] and a 36% NCD-related death rate[6].

In Zambia which has a population of 19.7 million(2021)[17],the prevalence of HIV stands at 10.8%[18] with NCDs contributing to 35% of total deaths[6].

Zimbabwe, with a population of almost 16 million(2021)[19], has an HIV prevalence 11.6% [20], and NCD-related deaths account for 39%[6].

It is worth noting that Eswatini, Zambia and Zimbabwe are among the six countries in East and Southern Africa that achieved the UNAIDS 90-90-90 targets prior to 2020[3].These countries were selected for this study due to their high HIV prevalence rates and significant proportions of NCD-related deaths.

To facilitate contact with the national HIV programme officers, the researchers sought assistance from the SADC secretariat - HIV and AIDS office. Introduction via email was made to the National AIDS Council(NAC) directors. The NAC directors provided guidance on suitable individuals to approach within each country, and subsequently, appointments for interviews were arranged. Each of the three countries had one key informant while one country had two key informants, giving us a total of five key informants only.

Data Collection

We conducted interviews from 23 February 2022 to 8 August 2022. The interviews were conducted online, using Microsoft Teams and in-person interviews in one country. These were semi-structured interviews, allowing the interviewer to request respondents to elaborate on relevant and interesting responses.

To assess the extent of integration between NCDs and HIV programs, a documentary data collection instrument (Appendix I) was employed. This documentary data collection instrument served as an assessment tool which was informed by the WHO's building blocks of a good health system[21], and Mensa et al[22] . It encompassed various dimensions of integration, including the number of NCDs integrated into the HIV programme, the availability of training for health care workers, the presence of health information systems, the accessibility of essential medicines/technologies, the allocation of budget for NCDs, the existence of national guidelines, the availability of NCD/HIV integrated care reports, and the presence of patient data on modifiable behavioural risk factors.

Data Analysis

Data collected using the documentary data collection instrument was tabulated to provide a concise summary of the extent of integration of HIV and NCDs in the four countries. We used thematic analysis[12] as the analytical framework for the qualitative data. The analysis process began with transcribing of the interviews and thoroughly reading through the text and taking notes to familiarize ourselves with the data. The next step involved coding, where specific phrases related to integration at PHC facilities in Southern African countries was highlighted. This was followed by identifying patterns among the codes

leading to generating of themes. Through this coding process, patterns and connections among the codes were identified, leading to generation of themes.

To ensure the accuracy and representativeness of the themes, a comprehensive review of the identified themes was conducted. This review involved revisiting the data and cross checking the themes generated. After finalizing the list of themes, each theme was given a name and a clear definition. Finally, the results of the analysis were synthesized and written up.

This multi-step process of thematic analysis allowed us to identify key patterns and themes within the interview data, thus providing a deeper understanding of the integration of HIV and NCD's at PHC facilities in the studied countries.

Ethical Approval

The research conducted in this study obtained ethical approval from the University of Pretoria Faculty of Health Sciences Research Ethics Committee (reference number:591/2021). Prior to participating, all individuals involved provided written informed consent. The information sheet provided to the participants clearly stated that the study was voluntary and that they had the freedom to withdraw at any point if they chose to do so. Moreover, participants consented to recording of interviews, and these recordings were securely stored on a computer protected by a password.

Results

The key informants comprised of individuals with backgrounds in medicine, nursing and monitoring and evaluation, with master's degrees in public health and epidemiology. They all had over ten years working experience in the Ministry of Health.

Cervical cancer, diabetes, and hypertension have been incorporated as main NCDs among PLHIV in all four countries. However, mental illnesses have not been explicitly integrated, although regular counselling for PLHIV is provided. Training specific to HIV integrated care has been reported in Eswatini and Zimbabwe indicating efforts to enhance healthcare professionals' knowledge and skills in managing both HIV and NCDs. Among the countries studied, Eswatini is the only country that has an incorporated health information system that includes data on NCDs. Budget allocation for the HIV /NCD integrated care was only reported in Eswatini, while the other three countries considered it a work in progress, suggesting the need for further resource mobilization. All countries reported having all the necessary medicines and technologies on the essential medicines list for primary health care facilities. National guidelines for HIV/NCD integrated care are available in Eswatini and Zimbabwe, while in Mozambique and Zambia, this is still work in progress. Reports for HIV/NCD care are available for Eswatini and Zambia (embedded in the HIV programme guidelines). Of the four countries, only Eswatini had begun to collect patient data on modifiable behavioural risk factors at the time of the study (Table 1).

Six themes emerged from the qualitative analysis and are reported in turn.

The importance of integrating major NCDs into HIV Care

The importance of integrating HIV and NCD care was recognized by all the participants in the mentioned countries. This recognition highlights the understanding that PLHIV are not only affected by HIV-related health issues but also by NCDs such as cervical cancer, diabetes, and hypertension. Examples are given below:

Eswatini: "I think we are all aware that we have reached the 95-95-95 target and that is telling us that the HIV population is aging. And as they age(PLHIV) they develop NCDs. So we are now experiencing a high influx of people that are developing NCDs and we are seeing NCDs even before the age of 40 among those that are living with HIV. So, that is why we want to improve, we don't want to lose the gains we have made in HIV, losing the clients just because we are not managing our NCDs as we are doing for HIV."

Mozambique: "Yes, I do think it is essential (Integrating HIV into NCD care) because, for example, we now know that the patients don't only have HIV, they have other chronic illnesses such as hypertension, diabetes. It's more common that we have to manage not only the HIV but also the diabetes, hypertension and the other chronic conditions. Drug administration may pose a challenge, because we cannot mix some drugs and if we don't know and if we don't integrate, sometimes it's very difficult to manage this."

Zambia:" This talk of integration has just started. We have some strategic plan documents and some components of integration, but they have not yet been implemented."

Mental illnesses have been relatively overlooked by comparison to other medical conditions.

The recognition of mental Illnesses, although significant has not received the same level of attention as physical ailments. The journey towards full integration of mental illnesses into HIV care is a work in progress.

The following are some of the examples of what respondents said:

Zambia: " Ministry of Health has plans to include psychologists on the list of health workers to be incorporated into the health system to ensure that as mental health services are expanded not only should the number of mental health care workers increase but the range of services being made available which means the range of specialist will also need to be broadened."

Zambia: "Under the project (we have included mental health specialists in provinces outside of Lusaka (the capital city). It is work in progress".

Zimbabwe: "We are still behind with COVID issues of mental illnesses. For advanced disease with mental health problems, we provide specialised care. We are just starting to

work on systems at primary level. Mainstream issues of drug abuse are also linked to mental health issues and government is working to address this."

Drug stock-outs and availability of laboratory tests are a challenge.

All key informants highlighted two critical challenges affecting provision of the integrated health service at PHC facilities: drug stock outs for NCDs and limited availability of laboratory tests. These issues have significant implications for patient care and pose substantial hurdles for healthcare providers. Quotations below demonstrate this point.

Zambia: "There are rarely stock outs of antiretroviral drugs whereas it is not uncommon to have drug stock outs for the other major NCDs."

Zambia: "Sometimes, you find that there are no laboratory tests for NCDs."

Mozambique: "For example, for hypertension you find that you start a patient on a particular drug and then when they come back for review, you do not have the drug you initially prescribed for them."

Mozambique: "Sometimes laboratory tests are not available due to a lack of reagents."

Scarcity of Funding for NCDs.

Another significant challenge identified by the participants is the limited funding available for the care and management of NCDs. Although NCDs pose a growing burden on healthcare systems in Southern Africa, the allocation of adequate financial resources to

address the prevention, treatment, and control of NCDs remains a major concern. While HIV is prioritised for funding, NCDs receive significantly less financial support from both national government and donors.

The following quotes capture the essence of the responses :

Zambia: "You will find that donors will fund HIV programmes but not for NCDs and you will find that there is no budget allocation for NCDs."

Mozambique: "Maybe some of national taxes should go towards funding NCD care."

Countries have national guidelines on HIV/NCD integrated care.

National guidelines are available in most of the countries studied. The statements below are examples of the key informants' responses to the availability of national guidelines:

Eswatini: "We have national guidelines for integrated care and a training package for both NCD and HIV with a module on NCD and HIV."

Mozambique: "National guidelines are available for hypertension and diabetes."

Zimbabwe: "It is work in progress , although they are embedded in the National HIV/AIDS programme"

The impact of COVID-19 on PHC services.

Although the COVID-19 pandemic was devastating in the already struggling health systems of SSA, it presented opportunities to improve and strengthen the existing

systems. Key informants' responses to the impact of COVID-19 on PHC services are shown below:

Eswatini: 'With COVID-19, we realised we could now give both ARV drugs and those for NCDs at the same time. During COVID-19 through implementing partner's support the country-initiated Community Commodity Distribution, where client medication was brought to the community where they live to assist them not to default as travel was restricted".

Eswatini: "We could now administer drugs that were not historically administered at the PHC level. NCDs services have been centralized at a doctor led facility , however, since 2016 the country piloted decentralization of NCD services in one region. The pilot was conducted in 10 facilities which were intervention sites and 10 control sites. The results from the pilot confirmed that nurses have the knowledge and skill to provide NCD services at PHC facilities. The country is currently scaling up decentralization of the service and now sitting at 197 out of 229 PHC facilities. Decentralizing NCD services improves access to the service and improves adherence as the service is closer to the service recipients."

Zimbabwe: "Patients working in South Africa would usually ask their relatives to collect medication on their behalf. But this was not possible during COVID-19 hard lockdowns because of restricted travel. The SADC should consider facilitating health systems that allow patients visiting other countries in the region to access antiretroviral drugs and treatment for NCDs, particularly in the case of pandemics such as COVID-19."

Discussion

From the perspective of HIV/NCD program managers, the extent of HIV/NCD care integration in the four Southern African countries is at various stages. The efforts to achieve integrated care for HIV and NCDs in Southern Africa have been met with positive reception. However, it is evident that the process of integration is still under development. All four nations recognize the benefits of adopting an integrated HIV/NCD care approach. Integrated care allows for more accessible and affordable healthcare, particularly for PLHIV who face the burden of NCDs. It is important to report major NCDs alongside HIV data to monitor and evaluate healthcare systems effectively.

Mental health is recognized as a public health emergency, including among PLHIV. Strengthening mental health services at PHC facilities in the studied countries is crucial, going beyond the regular psychosocial counselling and ensuring frequent availability of specialists at PHC facilities. Training counsellors and community health workers on addressing mental health issues could help prevent progression to advanced mental health conditions in PLHIV.

Limited healthcare resources and workforce shortages are challenges in the four countries. Task shifting has previously been discussed as an option to deal with staffing shortages in resource-limited health care systems. Insufficient funding for NCDs further strains already overstretched healthcare systems in the four countries. Local resource mobilization and community driven fundraising initiatives can help generate funds that

can supplement for shortages of medication and laboratory tests at PHC facilities in these settings.

The COVID-19 pandemic provided an opportunity to reimagine healthcare delivery do things differently. Provision of medication for longer periods for treatment adherent patients have reduced their number of visits to healthcare facilities. The pandemic has also exposed weaknesses in the existing healthcare systems, highlighting the importance of addressing NCDs to build a healthier and more resilient population that entails a more resilient population capable of facing future epidemics.

Leaders are keen on integrating care, but they face challenges primarily stemming from the lack of resources necessary to foster integration. Furthermore, NCD's receive less funding compared to infectious diseases like HIV. Considering these challenges, it is crucial for LMICs to explore innovative strategies to encourage prevention and promote general health, thereby minimizing the development of diseases and alleviating the burden on health systems.

Many NCDs can be prevented through non-pharmaceutical means and low-cost methods in the general population[7, 8]. Promoting regular exercise, healthy diets and adopting WHO buy-in strategies have been identified as cost-effective means of preventing NCDs in populations[8]. It is essential for countries in resource-constrained settings, such as Southern Africa, to consider these approaches even for PLHIV, where NCD burden is also

high, while pushing forward the HIV/NCD integrated care approach. By doing so, they can strive to achieve a healthier PLHIV population using limited resources.

To establish a solid foundation for integrated care, it is of immense importance for the Southern African region to agree on models for defining integration within their respective health facilities. Additionally, guidelines should be developed to promote health in the region. These efforts will not only facilitate the integration of HIV and NCD care but also contribute to future epidemic preparedness. As was observed during COVID-19 pandemic, individuals with existing co-morbidities such as cancer, diabetes, chronic respiratory diseases, overweight/obesity and mental health conditions were at a higher risk of having severe disease[23]. With established systems in place, countries will be better equipped to tackle epidemics and pandemics in a cost-effective manner at the regional level.

Study limitations

The study was limited in that it considered integration only from the perspective of the provider at a national level. Measuring the extent of integration is complex given its multifaceted and intricate nature. The study looked at the number of NCDs that are screened and/or treated at PHC facilities in the countries studied as a measure of extent of integration. This was a quite simple definition that could not clearly distinguish the

levels of integration between countries. However, the interviews and perspectives from the Managers gave some insight into the levels of health care service provision.

Conclusion

The findings in this study demonstrate varying levels of progress in integrating NCDs among PLHIV across the four countries, with Eswatini showing a more advanced state of integration in several aspects compared to Mozambique, Zambia, and Zimbabwe. We recommend strengthening of healthcare systems to provide increased mental healthcare at PHC level. Furthermore, we recommend local and community-initiated fund-raising initiatives to supplement shortages of resources at PHC facilities.

What is already known

- Integrated health service delivery is a complex and multifaceted phenomenon.
- There is a need for strengthening of the health systems in SSA to integrate HIV/NCD care at PHC level.
- The already under resourced PHC service faced several challenges during the COVID-19 pandemic.

What this study adds

- This study is the first published analysis of the implementation success of the extent of integrated HIV/NCD care from four countries, in SSA as informed by national HIV programme managers.
- As a pioneering paper, this research contributes to the existing body of knowledge on the extent of HIV and NCD care integration at PHC facilities in resource limited settings.
- The study specifically examines the perspectives on the extent of integration of national HIV/NCD programme leaders in four countries situated in the Southern African region, which has the highest number of PLHIV, worldwide and shows gaps for implementation in strengthening the integration of HIV/NCD care program in the region as informed by the national programmes.

Competing interests

The authors declare no competing interest , both financial and non-financial.

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Tables and figures

Table 1: The extent of integration of HIV and NCD care in Eswatini, Mozambique, Zambia, and Zimbabwe

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Table 1: The extent of integration of HIV and NCD care in Eswatini, Mozambique, Zambia, and Zimbabwe.

Country	NCDs integrated into HIV Programme	Training for HCWs for NCD management at PHC facilities	Availability of Health Information System	Essential Medicines /Technologies	Budget Allocation for NCDs	Availability of national guidelines	Availability of reports for NCD/HIV integrated care	Availability of data collected on Patient's Modifiable Behavioural risk factors
Eswatini	cervical cancer, CRDs, diabetes and hypertension	Yes(quarterly)	Yes	All medications are available on	Yes	Yes	Yes	Have just been incorporated tobacco use, alcohol intake and diet. Physical activity data is collected in Client Management Information system (system used to collect routine data)
Mozambique	cervical cancer, CRDs, diabetes and hypertension	During formal education and occasional trainings	No	All medications are available but with regular stock outs	Work in progress	Available for hypertension and diabetes	No	No
Zambia	cervical cancer, CRDs, diabetes and hypertension – at an infancy stage	Work in progress	No	All medications and technologies are available on the essential medicines list	Work in progress	Embedded in the HIV programme guidelines	Segments in the HIV national report	No
Zimbabwe	cervical cancer, CRDs, diabetes and hypertension	Yes(as needed)	No	All medication and equipment are available for primary health care	Work in progress	Yes	Work in progress	No

*AIDS=acquired immunodeficiency syndrome; CRD=chronic respiratory diseases; HIV=human immunodeficiency virus; HCW=health care workers; NCD=non-communicable diseases, PHC=primary health care,

Chapter 5: The cost of integrated HIV/NCD care

An investigation of the extent of integration from the perspective of national HIV program managers revealed that there was insufficient funding for national NCD programs. Knowing the cost of providing an integrated HIV/NCD care service is important as an aid to resource mobilization, budgeting, and planning. Furthermore, there are limited data on the cost of integrating HIV/NCD care at PHC facilities. As a result, it is necessary to determine the cost of providing integrated HIV and NCD care at primary healthcare facilities in the region. However, because of limited resources, a cost study at two PHC facilities in South Africa was conducted as a case study.

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Chapter 5 presents the costs of integrating HIV/NCD care at PHC facilities from a provider's perspective. The annual cost of providing integrated HIV/NCD care was approximately $200 per patient, assuming stable patients in care without complications at the two PHC facilities. This study highlights the scarcity of comprehensive and accessible costing data, underscoring the need to develop robust costing databases for integrated HIV/NCD care using techniques such as the activity-based costing method.

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ORIGINAL ARTICLE

The integrated care costs of HIV and non-communicable diseases in South Africa

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SETTING: In sub-Saharan Africa, the syndemic of HIV and non-communicable diseases (NCDs) poses a significant challenge. To address this, leading global think tanks like the WHO advocate for integrated HIV/NCD care at primary healthcare levels. However, comparative empirical data on the costs of integrated care are limited. South Africa, with the largest HIV programme globally, was purposively selected for our comparative case study.

OBJECTIVE: To determine the cost of integrated HIV/NCD care from the providers' perspective at two 'ideal status' public healthcare facilities in South Africa as case studies.

DESIGN: A multi-pronged methodology was used to collect provider cost data via retrospective documentary sources or records and a question-and-answer session with facility managers who provided key information on cost-related data. Data analysis utilised an activity-based costing (ABC) method.

RESULTS: Despite the difference in the size of the clinics, the cost per patient in terms of ABC is similar between the two primary healthcare facilities, USD261.60 and USD226.30, respectively.

CONCLUSION: The ABC method can be utilised to cost integrated care, foster health economic data availability for future research, and inform health policymakers.

Non-communicable diseases (NCDs) are, by proportion, the most lethal category of diseases.[1–4] According to the WHO, NCDs were responsible for a staggering 17 million premature deaths among individuals under the age of 70 in 2021. Alarmingly, 86% of these premature deaths occurred in low and middle-income countries (LMICs), constituting a significant 71% of all global mortality.[1]

Notably, the comorbid presentation of NCDs with HIV/AIDS is a serious public health problem, as evidenced in a recent systematic review, which highlighted a substantial burden of NCDs among people living with HIV (PLHIV) in sub-Saharan Africa (SSA).[5] The review reports noteworthy prevalence rates for depression (30.4%), hypertension (20.1%), chronic respiratory diseases (7.1%), diabetes (5.4%) and cervical cancer (1.5%) among PLHIV in SSA.[5] The impact of the co-existence of HIV/AIDS with the NCDs in several countries in SSA, along with an acceptance of best-practice protocols, has provided the impetus for country health systems to integrate the management of major NCDs into HIV care. This approach leverages well-established HIV care platforms that present a unique opportunity to piggyback and incorporate NCD care services, thereby benefiting from the existing effectiveness of HIV care services. The benefits of this integrated approach are well specified in the literature and include enhanced operational efficiency, optimisation of synergistic effects, and the ability to address diseases that share common risk factors within a unified management framework.[2] Despite these clear clinical benefits for SSA, little is known about the relative cost of integrated service models compared to parallel care options. To this end, the case for promoting integrated care platforms is incomplete. This observation is further supported by the WHO, which confirms a notable scarcity of data on the cost and cost-effectiveness of integrated NCD care within HIV care programmes, particularly in LMICs.[6,7]

South Africa is the country with the largest number of PLHIV, totalling 8.5 million. With an HIV prevalence rate of 14%, it ranks among the highest in SSA.[8] Furthermore, South Africa records a significant proportion of NCD-related deaths, exceeding 50% in the general population.[9] These disproportionately high rates of HIV and NCDs serve as a point of initial consideration for a clinical basis for integrated HIV and NCD care. Beyond the imperative of clinical outcomes, assessing the feasibility of integrated care models' cost implications is important.

As an aid to this discourse, the WHO's recently published comprehensive guidelines for the integration of NCD prevention and control within programmes related to HIV/AIDS, specifically highlights the key importance of financing as one of the five pivotal domains necessary for the successful integration of NCD services.[2] Adequate budget preparations are strongly encouraged to ensure the availability of funding for the implementation of these integrated services. To facilitate these budget preparations, it is critical to clearly understand the costs associated with integrating NCD care into HIV care programmes.

Guided by these observations, the current study aims to bridge this knowledge gap by measuring the costs of providing integrated care services from the providers' perspective. Additionally, it seeks to compare the costs between two 'ideal clinics'*, an operationalised status of primary health care facilities that are only used in South Africa. By addressing these research objectives, this study sought to make a valuable contribution to the South African National Strategic Plan 2023–2028 that supports the integration for

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KEY WORDS
HIV; non-communicable diseases; integrated; Southern Africa; cost

*The South African National Department of Health (NDOH) established a programme to create 'ideal clinics' which are defined as a 'clinic with good infrastructure, adequate staff, adequate medicine and supplies, good administrative processes, and sufficient adequate bulk supplies.' These clinics must excel in ten monitored components: administration, integrated clinical services management, medicines, supplies and laboratory services, human resources for health, support services, infrastructure, health information management, communication, district health system support and implementing partners and stakeholders. To attain ideal clinic status, specific minimum percentages according to the weighted categories must be achieved as outlined in the NDOH ideal clinic framework. Within the context of the current paper, reference to ideal clinics is synonymous with the provision of integrated care.

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management of communicable and NCDs for PLHIV[10] and sustainable development goal (SDG) 3.4, which strives to reduce premature mortality from NCDs by one third, through prevention and treatment while promoting mental health and well-being by the year 2030.[11]

METHODS

Study setting, design and participants

Due to the emphasis on integrated clinical services management at ideal clinics, we employed the purposive sampling method to select two primary health care facilities (ideal clinics) in Ekurhuleni municipality, serving as case studies for determining the cost of integrated HIV/NCD care in SSA from the provider's perspective. Ekurhuleni is one of three metropolitan municipalities within the Gauteng province, with an approximate population of 3.2 million.[12] The two ideal clinics are located in densely populated urban townships with a working age group (15–64 years) population of around 70%.

The clinics offer various services, including NCD management (for hypertension, congestive cardiac failure, chronic obstructive pulmonary disease, asthma, epilepsy, diabetes mellitus, and screening for cervical cancer), antenatal care, family planning, child health, acute services, and emergencies. They also provide mental health services and refer patients to secondary care when necessary. For laboratory services, these facilities rely on the National Health Laboratory Services (NHLS), which may offer mobile laboratory services or use a courier service to transport specimens to the central laboratory.

A multi-pronged approach was used to collect provider cost data: 1) secondary sources or records, and 2) health facility managers provided key information on cost-related data such as staff, patient, laboratory and drug costs. In cases where data was unavailable for one health facility, we used data from the other health facility, as both are publicly funded. Additionally, data were sourced from publicly available online resources and previous studies.

Integrated care services at the primary health care facilities were costing primarily via activity-based costing (ABC). Initially referenced as far back as 1949 by Goetz and subsequently refined by many, including Drury (2004)[13] and Botha & Vermaak (2015),[14] ABC is widely utilised globally and within the South African health system as a methodology to cost service delivery accurately. The approach is based on objectively allocating costs to key activities that relate to the care continuum of patients within specified care settings, e.g. 1) the cost of a bed, 2) the cost of human resource input in terms of medical and social care staff allocated to the care of a patient. The ABC approach helps managers understand the actual costs and cost drivers of activities within each health facility, facilitates informed decision-making, including cost allocation and cost reduction decisions, and improves budgeting and forecasting processes. Despite its numerous advantages, the ABC approach can be time-consuming and expensive to maintain and requires keeping a tab on the cost of each patient encounter within the health facility. Nonetheless, it is widely viewed as one of the most objective cost analysis methods for costing health care provision.

To determine the cost of integrated care at the primary health care facilities, we collected cost data on major components (personnel, drugs and other consumables and indirect/overhead costs), scale economies (size of programme/patients, number of staff, quantities of resources), scope economies (total cost of HIV and NCD care), efficiency (number of cases screened for the year), and proportion screened for NCDs. The data utilised were for 2022, and all pricing was calculated in 2022 United States Dollars (USD) (USD1 to South African rand 16.37). We ensured data quality by double entry onto Microsoft Excel spreadsheets, and the data was reconfirmed by health facility managers for accuracy before analysis.

To determine laboratory costs, we included the main tests utilised. For drug costs, only drugs that are utilised for first-line treatment without factoring in complications and combinations that may be prescribed depending on each patient's needs were included.

We used cost accounting methods, apportionments to identify cost centres, and unit costs to analyse the data.[15,16] We used a data extraction matrix tool for collecting supplementary data from the healthcare facilities and a checklist to assist with data collection for various categories.

Ethical approval

Ethical approval for this study was granted by the University of Pretoria Faculty of Health Sciences Research Ethics Committee, Pretoria, South Africa (ref number: 591/2021), and permission was given by the Ekurhuleni Health District Research Committee, Ekurhuleni, South Africa (ref number: GP 202223_044). Health facility managers provided written consent to

TABLE 1. Personnel characteristics of the two ideal clinics

Variable	Clinic A *n* (%)	Clinic B *n* (%)
Professional nurses	12 (22.6)	9 (30)
Administration clerks	8 (15.1)	5 (16.8)
Lay counsellors	5 (9.4)	4 (13.3)
Data capturers	5 (9.4)	3 (10)
General workers	5 (9.4)	—
Cleaners	4 (7.5)	4 (13.3)
Security officers	3 (5.7)	1 (3.3)
Enrolled nurses	2 (3.8)	2 (6.7)
Medical officers (sessional)	2 (3.8)	2 (6.7)
Junior pharmacy assistant	2 (3.8)	—
Social worker	1 (1.9)	—
Podiatrist	1 (1.9)	—
Psychologist	1 (1.9)	—
Psychiatrist	1 (1.9)	—
Pharmacy assistant	1 (1.9)	—
Total staff	53 (100)	30 (100)

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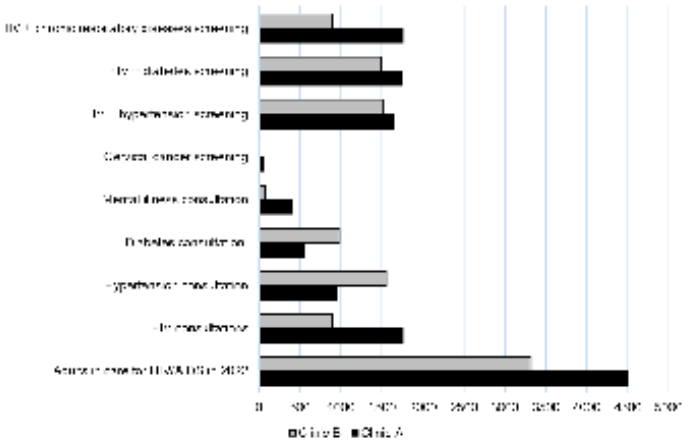

FIGURE. Patient consultations/screenings per month associated with integrated HIV/NCD care in clinics. NCD = non-communicable disease.

TABLE 2. Drug cost categories associated with integrated HIV/NCD care in clinics per month.

Drug description	Quantity	Medical condition targeted	Clinic A (USD)	Clinic B (USD)
Abacavir, lamivudine, tenofovir	50 mg/300 mg/300 mg; 28 tablets	HIV	6 518,84	3 348,62
Dolutegravir	50 mg; 30 tablets	HIV	2 435,46	1 251,05
Hydrochlorothiazide	12.5 mg; 28 tablets	Hypertension	427,80	698,81
Enalapril	10 mg; 30 tablets	Hypertension	87,35	142,33
Amlodipine	5 mg; 28 tablets	Hypertension	69,36	113,01
Metformin	500 mg; 56 tablets	Diabetes	350,51	619,70
Total drug costs, USD			9 889,32	6 173,52

NCD = non-communicable disease, USD = US dollar.

participate in the study and had the option to withdraw from the study at any point.

RESULTS

Personnel characteristics of the two ideal clinics

Table 1 shows the characteristics of the two clinics that provide integrated healthcare services as case studies. Clinic A boasts a larger staff contingent than Clinic B, predominantly comprising professional nurses, followed by administration clerks and data capturers. Both facilities host two sessional medical officers weekly. However, Clinic A provides a broader spectrum of on-site services compared to Clinic B. Notably, Clinic A accommodates weekly visits from a social worker, podiatrist, psychologist and psychiatrist, whereas Clinic B refers all patients requiring these specialised services to secondary facilities. There was no comparative data on staffing before integration.

Patient consultations/screening

The Figure shows the number of patients per condition at the PHC facilities. Clinic A has a larger number of patients in care for HIV/AIDS compared to Clinic B. However, Clinic B has a higher number of patients with diabetes and hypertension. Notably, mental illness consultations are remarkably higher at Clinic A than at Clinic B. Furthermore, patients are routinely screened for HIV, hypertension, diabetes and chronic respiratory diseases.

Drug costs

We report costs associated with 1) drug costs, 2) laboratory costs and 3) staffing and human resources. Table 2 illustrates that the primary drug expense for PLHIV is attributed to antiretrovirals. Antiretroviral drugs constitute 90% of total drug costs for Clinic A and 75% for Clinic B, assuming all patients are stable and without complications. The drugs included are primarily first-line drugs per national treatment guidelines per condition listed.[17–19] Additionally, the prices are negotiated for public healthcare facilities and may not reflect market rates.

Laboratory costs

Table 3 shows the annual laboratory test costs associated with integrated care, focusing on standard tests. Viral load testing is notably the most expensive individual category for both health facilities, while histology for cervical cancer screening represents the least costly category. However, when combined, the liver function tests are more expensive than the viral load test. Clinic A has a higher patient volume, so total laboratory costs are higher.

TABLE 3. Laboratory cost categories associated with integrated HIV/NCD care in clinics.

Name of test	Description	Clinic A (USD)	Clinic B (USD)
Viral load	HIV: viral load	42 655.22	21 911,26
CD4 count	HIV: immunity	22 826,37	11 725,52
Glutamyl transferase	Liver function	10 648,57	11 222,76
Alanine transaminase	Liver function	10 625,18	11 198,11
Phosphatase alkaline	Liver function	10 122,34	10 668,15
Serum bilirubin	Liver function	10 122,34	10 668,15
Total cholesterol	Risk factor for cardiovascular disease	10 556,71	11 136,49
Albumin	Cell/tissue function	9 409,01	9 916,35
Total protein	Cell/tissue function	6 099,60	6 428,50
Creatine	Kidney function	7 098,27	7 481,02
Glycated haemoglobine	Diabetes	3 403,13	6 016,68
Histology	Cervical cancer	907,61	302,54
Total laboratory costs, USD		155 099,53	118 650,88

NCD = non-communicable disease; USD = US dollar.

TABLE 4. The estimated annual costs of integrating HIV and NCD care in the two study clinics.

Item	Clinic A	Clinic B
Personnel costs	707 235.6 (60.1%)	432 895.4 (57.7%)
Costs of laboratory tests	155 099.53 (13.2%)	118 650.88 (15.8%)
Drug costs	118 671.84 (10.1%)	74 082.24 (9.9%)
Overhead costs	19 6201.4 (16.6%)	12 5125.7 (16.7%)
Estimated total costs of integrating HIV and NCD care	1 177 208.37 (100%)	750 754.22 (100%)
Total costs per patient per year, USD	261.60	226.30

NCD = non-communicable disease; USD = US dollar.

Estimated annual costs for integrated HIV/NCD care

Table 4 presents the total estimated costs per category per annum. Personnel costs rank highest for both facilities, followed by laboratory tests and drug costs, respectively. The annual estimated cost per patient is USD261.60 for Clinic A and USD226.30 for Clinic B. This suggests that, despite differences in patient load and staffing, the costs of the two health facilities are comparable.

DISCUSSION

We conducted a comparative case study of two PHC facilities in South Africa to ascertain the cost of integrated care for HIV patients with comorbidities. Specifically, we focused on examining baseline costs without complications.

Analysing two publicly funded PHC facilities, we found that despite differences in on-site resources, both facilities had similar annual estimated costs per patient (USD261.60 and USD226.30) from the provider's perspective. Our investigation revealed a lack of comparable studies conducted in economic settings similar to ours that we could use to compare our findings. However, a study on cervical cancer screening among HIV-positive women in Johannesburg showed screening costs ranging from USD3.67 to USD54.34, depending on the screening method used.[20]

Notably, a cohort study conducted in Tanzania and Uganda[21] demonstrated that the costs of integrated care (HIV/NCDs) were lower than managing the chronic conditions in a patient separately. Additionally, prior research has also indicated that incorporating NCD care into HIV programmes can increase costs by 1 to 30%.[6] Hence, there is a crucial need for context-specific costing of integrated HIV/NCD services to guide healthcare systems.

Our study employed the ABC method, allowing us to factor in personnel, laboratory diagnostics, drug, and overhead costs to estimate the cost of integrated HIV/NCD care based on resource utilisation.

Moreover, negotiated drug pricing presents a significant opportunity for the Southern African region. Bulk purchases can provide leverage for African countries, particularly within the public healthcare system, enabling more favourable negotiations and potentially reducing healthcare costs while considering drug manufacturing solutions within the region.[22]

Limitations of the study

The study revealed that integrated care costs were USD261.60 and USD226.30 per patient annually at two PHC facilities in South Africa. However, the Department of Health designated these facilities as 'ideal' clinics, potentially making them atypical compared to regular PHC facilities nationwide. Additionally, the study only accounted for provider costs, excluding capital and patient-related expenses. Furthermore, we did not capture costs related to treatment complications. Due to limited resources, we could not expand our study to include additional sites, potentially limiting the representativeness of our findings across the entire country.

Moreover, normative costs for integrated HIV/NCD care in countries similar to South Africa, such as Brazil, Russia, India, China and South Africa (BRICS) member states, were unavailable, limiting the study's ability to provide comparative insights. Data limitations also prevented comparing costs before and after

implementing integrated health services at the studied PHC facilities.

Directions for future research

Future studies should delve into more granular costing of the integrated HIV/NCD care systems, possibly implementing the ABC method within these programs. This approach could offer healthcare managers and researchers valuable costing data, aiding in informed decision-making and resource allocation. The persistent challenge lies in obtaining accurate cost estimates, which is crucial for our constrained budgets and prioritising activities at PHC facilities. Future studies should also consider longitudinal costing studies that can provide data over time, unlike cross-sectional studies that provide data only for specific points in time. Future studies should include multiple healthcare facilities nationwide to enhance the generalizability of cost data, thus increasing the relevance of the National Strategic Plan 2023-2028.

Additionally, there is a pressing need for multi-country costing studies of integrated HIV/NCD care in the African region to generate more generalisable data for efficient resource allocation in under-resourced healthcare systems. Health departments should establish cost databases to facilitate, plan, and budget for various services, with methods like ABC being a potential tool. Increased research is warranted to investigate the costs of integrated HIV/NCD services at the primary healthcare level, further informing healthcare policies and practices.

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CONTEXTE : En Afrique subsaharienne, la synergie entre le VIH et les maladies non transmissibles (NCD, pour l'anglais « *non-communicable diseases* ») représente un enjeu majeur. Pour y faire face, des organisations de réflexion internationales, telles que l'OMS, recommandent l'intégration des soins pour le VIH et les NCD dans le cadre des soins de santé primaires. Néanmoins, les données empiriques comparatives concernant les coûts associés à ces soins intégrés demeurent insuffisantes. L'Afrique du Sud, qui abrite le plus vaste programme de lutte contre le VIH au monde, a été choisie intentionnellement pour notre étude de cas comparative.

OBJECTIF : Évaluer le coût des soins intégrés VIH/NCD du point de vue des fournisseurs dans deux établissements de santé publique à statut optimal en Afrique du Sud.

MÉTHODES : Une méthodologie à plusieurs volets a été utilisée pour collecter des données sur les coûts des prestataires par le biais de sources documentaires rétrospectives ainsi que sur des dossiers, complétée par une session de questions-réponses avec les responsables des établissements. Ces derniers ont fourni des éléments essentiels concernant les données de coûts. L'analyse des informations a été réalisée en utilisant une méthode de calcul des coûts basée sur les activités (ABC, pour l'anglais « *activity-based costing* »).

RÉSULTATS : Bien que les cliniques varient en taille, le coût par patient en termes d'ABC est comparable entre les deux établissements de soins de santé primaires, s'élevant à 261,6 USD et 226,3 USD, respectivement.

CONCLUSION : La méthode ABC peut servir à évaluer le coût des soins intégrés, à améliorer l'accès aux données économiques relatives à la santé pour des recherches ultérieures et à éclairer les décideurs dans le domaine de la santé.

Public Health Action (PHA) welcomes the submission of articles on all aspects of operational research, including quality improvements, cost-benefit analysis, ethics, equity, access to services and capacity building, with a focus on relevant areas of public health (e.g. infection control, nutrition, TB, HIV, vaccines, smoking, COVID-19, microbial resistance, outbreaks etc).

Chapter 6: A framework of integrated HIV/NCD care

After estimating the cost of integrated HIV/NCD care, this culminated sufficient data that we required to begin developing a framework for integrating HIV/NCD care at PHC facilities in Southern Africa

Chapter 6 utilised findings from Objectives 1 to 3 to inform the development of a framework of integrated HIV/NCD care. This chapter is presented in the manuscript format according to journal requirements. The manuscript has been submitted to the International Journal of Integrated Care, and is currently under peer review. The manuscript is titled *"A framework for implementing integrated HIV and non-communicable disease care at primary health care facilities in Southern Africa"*.

This chapter introduces a framework for integrated HIV/NCD care in Southern Africa using a modified version of the BFFS method. The framework introduced seven new themes, which included prioritizing NCDs per country for integration, fostering stakeholder partnerships, addressing the mental wellbeing of healthcare workers, unified health information systems with improved privacy and confidentiality measures, establishing costing databases for HIV/NCD integrated care, implementing enhanced monitoring and evaluation procedures, and exploring opportunities for regional coordination.

A framework for implementing integrated HIV and non-communicable disease care at primary health care facilities in Southern Africa

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Abstract

Introduction

Comorbidities of HIV/AIDS and non-communicable diseases (NCD) are on the rise, affecting up to 30% of individuals living with HIV/AIDS. Sub-Saharan African countries experience notably high rates of these comorbid presentations. The conventional approach of treating NCDs separately from HIV/AIDS care has been criticised for inefficiency, highlighting the need for integration. This study addresses this need by developing a framework for integrating NCD care into HIV programs at primary healthcare facilities in Southern Africa.

Methods

This study was a component of a broader study looking at the burden, extent and cost of integrating HIV/NCD care at primary health care facilities in Southern Africa. To inform the framework, we utilised a modified version of the 'Best fit' framework synthesis method. Thematic analysis was utilised as the primary method of analysis.

Results

The study expanded upon existing framework themes related to effective team-working, organizational leadership, patient-centred care, community and patient/provider partnerships by introducing seven new themes. These new themes include prioritizing NCDs per country for integration, fostering stakeholder partnerships, addressing the mental wellbeing of healthcare workers, unified health information systems, with improved privacy and confidentiality measures, establishing costing databases for HIV/NCD

integrated care, implementing enhanced monitoring and evaluation procedures, and exploring opportunities for regional coordination.

Conclusion

There are opportunities for improving current implementation frameworks for integrating HIV/NCD care in Southern Africa by utilising the established HIV care platforms.

Key words: Framework, HIV, Integrated, noncommunicable diseases, primary healthcare, Southern Africa

Background

Human immunodeficiency virus infection (HIV) and non-communicable diseases (NCDs) remain important public health problems in Southern Africa, which is the home of the majority of people living with HIV (PLHIV), globally. [1]

The prevalence of HIV is highest in Eswatini (25.9%), [2] followed by Lesotho (19.3%), [3] Botswana (16.4%), [4]and South Africa (13.9%).[5] Furthermore, South Africa has the highest number of PLHIV at 8.5 million. [5] All the Southern African countries with a high burden of HIV also have a high proportion of NCD related deaths. For example, Eswatini, Lesotho , Botswana and South Africa have NCD related death proportions of 37%, 32%, 46% and 51%, respectively. [6]

Despite countries having attained the UNAIDS 95-95-95 targets, [1] gains made in HIV care may be lost due to the rising burden of NCDs, as indicated by a recent systematic review with the burden of NCDs among PLHIV, ranging from 1% to 30%. [7] Criticism has been directed towards the conventional approach of treating NCDs in PLHIV separately from HIV/AIDS care, deeming it clinically inefficient. Consequently, the integration of NCD care into the HIV care programs emerges as a novel treatment paradigm providing benefits of leveraging on the well-established HIV care programs in the Southern African region to strengthen health systems for provision of NCD care at primary health care (PHC) facilities. [8-13] Notably, the establishment of an integrated HIV/NCD care programme provides an opportunity to expand these services to the rest of the population, and thereby fostering universal health coverage (UHC). [10]

Guided by the above noted priority, the current study sought to address the pressing need for integrating HIV and NCD care in PHC facilities in Southern African countries. Our objective was to formulate a comprehensive framework that facilitates the seamless integration of HIV and NCD care, thereby enhancing the effectiveness of health systems in these resource-constrained settings.

Methods

The methodology adopted for the study was made up of four empirical and theoretical data collection approaches. (Figure 1)

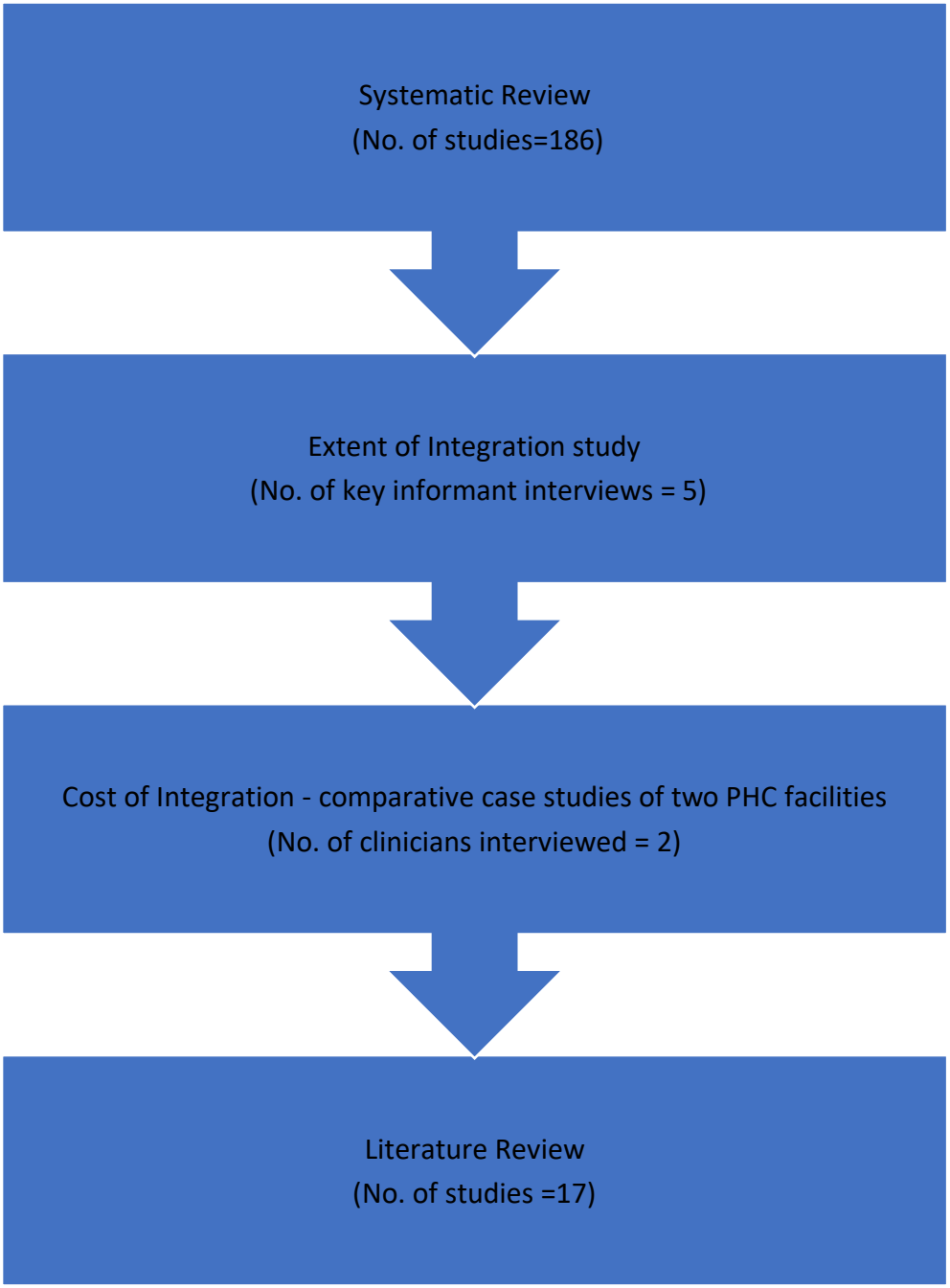

Figure 1: The four data collection approaches utilised to build the framework

We utilised a modified version of the “Best Fit” framework synthesis (BFFS) method described by Carroll C et al. [14] This method involves both framework and thematic analysis techniques to compile the synthesis and is usually accompanied by a systematic review of literature. The BFFS was selected as our preferred approach owing to its more comprehensive application of analytical techniques. We utilised the following steps of the BFFS method: 1) Formulated the review question 2) Conducted a literature review to identify existing conceptual or theoretical frameworks for integrating NCDs into HIV care at PHC facilities or general chronic disease care integration into PHC services. 3) The results of the review were analysed to construct an *a priori* framework 4) Coded the study evidence against the *a priori* framework 5) Interpreted any data that could not be placed within the framework using inductive, thematic analysis 6) Developed a new framework incorporating both the *a priori* and new themes identified from the primary research, including insights from three prior studies. 7) Further thematic analysis resulted in the creation of a conceptual model.

The selected theoretical framework was reduced to its key elements and variables which formed the themes of the *a priori* framework. Evidence from the identified studies from the search were coded along with the primary data collected from three prior studies. Figure 2 offers a summative overview of the framework development process.

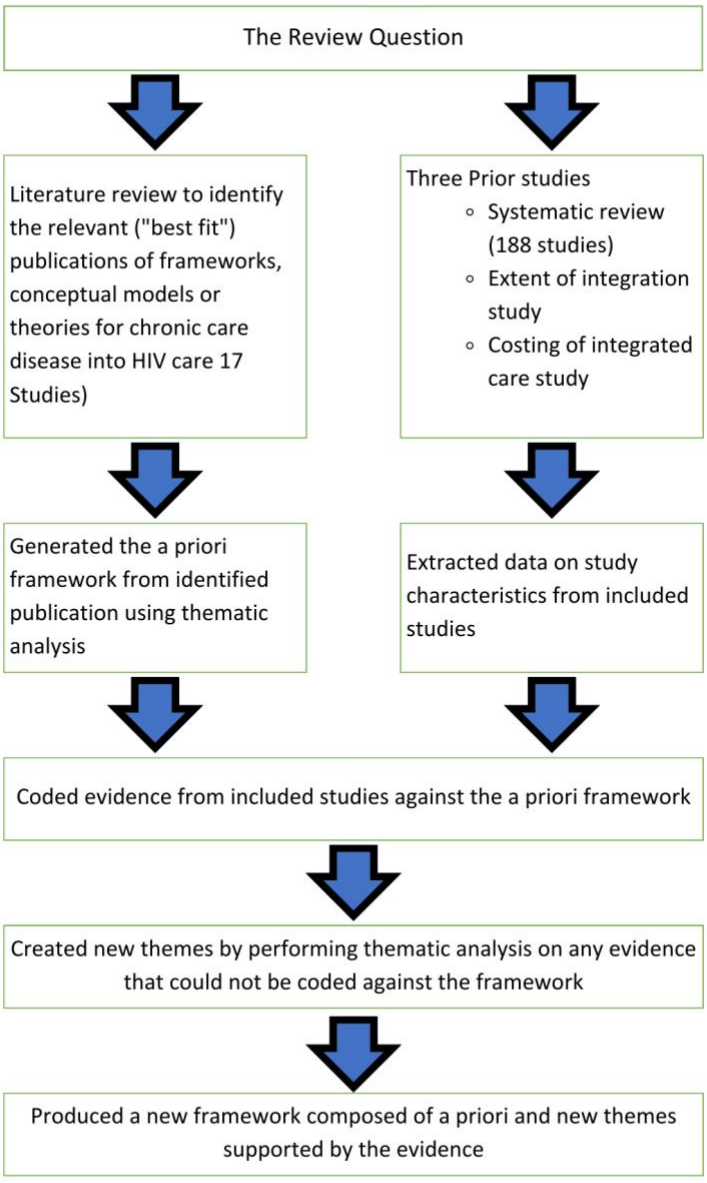

Figure 2: Summary of the framework development process

In our study we utilised a non-systematic literature search because we wanted to inform the framework from insights obtained from three prior studies, that included a systematic review, hence the authors were familiar with the current publications. The three preceding studies included a systematic review on the burden of non-communicable diseases among PLHIV, [7] an extent of integration study (unpublished data) and costing of providing an integrated HIV/NCD care service as case studies at PHC facilities in Southern Africa. (unpublished data) During the extent of integration study, we interviewed national HIV programme managers that shared their perspectives and insights on the extent of integrated HIV/NCD care within their respective countries. Furthermore, based on the costing study, health facility managers provided insights into the integrated process of caring for patients with both HIV and NCDs.

We conducted the literature search on Pubmed and Google scholar. Authors were familiar with keywords utilised for the search from prior studies conducted for the integration of HIV/NCD care in Southern Africa. The main search terms used were “Integrated”, “framework”, “HIV”, “AIDS”, “NCDs”, “Diabetes”, “cardiovascular disease”, “hypertension,” “depression”, “chronic respiratory disease” and Äfrica”.

The main selection criteria focussed on the theme of integrated HIV care with any of the four major NCDs and depression in Sub Saharan Africa. The literature search utilised the snowball search strategy based on keywords, concepts and themes in order to complement information from our previous studies. Selected studies included both peer reviewed publications and grey literature.

Themes forming the *a priori* framework were identified from the selected study with a conceptual framework on the integration of NCDs into primary health care services.

The evidence from the selected studies was coded along with the primary data collected from three preceding studies. We selected 19 publications that informed the development of the framework.

Involvement of people with lived experience

The first author possesses lived experience as defined by the International Journal of Integrated Care(IJIC). Her specific involvement is described in the author contributions' section.

Ethics

Ethical review for this study was obtained from the University of Pretoria, Faculty of Health Sciences, Ethics Review Committee (Ref number: 591/2021).

Results

The study aimed to develop a framework for the integration of NCD care into HIV/AIDS care programmes in Southern Africa.

From the literature review, we selected a framework on chronic disease care integration into PHC services developed by Simon and Aileen, 2022. [15] This framework was based on the chronic care model(CCM),[16] and the innovative care for chronic conditions framework (ICCCM). [17] The *a priori* themes are shown in Table 1. People living with HIV, without complications in SSA, are cared for at PHC level. For this reason, we utilised this framework to develop a framework for integrating NCDs into HIV care. We isolated

the themes from this framework to determine the *a priori* themes. From the 17 other selected articles, we coded for themes to either provide more evidence for the existing themes or to develop new themes for the framework. Among the articles that were used to inform the framework were the WHO Afro framework 2017 [8] and the WHO implementation guidance on integrating the prevention and control of NCDs in HIV/AIDS, tuberculosis, and sexual and reproductive health programmes.[10]

***A priori* Framework themes**
1. Effective team-working to deliver continuity and coordinated proactive care
2. Organizational leadership, culture, and mechanisms to promote quality and safety
3. Equipped health care teams to deliver evidence-based patient-centred care
4. Empowerment and support of patients for self-management and prevention
5. Use of data collection systems to facilitate effective care and follow-up
6. Community partnerships to promote awareness, mobilize resources and support health service provision
7. Improving patient access to chronic disease care
8. Task shifting
9. Clinical mentoring
10. Stigma and confidentiality
11. Patient provider partnerships

Table 1: *A priori* framework themes for integrated chronic disease care into primary healthcare services [15]

Identification of new themes

Identifying priority NCDs for each country for integration into HIV care services

This theme was derived from the WHO guidance document [10] and supported by Kintu et al.[11] Furthermore, a recent systematic review showed that despite numerous studies on the burden of NCDs among PLHIV in SSA, data was not available for most of the countries in the region.[7] The majority of studies are conducted in a few select countries signifying the need for more research to be conducted in underrepresented countries in order to identify which NCDs should be prioritized in their respective HIV/NCD programs. As stated by WHO, there is a need for context specific findings per country. [10] Upon identification of the priority NCDs, the need to adapt WHO guidelines to context specific guidelines arises. [8]

Stakeholder Partnerships for HIV/NCD integrated care at PHC

The *a priori* framework alludes to the importance of patient/provider, and community /provider partnerships. Additionally, WHO [10] included private/public partnerships as important in the delivery of an integrated NCD service. Resultantly, we reframed these themes to create “stakeholder partnerships” as important for HIV/NCD integrated care service delivery at PHC facilities. These partnerships could allow for resource mobilization, for example formation of drug clubs, with the support of the community, to supplement drug shortages. [18] The private/public partnerships in addition to resource

mobilization, could be ideal platforms to engage corporates that are directly involved in industry that is involved with products that are known to promote NCDs in the general population, such as the tobacco, food and alcohol industries. [10] With all stakeholders engaged, prevention and care for NCDs among PLHIV is likely to improve and strengthen the health systems.

Supporting the mental wellbeing of healthcare workers

The increase in workload due to an integrated HIV/NCD service has been reported in a recent scoping review.[12] Although task shifting has been identified as remedial to staff shortages and assisting with handling workload, it is not uncommon for healthcare workers (HCWs) to experience burnout. [19] Some of the proposed solutions to support HCWs from the a priori themes highlighted the need to incentivize HCWs, both financially and non-financially. [8, 10, 15] Additionally, we found a need to go a step further to prioritize the mental wellbeing of HCWs. [20]

Establishment of health information systems for PLHIV that have HIV and NCD data in one place and to improve privacy and confidentiality of patients

There is a need for integrating the health information systems to have patient health records for PLHIV in one place for HIV and NCDs. From the costing study (unpublished) we found that HIV data was kept separate from the NCD data. In addition to providing efficiency for accessing patient health records, integrating health information systems could also aid in mitigating stigma at the PHC facilities as all patients carry similar coloured and barcoded patient cards. It was noted from the extent of integration study

(unpublished) that some countries have disease-specific colour coded patient cards. This system may foster stigma, unlike the use of patient barcodes that are not identifiable with a particular disease. This theme also speaks to the a priori component of improving data collection systems to facilitate effective delivery of health care. [8, 10, 15]

Establishment of a costing database for HIV/NCD integrated care

Due to the dearth of costing and cost effectiveness data for HIV/NCD integrated care, creation of costing databases [13] for PHC facilities would improve the availability of such data.

In our case study, we utilised the activity-based costing method [21] to estimate the cost of HIV/NCD integration at two PHC clinics in South Africa, as case studies, a method that can be used routinely for costing of the integrated programme, ensuring availability of costing data that can be used for budgeting, resource mobilisation, and research.

Improved monitoring and evaluation processes that inform progress made in the HIV/NCD integrated programme

Including NCD care performance indicators into the HIV monitoring and evaluation program will help visualise progress made with respective performance indicators such as patient outcomes for both NCDs and HIV.[8, 10] In a similar way that HIV programme performance indicators are well designed and utilised, there is a need to improve the monitoring and evaluation process of the HIV/NCD integrated service at PHC level.

Regional Coordination Opportunities

As observed during the COVID-19 pandemic, Africa needs to utilise the regional economic communities to strengthen their health systems and fight future pandemics more effectively. [22] For example, the Southern African Development Community (SADC) can be utilised to implement integrated NCD care and facilitate coordinated efforts, with the inclusion of patients crossing borders [23] and requiring access to both HIV and NCD drugs. Well-coordinated regional efforts could prepare the existing health systems for future pandemics, having designed efficient systems and in turn produced a more resiliently healthy population. Additionally, regional efforts could aid in resource mobilization and provide opportunities for negotiated pricing for essential drugs with manufacturers.

We show a summary of the developed framework for implementing integrated HIV and NCD care at primary health care facilities in Southern Africa. Figure 3

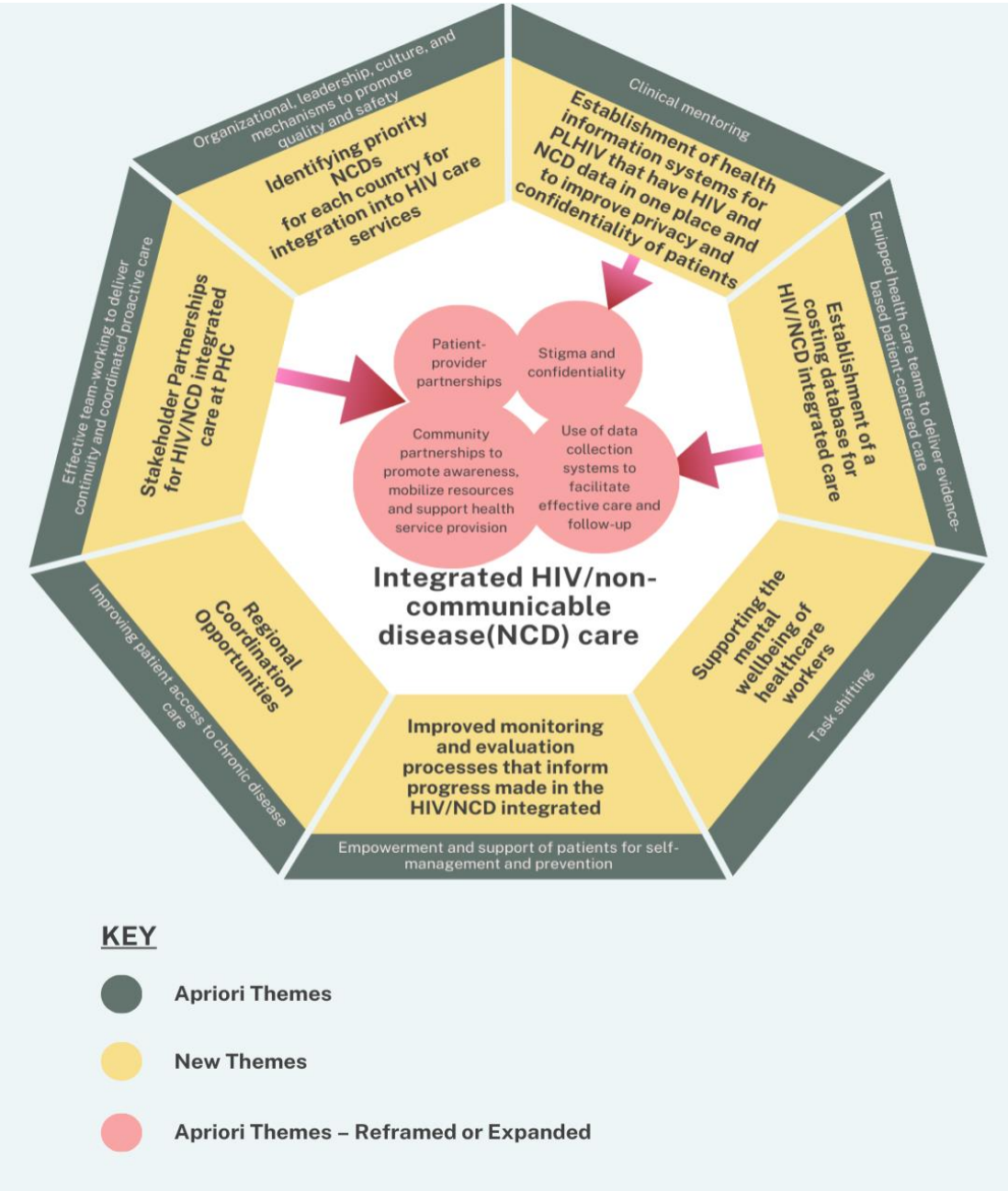

Figure 3: A summary of a framework for implementing HIV and non-communicable disease care at primary health care facilities in Southern Africa

Discussion

This study employed a modified method of the BFFS to develop a conceptual framework for the integration of NCD care into the HIV care programs at PHC facilities in under-resourced Southern African settings. Our framework development is based on the model of integration that incorporates NCD care into the existing HIV care platforms at PHC facilities [9] with a focus on prioritizing cardiovascular diseases, diabetes, cancers and chronic respiratory diseases, alongside mental illnesses.

The a *priori* framework was based on the CCM and ICCCM models and further informed by primary studies on integration of HIV services with diabetes. [15] Constructing the a *priori* framework involved employing the BFFS method, utilising two systematic reviews: one for existing frameworks and models and another for primary studies on integrated HIV and diabetes in low and middle income countries (LMICs). The resulting framework was patient-centred and thus focused on the micro (patient interaction) level integration. Building upon this foundation, the updated framework expands its scope to encompass the meso (public healthcare) level and the macro (community) level considerations. While maintaining its patient-centred approach, this framework extends beyond HIV and diabetes integration to include other NCDs, namely; cardiovascular diseases, chronic respiratory diseases, cervical cancer and depression. The framework was guided by WHO Afro and the recent WHO guideline document on integrating prevention and control of NCDs with HIV/AIDS programme thereby enhancing the theoretical framework.

To effectively implement integrated HIV/NCD care services at the PHC level, its essential for countries to first identify priority NCDs and concentrate efforts on these. Given resource constraints, prioritization becomes imperative as an initial step.

Stakeholder partnerships are pivotal in the successful implementation of integrated services. Collaborative efforts involving all community stakeholders enhances the likelihood of success. This theme expands beyond mere patient/provider and community/provider partnerships to include the private/public partnerships, emphasizing the importance of community-wide engagement.

Health care workers in our setting often face excessive workloads due to staff shortages and various challenges. Therefore, it is crucial for leadership to prioritize their mental wellbeing enabling them to deliver professional and compassionate care to clients.

Integration of health information systems is also paramount. Leveraging technology allows for centralized data storage and visualization, potentially improving privacy and confidentiality by eliminating the need for disease specific identifiable patient cards or files. Additionally, addressing the paucity of costing data [13] for integrated HIV/NCD requires the establishment of costing databases utilising methods such as activity based costing.

Enhanced monitoring and evaluation of the integrated HIV/NCD processes are necessary. Countries should collaboratively push the implementation agenda forward transcending theory to successful practice. Regional economic centres such as SADC can play a crucial role in coordinating these efforts.

The framework, builds upon the foundation laid by the a *priori* framework, introducing a heightened emphasis on integrating NCD services into HIV/AIDS programmes. It underscores the need to prioritize the NCDs for integration according to country-specific needs. Moreover, the framework broadens the scope of partnerships, now encompassing the private sector alongside other stakeholders, under the reframed theme of stakeholder partnerships, fostering a more inclusive community engagement.

Additionally, the framework prioritizes the mental wellbeing of the healthcare workers, advocates for the unification of health information systems and calls for the establishment of costing databases at PHC facilities to mitigate the scarcity of costing data. It also underscores the significance of regional coordination, highlighting opportunities for collaboration across borders. These enhancements aim to bolster the effectiveness and sustainability of integrated HIV and NCD healthcare delivery systems.

Limitations of the study

Although our study provides valuable insights, it is important to acknowledge that it had some limitations. Firstly, our search was not systematic, potentially resulting in the omission of informative publications. The BFFS method relies on available primary studies and there is generally a paucity of primary studies on frameworks for integrated HIV/NCD care at primary healthcare facilities in LMICs. Additionally, our key informants contributing to the development of the framework via our prior studies were from five countries within Southern African and the costing study was only conducted in one

country. Therefore, the generalisability of our results to the entire Southern African region may be limited.

Implications for future research and practice

Our findings underscored the necessity of assessing the burden of NCDs for PLHIV in most countries of Southern Africa to tailor context specific prioritization strategies in these under-resourced settings. In addition to training, it is crucial to offer incentives to healthcare workers who assume added responsibilities in integrated care, prioritizing both their workload and mental wellbeing. Despite observed progress in patient screening and care integration, there are gaps regarding unified health data systems for NCD and HIV data at primary healthcare level. We also observed the need for costing databases for integrated HIV/NCD care services at PHC facilities. There is a need for further research on cost effective strategies of integrating NCD care into HIV care programmes for PLHIV and expanding care to the general population, as a step towards universal health coverage.

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Author Contribution

MMC – conception, design, data acquisition, drafting of manuscript, analysis and interpretation.

TM – Revising the article critically, visualization, interpretation.

AM - Conception, design, data acquisition, revising the article, interpretation and supervision.

CH - Conception, design, data acquisition, analysis, interpretation, revising the article and supervision.

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Conflicts

The authors declare no conflict of interest, both financial and non-financial.

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Chapter 7: Synthesis of findings

Following the development of this framework, the study moved on to synthesise the overall findings, culminating in a general discussion and conclusion.

This chapter captures the climax of this PhD project, consolidating its findings across the various components of the thesis. It not only presents the strengths and limitations of these findings but also draws conclusions, identifies implications for future research, and offers recommendations to inform policymakers and to strengthen health systems in under-resourced Southern African settings.

Synthesis of Findings

7.1 Introduction

This chapter provides a comprehensive synthesis of findings from this thesis. It also assesses the methodological strengths and limitations of the entire study, culminating in key findings and recommendations intended to influence policy, practice, and future research endeavours.

7.2 Background

The integration of HIV and non-communicable diseases (NCDs) services has been widely discussed for its potential benefits. However, there remains a significant lack of information regarding the burden of NCDs among people living with HIV (PLHIV), the extent and cost of integrating HIV/NCD care, and frameworks for implementing integrated NCD care within established HIV programmes at PHC facilities in Southern Africa. This region and Eastern Africa is home to the majority of PLHIV globally (54%) [1] and is also experiencing a growing burden of NCDs among both PLHIV and the general population. [2-4]

While integrating NCD care into HIV programmes is recognized as a promising approach for managing comorbidities among PLHIV, the absence of cost and cost effectiveness data [5], coupled with limited frameworks suitable for resource-constrained settings, presents significant public health challenges. This situation hinders progress and the realization towards the third sustainable development goal, which targets reducing by one

third premature mortality from NCDs through prevention and treatment and promotes mental health and well-being by 2030, [6] particularly in Southern Africa. There are several gaps to offering comprehensive and integrated care for PLHIV at PHC facilities in the strained healthcare systems of Southern Africa.

This thesis aimed to address these gaps and provide insights to inform practice and policy decisions. Its goal is to foster the implementation of integrated HIV/NCD care in the region with a view of extending integrated care to the rest of the general population in Southern Africa.

7.3 Summary of key findings

The thesis has successfully informed the burden, the extent of integration, cost of integrated care and a framework of integrated HIV/NCD care in Southern Africa. This was achieved by conducting a systematic review on the burden of NCDs and their risk factors in Sub Saharan Africa, [7] a qualitative study that interviewed national HIV program managers on the extent of HIV/NCD integration in the region, a comparative costing study of HIV/NCD integrated care conducted at two PHC facilities in South Africa, and the development of a framework for integrated HIV/NCD care using a modified version of the Best Fit Framework Synthesis method. [8]

7.3.1 The burden of NCDs among PLHIV

From the systematic review, we estimated the burden of NCDs and their respective risk factors among PLHIV in SSA. Hypertension had the highest number of studies (n=97) followed by overweight/obesity (n=85), smoking (n=84) and diabetes (n=73). Being overweight/obese (32.2%) and depression (30.4%) had the highest prevalences. Alcohol consumption (22.3%) was more prevalent than smoking (6.4%) among PLHIV. Cervical cancer(n=12) and chronic respiratory diseases (n=11) had the least number of studies. Figure 1

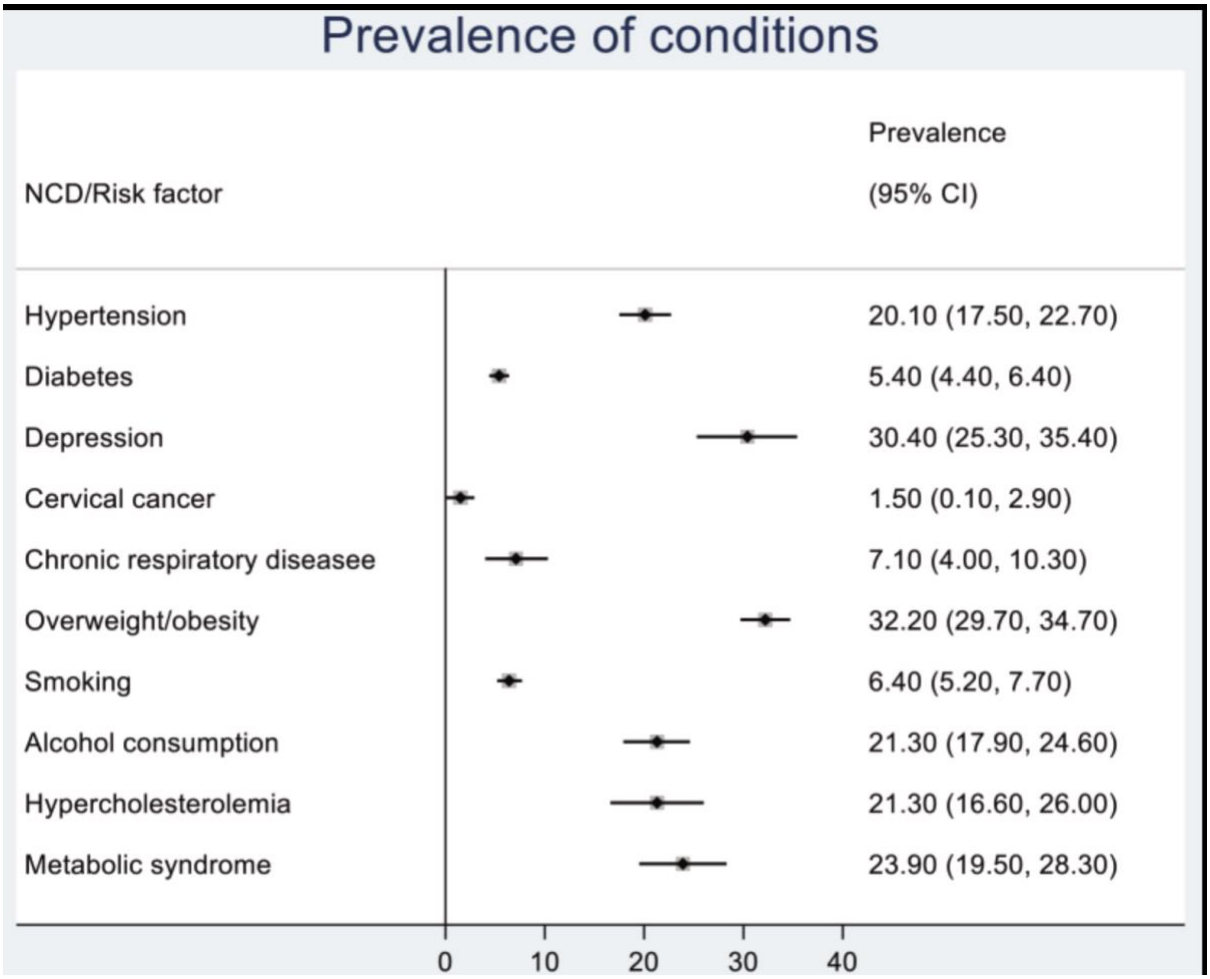

Figure 1: Forest plot of pooled estimates generated by meta-analysis for prevalence of selected conditions among people living with HIV in Sub Saharan Africa [7]

7.3.2 The extent of integrated HIV/NCD care at PHC facilities

The extent of integration from the perspective of national HIV program managers showed that there is a varying degree of integration of the major NCDs and mental illnesses into the HIV programs at PHC facilities in the region. Hypertension, diabetes chronic

respiratory diseases and cervical cancer have been well integrated. However, little progress has been made regarding integrating mental illness screening with HIV care, apart from the initial psycho-social counselling that is offered upon diagnosis with HIV. Other factors such as regular drug stock outs, unavailability of laboratory tests due to insufficient funding for NCD programs were highlighted, as impeding integration. The COVID-19 pandemic affected provision of NCD care services but also provided an opportunity to offer healthcare services creatively. For example, adherent patients who were stable on treatment were given medication to cover longer periods of time and hence reducing the frequency of their hospital visits. Furthermore, some drugs that were historically only prescribed at tertiary level of care could also now be prescribed at PHC level. Additionally, opportunities for regional coordination in Southern Africa through regional economic communities, such as Southern African Development Community (SADC) were identified as having the potential to support countries in developing systems of HIV/NCD integration that can also be utilised within countries and across borders, to facilitate healthcare for PLHIV who travel across the region. This need for regional coordination was a notable challenge during the hard COVID-19 lockdown for PLHIV who were travelling and got stuck in other countries and could not access their medication.

7.3.3 The cost of integrating HIV and NCD care

The costing study established that the cost of integrating NCDs into HIV care programs at the two PHC facilities in South Africa were $261.60 and $226.30, per patient, per year,

respectively, using the activity-based costing (ABC) method. The personnel, drug, laboratory and overhead costs were utilised in this study. The major costs are personnel related costs, followed by drug costs. The primary drug expense for PLHIV is attributed to antiretrovirals which constitutes approximately 80% of total drug costs.

7.3.4 The development of a framework for integrating HIV/NCD care

We utilised a modified version of the Best-Fit Framework Synthesis (BFFS) method to develop the framework for implementing integrated HIV and NCD care at PHC facilities in Southern Africa. The study expanded upon existing framework themes related to effective team-working, organizational leadership, patient-centred care, community and patient/provider partnerships by introducing seven new themes. These new themes include prioritizing NCDs per country for integration, fostering stakeholder partnerships, addressing the mental wellbeing of healthcare workers, unified health information systems, with improved privacy and confidentiality measures, establishing costing databases for HIV/NCD integrated care, implementing enhanced monitoring and evaluation procedures, and exploring opportunities for regional coordination.

7.4 Discussion

7.4.1 The burden of non-communicable diseases among PLHIV

The systematic review determined the prevalence of major NCDs and their risk factors among PLHIV in SSA, based on a comprehensive analysis of 188 studies. [7] We found variations in disease prevalence compared to earlier reviews that focused on low- and middle-income countries (LMICs).[9] Depression emerged as the most prevalent NCD among PLHIV in SSA, affecting 30.4% (95% CI: 24.4–38.3), though other studies reported rates ranging from 24.4% (95%CI: 12.5 – 42.1) in LMICs [9] to 36.3% (95%CI: 28.4 – 44.2). [10] The disparity in estimates could be attributed to differences in diagnostic tools, study settings, and potential publication bias.

Hypertension, the most common cardiovascular disease risk factor, was prevalent at 20.1% (95% CI: 17.5–22.7) among PLHIV in SSA, similar to previous studies; 21.2% (95% CI: 16.3–17.1) in LMICs, [9] 19.9% (95% CI: 17.2–22.8) in Eastern and Southern Africa, [11] and 23.5% (95% CI: 16.6–31.0) in West and Central Africa. [11] Variations in measurement methods for blood pressure likely contributed to the slight differences observed across studies. [12]

Diabetes prevalence was estimated at 5.4% (95% CI: 4.4–6.4, min 0.3%; max 41%), with a wider range than previous findings in SSA, that reported prevalence rates ranging from 1% to 26%. [13] Cervical cancer and chronic respiratory diseases (CRDs) showed lower prevalence rates among PLHIV in SSA, at 1.5% and 7.1%, respectively. The prevalence

of cervical cancer was consistent with previous findings that reported prevalence of 1.3% - 1.7% in LMICs. [9] Meanwhile, the prevalence of CRDs was lower than the global estimate of 10.4% recorded in a systematic review that had most of its included studies from Europe with only four studies from Africa. Overweight/obesity was prevalent in 32.2% (95% CI: 29.7–34.7) of PLHIV in SSA, which was similar to previous finding in LMICs. [9] The prevalence of hypercholesterolemia in this population was high and comparable to previous findings, at 24.3% (95% CI: 19.1–29.6). [9]. Smoking (7.7%) was less prevalent than alcohol consumption (19.7%), showing that interventions should target reducing alcohol consumption. Metabolic syndrome was notably prevalent at 23.9% (95% CI: 19.5–28.3), and similar to previously reported rates, [14] with definitions varying across studies and possibly contributing to heterogeneity.

Hypercholesterolemia and alcohol consumption showed high heterogeneity across studies, possibly due to differences in lifestyle and healthcare access among the study population.

7.4.2 The extent of integration

From the perspective of HIV/NCD program managers, the integration of HIV and NCD care in the four Southern African countries is currently at varying stages of development. While efforts to achieve integrated care have been positively received, the process is still evolving. All four nations that participated in the study acknowledge the advantages of adopting an integrated approach to HIV/NCD care. Integrated care enhances healthcare

accessibility and affordability, particularly for PLHIV who also face the burden of NCDs. [14] It is crucial to report major NCDs alongside HIV data to effectively monitor and evaluate healthcare systems.

Mental health is recognized as a pressing public health concern, especially among PLHIV. [7] Strengthening mental health services at PHC facilities in these countries is vital. This includes extending beyond routine HIV-related psychosocial counselling by ensuring regular availability of specialists. Training counsellors and community health workers to address mental health issues can help prevent the progression to more severe conditions among PLHIV.

Challenges such as limited healthcare resources and workforce shortages [15] persist across the four countries. Task shifting has been proposed as a strategy to mitigate staffing shortages in resource-limited healthcare systems. [16] Furthermore, insufficient funding for NCDs further strains the under-resourced healthcare systems. Local resource mobilization and community-driven fundraising initiatives are essential to supplement shortages of medications and laboratory tests at PHC facilities in these settings. Brikci 2024 [17] has explored several innovative domestic funding mechanisms, primarily through tax strategies .

The COVID-19 pandemic catalysed a rethinking of healthcare delivery. As an example, providing medication sufficient for longer periods, for adherent patients has reduced their need for frequent clinic visits. However, the pandemic also exposed weaknesses in

existing healthcare systems, underscoring the importance of addressing NCDs to build a healthier and more resilient population capable of withstanding future epidemics.

While leaders are eager to integrate care, they face challenges primarily due to inadequate resources, exacerbated by NCDs receiving less funding compared to infectious diseases like HIV. In light of these challenges, it is crucial for LMICs to explore innovative strategies to prevent diseases and promote general health, thereby reducing the burden on health systems.

Many NCDs can be prevented through non-pharmaceutical and cost-effective methods, such as promoting regular exercise and healthy diets. It is essential for resource-constrained countries like those in Southern Africa to adopt these approaches, particularly for PLHIV who face a high burden of NCDs, while advancing the integrated HIV/NCD care approach.

The perspectives of the national HIV programme managers were consistent with findings from a study conducted in Tanzania, that included both health care workers and PLHIV perspectives. [18]

7.4.3 The cost of integrating HIV/NCD at PHC level

We conducted a comparative case study of two PHC facilities in South Africa to determine the cost of integrated care for HIV patients with comorbidities, using the ABC Method. Specifically, we focused on analysing baseline costs without complications.

Examining two publicly funded PHC facilities, we found that despite differences in available resources, both facilities had similar annual estimated costs per patient ($261.6 and $226.3), from the provider's perspective. Our investigation highlighted a scarcity of comparable studies conducted in similar economic contexts to ours that could serve as benchmarks for comparison. However, a study on cervical cancer screening among HIV-positive women in Johannesburg showed screening costs ranging from $3.67 to $54.34, depending on the method used. [19]

Significantly, a cohort study conducted in Tanzania and Uganda [20] demonstrated that the costs of integrated care (HIV/NCDs) were lower than managing chronic conditions separately. Previous research has also indicated that incorporating NCD care into HIV programs can increase costs by 1 to 30% [6]. Therefore, there is a critical need for context-specific costing of integrated HIV/NCD services to inform healthcare systems.

7.4.4 A framework for integrating HIV/NCD care at PHC facilities

This study utilised a modified approach of the BFFS method to develop a conceptual framework for integrating NCD care into HIV care programs at primary PHC facilities in resource-limited Southern African settings. The *a priori* framework was guided by the CCM and ICCCM models and informed by primary studies on HIV-diabetes integration in LMICs. Our framework built upon the *a priori* framework and prioritized cardiovascular diseases, diabetes, cancers, chronic respiratory diseases, and mental illnesses.

The framework evolved from a patient-centred micro-level integration to include meso-level (public healthcare) and macro-level (community) considerations. It expanded beyond HIV-diabetes integration to incorporate a broader spectrum of NCDs—cardiovascular diseases, chronic respiratory diseases, cervical cancer, and depression—aligned with WHO Afro and recent WHO guidelines on integrating NCD prevention with HIV/AIDS programs.

Effective implementation hinges on identifying priority NCDs amidst resource constraints and fostering stakeholder partnerships across public, private, and community sectors. Recognizing the strain on healthcare workers, the framework emphasizes supporting their mental wellbeing to ensure quality care delivery. It advocates for integrated health information systems to streamline data management and enhance patient confidentiality. Addressing the scarcity of costing data, it proposes establishing costing databases using methods like activity-based costing.

Enhanced monitoring and evaluation are critical for translating theory into practice. Additionally, the framework recognises the importance of regional coordination in under resourced Southern Africa. By broadening partnerships, prioritizing healthcare worker welfare, and improving data integration and costing practices, the framework aims to strengthen integrated HIV/NCD healthcare systems' effectiveness and sustainability.

7.5 Strengths of the study

The systematic review included 188 studies conducted in 21 countries within SSA, representing 2,838,350 million PLHIV. This was a large sample size and a good representation of data that is available in the region. Moreover, the systematic review reported on the major NCDs, NCD risk factors and depression, thus explored a wide range of conditions which provided a good overview of the burden of NCDs among PLHIV in SSA.

The extent of integration study is the first published analysis of the implementation success of the extent of integrated HIV/NCD care from four countries in SSA as informed by national HIV programme managers. As a pioneering paper, this research contributes to the existing body of knowledge on the extent of HIV and NCD care integration at PHC facilities in resource limited settings. The study specifically examined the perspectives on the extent of integration of national HIV/NCD programme leaders in four countries situated in the Southern African region, which has the highest number of PLHIV worldwide, and shows gaps for implementation in strengthening the integration of HIV/NCD care program in the region as informed by the national programmes.

The costing study utilised the ABC method that included personnel, drug, laboratory and overhead costs to estimate the integrated HIV/NCD care costs. It adds to the limited pool of data on costs of integrated care in the region, assuming baseline costs without complications.

The study developed a framework utilizing a modified version of the BFFS method. The framework covers the micro, meso and macro levels of integrated HIV/NCD care and was informed by primary studies, systematic and literature reviews; extensive data sources.

7.6 Limitations of the study

Despite the strengths of the study, it was not without limitations. For the systematic review, we only searched databases for which we had access. Therefore, we may have missed some relevant articles. Secondly, the included articles were only from 21 countries. Therefore, our findings may not be generalisable to the entire SSA region. Furthermore, our findings may have been affected by publication bias, and therefore results need to be interpreted with caution. Our study focused solely on SSA, limiting generalisability, with most data concentrated in a few countries, potentially introducing bias. The systematic review did not include age and gender stratification, urban versus rural disparities, and differences in antiretroviral treatment (ART), to better understand NCD prevalence among PLHIV.

The extent of integration study was limited in that it considered integration only from the perspective of the providers at a national HIV programme level. Measuring the extent of integration is complex given its multifaceted and intricate nature. The study looked at the number of NCDs that are screened and/or treated at PHC facilities in the countries studied

as a measure of extent of integration. This was a simple definition that could not clearly distinguish the levels of integration between countries. The target sample size was ten countries in the SADC region with HIV prevalence above 5%. After several efforts of contacting all the ten countries, only four consented to participate, limiting the generalisability of our findings.

The comparative costing case study was conducted at two health facilities in South Africa due to insufficient resources. Data unavailability was an issue, hence we could not compare costs before and after integration. Furthermore, the findings of this study are not generalisable due to the economic diversity among the Southern African countries.

The framework was informed by national HIV programme managers, who were the intended stakeholders to assess its acceptability. Through multiple engagements and interviews with these managers, their input significantly shaped the framework. As a result, it was unnecessary to explicitly ask them if the framework was acceptable to them, as their involvement throughout the process indicated their acceptance and endorsement of it.

7.7 Conclusions

The study aimed to assess the burden of NCDs among PLHIV in SSA, evaluate the extent and cost of integrating HIV/NCD care and to develop a framework for HIV/NCD integration in SSA. The investigation revealed a substantial burden of NCDs among PLHIV, with

varying degrees of integrated care across Southern African countries. Further research is warranted to report the burden of NCDs among PLHIV across SSA, as there is underrepresentation of countries and certain NCDs, such as cervical cancer and CRDs. Despite notable progress, national HIV program managers identified a persistent need to strengthen health systems. Significant strides were made in integrating screening for diabetes, chronic respiratory diseases, and cardiovascular diseases. Policymakers should facilitate the inclusion of screening and care for mental illnesses at PHC facilities by providing first responder cadre of staff at that level of care. The cost analysis estimated an average integration cost of $200 per patient annually for those stable and without complications at the primary healthcare level and emphasised the necessity for cost databases. These cost databases should be established at the PHC level, where they can be regularly updated and made accessible to decision-makers and researchers. These findings informed the development of a framework for implementing integrated NCD care within HIV programmes at PHC facilities, thereby influencing both practice and future research in this field. The components of the framework can be addressed simultaneously and require the involvement of all stakeholders (patients, healthcare providers, the community, private and public corporations, and non-governmental organisations).

7.8 Implications for future research and practice

7.8.1 The burden of NCD

Countries should conduct primary studies on the burden of NCDs in SSA, particularly where they are underrepresented. Future systematic reviews will need broader geographical coverage and more comprehensive studies on less represented NCDs to better understand and address their impact on PLHIV in the region. Researchers should ensure that negative findings are equally reported to minimize the effects of publication bias. Additionally, age and gender stratification, urban versus rural disparities, and differences in ART should be included in future studies.

7.8.2 Extent of integration

Future research should prioritize longitudinal studies to monitor the implementation of integrated HIV/NCD care services. These studies should adopt a mixed methods approach that incorporates patient perspectives and outcomes, offering a comprehensive view of the benefits of integrated care at PHC facilities across respective countries. Encouraging the preparation of regular country reports on integrated HIV/NCD care is essential to enhance data availability and foster collaborative efforts within the region. Coordination of these efforts could be facilitated by regional economic communities like SADC, promoting consistency and effectiveness in addressing regional PHC challenges.

7.8.3 Costing

Future studies should delve into more granular costing of the integrated HIV/NCD care systems. This approach could offer valuable costing data for healthcare managers and researchers aiding in informed decision-making and resource allocation. The persistent challenge lies in obtaining accurate cost estimates, crucial for our constrained budgets and for prioritizing activities at PHC facilities. Future studies should also consider longitudinal costing studies that can provide data over time unlike the cross-sectional studies that provide data only for specific points in time, using methods such as the ABC. The development of costing databases and the unification of all HIV and NCD databases should be fostered,

Additionally, there is a pressing need for multi-country costing studies of integrated HIV/NCD care in the African region to generate more generalisable data for efficient resource allocation in the under resourced healthcare systems.

Negotiated drug pricing presents a significant opportunity for the Southern African region. Bulk purchases can provide leverage for African countries, particularly within the public healthcare system, enabling more favourable negotiations and potentially reducing healthcare costs. This approach should be considered while working on local drug manufacturing solutions.

7.8.4 Framework

Our findings underscored the necessity of assessing the burden of NCDs for PLHIV in most countries of Southern Africa to tailor context specific prioritisation strategies in these

under-resourced settings. In addition to training, it is crucial to offer incentives to healthcare workers who assume added responsibilities in integrated care, prioritizing both their workload and mental wellbeing. Despite observed progress in patient screening and care integration, there are gaps regarding unified health data systems for NCD and HIV data at PHC level. We also observed the need for costing databases for integrated HIV/NCD care services at PHC facilities. There is a need for further research on cost effective strategies of integrating NCD care into HIV care programmes for PLHIV and expanding care to the general population, as a step towards universal health coverage.

These efforts will not only facilitate the integration of HIV and NCD care but also enhance preparedness for future epidemics and pandemics. The COVID-19 pandemic underscored the vulnerability of individuals with existing comorbidities, emphasising the need for robust healthcare systems capable of cost-effectively managing regional health crises.

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9.0 Appendices

1. **Ethics approval**
2. **Ekurhuleni ethics approval**
3. **Consent form – Extent of Integration**
4. **Consent form – Costing Study**
5. **Proof of Article Submissions**

Appendix A: University of Pretoria Ethics Approval and renewal 2024

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Health Sciences

Institution: The Research Ethics Committee, Faculty Health Sciences, University of Pretoria complies with ICH-GCP guidelines and has US Feceral wide Assurance.
- FWA 00002567, Approved dd 18 March 2022 and Expires 18 Marul. 2027
- IORG #: IORG0001762 OMB No. 0990-0279 Approved for use through June 30, 2025 and Expires 07/28/2026.

Faculty of Health Sciences **Research Ethics Committee**

18 January 2024

Approval Certificate
Annual Renewal

Dear Ms MM Chilufya,

Ethics Reference No.: 591/2021 – Line 3
Title: The burden of non-communicable diseases among people living with HIV and the extent, cost and framework development of integrated HIV and non-communicable diseases care at primary health care facilities in Southern Africa

The **Annual Renewal** as supported by documents received between 2023-12-05 and 2024-01-17 for your research, was approved by the Faculty of Health Sciences Research Ethics Committee on 2024-01-17 as resolved by its quorate meeting.

Please note the following about your ethics approval:

- Renewal of ethics approval is valid for 1 year, subsequent annual renewal will become due on 2025-01-18.
- The Research Ethics Committee (REC) must monitor your research continuously. To this end, you must submit as may be applicable for your kind of research:
  a) annual reports;
  b) reports requested *ad hoc* by the REC;
  c) all visitation and audit reports by a regulatory body (e.g. the HPCSA, FDA, SAHPRA) within 10 days of receiving one;
  d) all routine monitoring reports compiled by the Clinical Research Associate or Site Manager within 10 days of receiving one.
- The REC may select your research study for an audit or a site visitation by the REC.
- The REC may require that you make amendments and take corrective actions.
- The REC may suspend or withdraw approval.
- Please remember to use your protocol number (591/2021) on any documents or correspondence with the Research Ethics Committee regarding your research.

Ethics approval is subject to the following:

- The ethics approval is conditional on the research being conducted as stipulated by the details of all documents submitted to the Committee. In the event that a further need arises to change who the investigators are, the methods or any other aspect, such changes must be submitted as an Amendment for approval by the Committee.

We wish you the best with your research.

Yours sincerely

On behalf of the FHS REC, Dr R Sommers
MBChB, MMed (Int), MPharmMed, PhD
Deputy Chairperson *of the Faculty of Health Sciences Research Ethics Committee, University of Pretoria*

The Faculty of Health Sciences Research Ethics Committee complies with the SA National Act 61 of 2003 as it pertains to health research and the United States Code of Federal Regulations Title 45 and 46. This committee abides by the ethical norms and principles for research, established by the Declaration of Helsinki, the South African Medical Research Council Guidelines as well as the Guidelines for Ethical Research: Principles Structures and Processes, Second Edition 2015 (Department of Health).

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Fakulteit Gesondheidswetenskappe
Lefapha la Disaense tsa Maphelo

Appendix B: University of Pretoria Ethics Approval and Amendment 2023

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Health Sciences

Institution: The Research Ethics Committee, Faculty Health Sciences, University of Pretoria complies with ICH-GCP guidelines and has US Federal wide Assurance.
- FWA 00002567, Approved dd 18 March 2022 and Expires 18 March 2027.
- IORG #: IORG0001762 OMB No. 0990-0278 Approved for use through August 31, 2023.

Faculty of Health Sciences **Research Ethics Committee**

16 February 2023

Approval Certificate
Amendment

Dear Ms MM Chilufya,

Ethics Reference No.: 591/2021 – Line 2
Title: The burden of non-communicable diseases among people living with HIV and the extent, cost and framework development of integrated HIV and non-communicable diseases care at primary health care facilities in Southern Africa

The **Amendment** as supported by documents received between 2023-02-02 and 2023-02-15 for your research, was approved by the Faculty of Health Sciences Research Ethics Committee on 2023-02-15 as resolved by its quorate meeting.

Please note the following about your ethics approval:
- Please remember to use your protocol number (591/2021) on any documents or correspondence with the Research Ethics Committee regarding your research.
- Please note that the Research Ethics Committee may ask further questions, seek additional information, require further modification, monitor the conduct of your research, or suspend or withdraw ethics approval.

Ethics approval is subject to the following:
- The ethics approval is conditional on the research being conducted as stipulated by the details of all documents submitted to the Committee. In the event that a further need arises to change who the investigators are, the methods or any other aspect, such changes must be submitted as an Amendment for approval by the Committee.

Additional Conditions:
- Approval is conditional upon the Research Ethics Committee receiving

  Approval is conditional that the title is also changed at the PhD. Committee.

We wish you the best with your research.

Yours sincerely

On behalf of the FHS REC, Dr R Sommers
MBChB, MMed (Int), MPharmMed, PhD
Deputy Chairperson *of the Faculty of Health Sciences Research Ethics Committee, University of Pretoria*

The Faculty of Health Sciences Research Ethics Committee complies with the SA National Act 61 of 2003 as it pertains to health research and the United States Code of Federal Regulations Title 45 and 46. This committee abides by the ethical norms and principles for research, established by the Declaration of Helsinki, the South African Medical Research Council Guidelines as well as the Guidelines for Ethical Research: Principles Structures and Processes, Second Edition 2015 (Department of Health).

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Appendix C: University of Pretoria Ethics Approval 2023

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Health Sciences

Institution: The Research Ethics Committee, Faculty Health Sciences, University of Pretoria complies with ICH GCP guidelines and has US Federal wide Assurance.

- FWA 00002567. Approved dd 18 March 2022 and Expires 18 March 2027.
- IORG #: IORG0001762 OMB No. 0990-0278 Approved for use through August 31, 2023.

Faculty of Health Sciences **Research Ethics Committee**

16 February 2023

Approval Certificate
Annual Renewal

Dear Ms MM Chilufya,

Ethics Reference No.: 591/2021 – Line 1
Title: The burden of non-communicable diseases among people living with HIV and the extent, cost and framework development of integrated HIV and non-communicable diseases care at primary health care facilities in Southern Africa

The **Annual Renewal** as supported by documents received between 2023-02-01 and 2023-02-15 for your research, was approved by the Faculty of Health Sciences Research Ethics Committee on 2023-02-15 as resolved by its quorate meeting.

Please note the following about your ethics approval:

- Renewal of ethics approval is valid for 1 year, subsequent annual renewal will become due on 2024-02-16.
- Please remember to use your protocol number (591/2021) on any documents or correspondence with the Research Ethics Committee regarding your research.
- Please note that the Research Ethics Committee may ask further questions, seek additional information, require further modification, monitor the conduct of your research, or suspend or withdraw ethics approval.

Ethics approval is subject to the following:

- The ethics approval is conditional on the research being conducted as stipulated by the details of all documents submitted to the Committee. In the event that a further need arises to change who the investigators are, the methods or any other aspect, such changes must be submitted as an Amendment for approval by the Committee.

We wish you the best with your research.

Yours sincerely

On behalf of the FHS REC, Dr R Sommers
MBChB, MMed (Int), MPharmMed, PhD
Deputy Chairperson *of the Faculty of Health Sciences Research Ethics Committee, University of Pretoria*

The Faculty of Health Sciences Research Ethics Committee complies with the SA National Act 61 of 2003 as it pertains to health research and the United States Code of Federal Regulations Title 45 and 46. This committee abides by the ethical norms and principles for research, established by the Declaration of Helsinki, the South African Medical Research Council Guidelines as well as the Guidelines for Ethical Research: Principles Structures and Processes, Second Edition 2015 (Department of Health)

Research Ethics Committee
Room 4-60, Level 4, Tswelopele Building
University of Pretoria, Private Bag x323
Gezina 0031, South Africa
Tel +27 (0)12 356 3084
Email: deepeka.behari@up.ac.za
www.up.ac.za

Fakulteit Gesondheidswetenskappe
Lefapha la Disaense tša Maphelo

Appendix D: University of Pretoria Ethics Approval 2022

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Health Sciences

Institution: The Research Ethics Committee, Faculty Health Sciences, University of Pretoria complies with ICH-GCP guidelines and has US Federal wide Assurance.

- FWA 00002567, Approved cd 22 May 2002 and Expires 03/20/2022.
- IORG #: IORG0001762. OMB No. 0990-0279 Approved for use through February 28, 2022 and Expires: 03/04/2023.

Faculty of Health Sciences **Research Ethics Committee**

20 January 2022

Approval Certificate
New Application

Dear Ms MM Chilufya

Ethics Reference No.: 591/2021
Title: The burden of non-communicable diseases among people living with HIV and the extent, cost effectiveness and framework development of integrated HIV and non-communicable diseases care at primary health care facilities in Southern Africa

The **New Application** as supported by documents received between 2021-10-15 and 2022-01-19 for your research, was approved by the Faculty of Health Sciences Research Ethics Committee on 2022-01-19 as resolved by its quorate meeting.

Please note the following about your ethics approval:

- Ethics Approval is valid for 1 year and needs to be renewed annually by 2023-01-20.
- Please remember to use your protocol number (591/2021) on any documents or correspondence with the Research Ethics Committee regarding your research.
- Please note that the Research Ethics Committee may ask further questions, seek additional information, require further modification, monitor the conduct of your research, or suspend or withdraw ethics approval.

Ethics approval is subject to the following:

- The ethics approval is conditional on the research being conducted as stipulated by the details of all documents submitted to the Committee. In the event that a further need arises to change who the investigators are, the methods or any other aspect, such changes must be submitted as an Amendment for approval by the Committee.

We wish you the best with your research.

Yours sincerely

On behalf of the FHS REC, Dr R Sommers
MBChB, MMed (Int), MPharmMed, PhD
Deputy Chairperson *of the Faculty of Health Sciences Research Ethics Committee, University of Pretoria*

The Faculty of Health Sciences Research Ethics Committee complies with the SA National Act 61 of 2003 as it pertains to health research and the United States Code of Federal Regulations Title 45 and 46. This committee abides by the ethical norms and principles for research, established by the Declaration of Helsinki, the South African Medical Research Council Guidelines as well as the Guidelines for Ethical Research: Principles Structures and Processes, Second Edition 2015 (Department of Health).

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Appendix E: Ekurhuleni Health District Research Permission 2022

City of Ekurhuleni

GAUTENG PROVINCE
REPUBLIC OF SOUTH AFRICA

EKURHULENI HEALTH DISTRICT RESEARCH PERMISSION

Research Project Title: The burden of non-communicable diseases among people living with HIV and the extent, cost effectiveness and framework development of integrated HIV and non-communicable diseases care at primary health care facilities in Southern Africa

NHRD No: GP_202203_044

Research Project Number: 17/06/2022/01

Name of Researcher(s): Mrs Maureen Moyo Chilufya

Division/Institution/Company: University of Pretoria

Date of review by the EHDRC: 17/06/2022

DECISION TAKEN BY THE EKURHULENI HEALTH DISTRICT RESEARCH COMMITTEE (EHDRC)

- This document certifies that the above research project has been reviewed by the EHDRC and permission is granted for the researcher(s) to commence with the intended research project.
- Facilities approved for the research: Daveyton East Clinic and Barcelona clinic
- Participants' rights and confidentiality must be maintained throughout the study period and when disseminating the findings.
- No resources (financial, material, and human resources) from the health facilities will be used for the study. Neither the district nor the health facilities will incur any additional cost for the study.
- The study will comply with Publicly Financed Research and Development Act 2008 (Act 51 of 2008) and its related regulations.

Appendix F: Participant's information and informed consent – Extent of Integration

ICD 5

PARTICIPANT'S INFORMATION & INFORMED CONSENT DOCUMENT FOR AN

INDIVIDUAL IN-DEPTH INTERVIEW RESEARCH STUDY

Study title: The burden of non-communicable diseases among people living with HIV and the extent, cost effectiveness and framework development of integrated HIV and non-communicable diseases care at primary health care facilities in Southern Africa

Principal Investigator: Maureen Moyo -Chilufya

Supervisor: Dr Alfred Musekiwa

Co-Supervisor: Prof Charles Hongoro

Institution: University of Pretoria

DAYTIME AND AFTER HOURS TELEPHONE NUMBER(S):

Daytime number/s: +27 871 514 971

Afterhours number: +27 810 888 324

DATE AND TIME OF FIRST INFORMED CONSENT DISCUSSION:

			:
date	**month**	**year**	**Time**

Dear Prospective Participant

Dear Mr. / Mrs./Dr./Prof .....……..

1) INTRODUCTION

You are invited to volunteer for a research study. I am doing this research for purposes of my PhD in Public Health at the University of Pretoria. This document gives information about the study to help you decide if you would like to participate. Before you agree to take part in this study, you should fully understand what is involved. If you have any questions, which are not fully explained in this document, do not hesitate to ask the investigator. You should not agree to take part unless you are completely happy about what we will be discussing during the interview.

2) THE NATURE AND PURPOSE OF THIS STUDY

The aim of this study is to determine the extent of integrated HIV and non- communicable disease (NCD) care in primary health care facilities in Southern African countries from the national HIV programme Manager's perspective. To do this, I wish to learn more about the NCDs that are integrated into HIV care in your country, challenges, current frameworks and suggestions on how integrated care can be improved for all the five major NCDs among people living with HIV in your country and the low resourced Southern African region.
You will be interviewed by the researcher on an online platform that is accessible to you such as Microsoft Teams and Zoom at a time that is most convenient to you.

3) EXPLANATION OF PROCEDURES AND WHAT WILL BE EXPECTED FROM THE PARTICIPANTS

If you agree to participate, you will be asked to participate in an individual interview which will take about 45 to 60 minutes. The individual interview will be a one-on-one meeting between the

two of us via an online platform such as Zoom or Microsoft Teams. I will ask you several questions about the research topic. This study involves answering some questions such as the type of non-communicable diseases that are integrated into HIV care, availability of national guidelines on HIV/NCD integrated care, recommendations for integrating HIV/NCD care in the country and the effect of COVID-19 on the management of NCDs at primary health care facilities among people living with HIV.

With your permission, the interview will be recorded on a recording device to ensure that no information is missed.

4) RISKS AND DISCOMFORTS INVOLVED?

We do not think that taking part in the study will cause any physical or emotional discomfort or risk. In the unlikely event that your identity is linked to your responses, there is a minimal risk that your reputation may be compromised.

5) POSSIBLE BENEFITS OF THE STUDY

Although you may not benefit directly by taking part in this study, your participation is important for us to better understand the extent of HIV /NCD integrated care in primary health care facilities in your country. The information you give may help the researcher develop a novel framework for the integration of NCD care with HIV services in primary health care facilities in limited resource Southern Africa.

6) COMPENSATION

Although you will not be paid directly for taking part in this study, any cost that you may accrue as a result of taking part in the study, for example data costs, will be paid back to you (reimbursed).

7) VOLUNTARY PARTICIPATION

The decision to take part in the study is yours and yours alone. You do not have to take part if you do not want to. You can also stop at any time during the interview without giving a reason. If you refuse to take part in the study, this will not affect you in any way.

8) ETHICAL APPROVAL

This study was submitted to the Research Ethics Committee of the Faculty of Health Sciences at the University of Pretoria, Medical Campus, Tswelopele Building, Level 4-59, telephone numbers 012 356 3084 / 012 356 3085. Also, written approval has been given by that committee. The study will follow the Declaration of Helsinki (last update: October 2013), which guides doctors on how to do research in people. The researcher can give you a copy of the Declaration if you wish to read it.

9) INFORMATION ON WHO TO CONTACT

If you have any questions about this study, you should contact:

Ms Maureen Moyo-Chilufya (email: u21572152@tuks.co.za mobile: +27 810 888 324)

10) CONFIDENTIALITY

While it may appear that your identity may be revealed to those who know your position in the national HIV programme, this is not the case because the data will be stripped of any identity information, and no one will be able to link your responses to your identity and we will not disclose your specific job title. Your answers will be linked to a fictitious code number, or a pseudonym (another name) and we will refer to you in this way in the data, any publication, report, or other research output.

All records from this study will be regarded as confidential. Results will be published in medical journals or presented at conferences in such a way that your identity will not be disclosed.

The records from your participation may be reviewed by people responsible for making sure that research is done properly, including members of the Research Ethics Committee. All these people are required to keep your identity confidential. Otherwise, records that identify you will be available only to people working on the study, unless you give permission for other people to see the records.

All hard copy information will be kept in a locked facility at School of Health Systems and Public Health at the University of Pretoria, for a minimum of 5 years and only the research team will have access to this information.

11) CONSENT TO PARTICIPATE IN THIS STUDY

- I confirm that the person requesting my consent to take part in this study has told me about the nature and process, any risks or discomforts, and the benefits of the study.
- I have also received, read and understood the above written information about the study.
- I have had adequate time to ask questions and I have no objections to participate in this study.
- I am aware that the information obtained in the study, including personal details, will be anonymously processed and presented in the reporting of results.
- I understand that I will not be penalised in any way should I wish to stop taking part in the study.
- I am participating willingly.
- I have received a signed copy of this informed consent agreement.

_____	_____
Participant's name (Please print)	Date
_____	_____
Participant's signature	Date
_____	_____
Researcher's name (Please print)	Date
_____	_____
Researcher's signature	Date

Appendix G: Informed consent – Costing Study

ICD 1A

PARTICIPANT'S INFORMATION & INFORMED CONSENT DOCUMENT

STUDY TITLE: The burden of non-communicable diseases among people living with HIV and the extent, cost effectivenes and framework development of integrated HIV and non-communicable diseases care at primary health care facilities in Southern Africa

Sponsor: Dr. Alfred Musekiwa **Co-Sponsor:** Prof Charles Hongoro

Principal Investigators: Maureen Moyo-Chilufya

Institution: University of Pretoria

DAYTIME AND AFTER HOURS TELEPHONE NUMBER(S):

Daytime number/s: +27 810 888 324

Afterhours number: +27 810 888 324

DATE AND TIME OF FIRST INFORMED CONSENT DISCUSSION:

				:
Date	**month**	**year**		**Time**

Dear Prospective Participant

Dear Mr. / Mrs. .....

1) INTRODUCTION

You are invited to volunteer for a research study. I am doing research for a PhD Public Health Degree purpose at the University of Pretoria. This information in this document is to help you to decide if you would like to participate. Before you agree to take part in this study you should fully understand what is involved. If you have any questions, which are not fully explained in this document, do not hesitate to ask the researcher. You should not agree to take part unless you are completely happy about all the procedures involved.

2) THE NATURE AND PURPOSE OF THIS STUDY

The aim of this study is to evaluate the cost effectiveness of integrating non-communicable disease (NCD) care with HIV services at a primary health care facility. The NCDs of interest are cardiovascular diseases, cancers, chronic respiratory diseases, diabetes, and mental illnesses. By doing so we wish to learn more about the cost of integrating NCDs and HIV care at primary health care facilities in poor resourced Southern African settings.

3) EXPLANATION OF PROCEDURES AND WHAT WILL BE EXPECTED FROM PARTICIPANTS.

This study involves answering some questions regarding the cost of provision of NCD health care services among people living with HIV at primary health care facilities. We will ask you about staff time spent with patients during their regular hospital visits, the cost of equipment such as scales, blood pressure monitors and costs of laboratory tests. We will also require to review your on-site databases and routine records for cost information.

4) POSSIBLE RISKS AND DISCOMFORTS INVOLVED

There are no medical risks associated with the study.

5) POSSIBLE BENEFITS OF THIS STUDY

Although you may not benefit directly. The study results may help us to inform policy makers on the cost effectiveness of integrating HIV/NCD care from the provider's perspective.

6) COMPENSATION

You will not be paid to take part in the study. However, any cost you have because of taking part in the study, for example, transport costs will be paid back to you (reimbursed).

7) YOUR RIGHTS AS A RESEARCH PARTICIPANT

Your participation in this trial is entirely voluntary and you can refuse to participate or stop at any time without stating any reason.

8) ETHICS APPROVAL

This Protocol was submitted to the Faculty of Health Sciences Research Ethics Committee, University of Pretoria, telephone numbers 012 356 3084 / 012 356 3085 and written approval has been granted by that committee. The study has been structured in accordance with the Declaration of Helsinki (last update: October 2013), which deals with the recommendations guiding doctors in biomedical research involving human/subjects. A copy of the Declaration may be obtained from the investigator should you wish to review it.

9) INFORMATION

If I have any questions concerning this study, I should contact:

Ms Maureen Moyo-Chilufya Tel: 087 151 4971 Cell: 081 0888 324

10) CONFIDENTIALITY

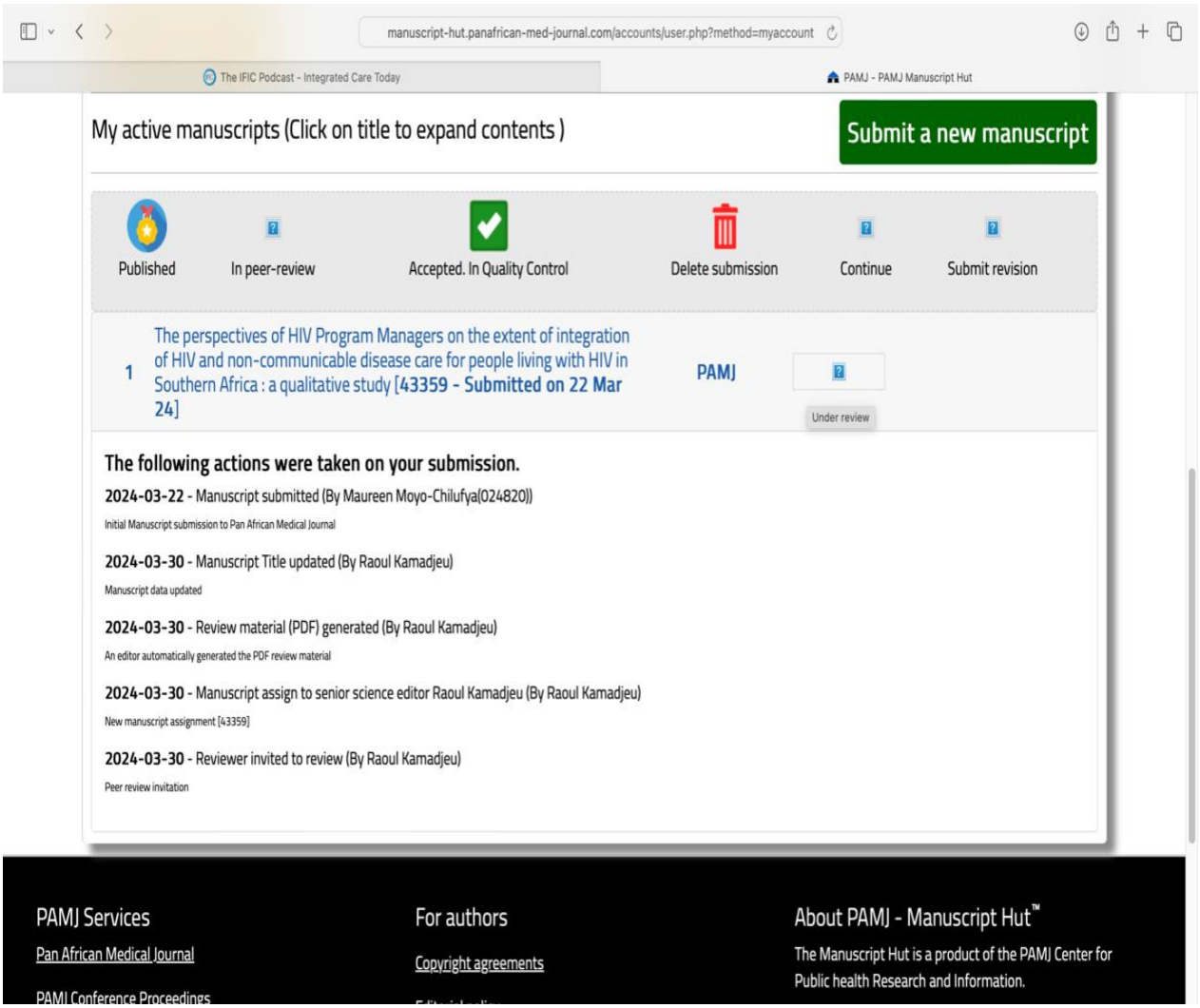
All information obtained during the course of this study will be regarded as confidential. Each participant that is taking part will be provided with an alphanumeric coded number e.g. A001. This will ensure confidentiality of information so collected. Only the researcher will be able to identify you as participant. Results will be published or presented in such a fashion that patients remain unidentifiable. The hard copies of all your records will be kept in a locked facility at School of Health Systems and Public Health, The University of Pretoria.

11) CONSENT TO PARTICIPATE IN THIS STUDY

- I confirm that the person requesting my consent for my child to take part in this study has told me about the nature and process, any risks or discomforts, and the benefits of the study.
- I have also received, read and understood the above written information about the study.
- I have had adequate time to ask questions and I have no objections to participate in this study.
- I am aware that the information obtained in the study, including personal details, will be anonymously processed and presented in the reporting of results.
- I understand that I will not be penalised in any way should I wish to discontinue with the study and that withdrawal will not affect my further treatments.
- I am participating willingly.
- I have received a signed copy of this informed consent agreement.

_____	_____
Participant's name (Please print)	Date
_____	_____
Participant's signature	Date
_____	_____
Researcher's name (Please print)	Date
_____	_____
Researcher's signature	Date

Appendix H: Proof of Submission: Extent of Integration Paper



Appendix I: Proof of Submission -Framework Paper