Physiotherapists' awareness of bone demineralisation and falls risk in people living with HIV and their perceptions about falls risk management.

by
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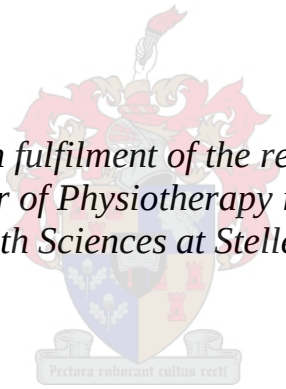

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DECLARATION

By submitting this dissertation electronically, I declare that the entirety of the work contained therein is my own, original work, that I am the sole author thereof (save to the extent explicitly otherwise stated), that reproduction and publication thereof by Stellenbosch University will not infringe any third-party rights and that I have not previously in its entirety or in part submitted it for obtaining any qualification.

This dissertation includes a manuscript submitted for review in a peer-reviewed journal. The development and writing of the chapters were my principal responsibility. Where this is not the case, a declaration is included in the dissertation indicating the nature and extent of the contributions of co-authors.

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ABSTRACT

Background

Sub-Saharan Africa has the greatest disease burden due to HIV globally. Improved access to better antiretroviral regimens has increased numbers and longevity of people living with HIV (PLWH). However, recent research has indicated a seemingly increased propensity for both falls and accelerated bone loss at younger-than-expected ages in PLWH. The benefits of anti-retroviral drugs may be overshadowed if PLWH suffer from excess morbidity such as falls, fractures and functional impairments. Physiotherapists play a crucial role in optimising function and quality of life of PLWH through prevention of falls and reducing the harm that results.

Aim

This research aimed to describe the extent and nature of existing research relating to falls in PLWH and describe the relationship between bone demineralisation and falls in PLWH. It further aimed to explore physiotherapists' awareness of falls risk and accelerated bone demineralisation in PLWH and their perceptions about current falls prevention in the care of PLWH in selected regions of sub-Saharan Africa.

Method

The research consisted of a scoping review and a primary study. The scoping review included peer-reviewed studies (excluding narrative reviews) available in English with any information referring to falls in PLWH. Any data regarding bone demineralisation in these studies were also extracted. The results were used to explain concepts arising from the qualitative study.

In the primary study, an interpretative exploratory qualitative research method with a phenomenological approach was employed to explore physiotherapists' perceptions and experiences regarding bone health and falls in PLWH. In-depth semi-structured telephonic interviews were used to collect data from 21 physiotherapists working in primary HIV care. Transcribed interview data were coded in Atlas.ti.8® and analysed using inductive thematic analysis.

Results

The scoping review identified 14 studies on falls in PLWH, with all but one study published in high income countries (HIC). Prevalence of falls in PLWH approximated that of seronegative

counterparts, but the studies were mostly in middle-aged to older adults in whom geriatric syndromes may already be prevalent. Considerable agreement existed for risk factors regarding use of medications while evidence regarding functional and cognitive impairments were variable. Few studies compared risk factors for falls in PLWH with those in age and sex-matched seronegative population. There is currently no evidence for interventions to prevent or reduce falls risk in PLWH.

The primary study revealed a lack of awareness by physiotherapists of falls risk and bone demineralisation in PLWH. As such, physiotherapists did not link falls or fractures to HIV or antiretroviral therapy (ART) when they did observe such events during their general patient assessments. However, in retrospect, some physiotherapists were able to recognise risk factors linked to falls in those with HIV. Current services for falls prevention as perceived by the physiotherapists were sub-optimal and lacked a patient-centred approach.

Conclusion

Physiotherapists may need to be more aware of the potential risk of falls and bone demineralisation in PLWH and routinely assess for these phenomena in both older and younger PLWH. More awareness also needs to be created among other healthcare professionals and PLWH. Meanwhile, research on falls in younger PLWH and in sub-Saharan Africa, where HIV is most prevalent and where more robust clades exist, is needed. Relevant stakeholders including governments and PLWH themselves require concerted efforts in addressing health system challenges affecting the implementation of falls prevention services to PLWH at primary care level.

OPSOMMING

Agtergrond

Sub-Sahara-Afrika het die grootste siektelas as gevolg van MIV wêreldwyd. Verbeterde toegang tot beter antiretrovirale regimens het die aantal en lewensverwagting van mense wat leef met MIV (MLM) verhoog. Nogtans dui onlangse navorsing op ‘n skynbaar verhoogte geneigdheid tot valle asook versnelde beenverlies in jonger-as-verwagte MLM. Die voordele van antiretrovirale medikasie kan oorskadu word as MLM ly aan oormatige morbiditeit, soos valle, frakture en funksionele gestremdhede. Fisioterapeute speel ’n belangrike rol in die optimalisering van funksie en lewenskwaliteit in MLM deur die voorkom van valle en die vermindering van die skade waartoe dit lei.

Doel

Die doel van hierdie navorsing was om die omvang en aard van bestaande navorsing rakende val in MLM te beskryf, en ook om die verband tussen verminderde beendigtheid en valle in MLM te beskryf. Die navorsing het verder ten doel gehad om fisioterapeute se bewustheid van val-risiko en versnelde beendigtheidvermindering in MLM, asook hul persepsies oor huidige valvoorkoming in die sorg van MLM, in geselekteerde streke in sub-Sahara-Afrika te ondersoek.

Metodes

Die navorsing het bestaan uit ’n omvangsbepaling en ’n primêre kwalitatiewe studie. Die omvangsbepaling het ingesluit eweknie-geëvalueerde studies (uitsluitend narratiewe oorsigte) met enige inligting rakende valle in MLM en wat in Engels beskikbaar was. Enige data aangaande verminderde beendigtheid is ook onttrek uit die studies. Die resultate is gebruik om konsepte voortspruitend uit die kwalitatiewe studie te verduidelik.

In die primêre studie is ’n interpretatiewe verkennende kwalitatiewe navorsingsmetode met ’n fenomenologiese benadering gebruik om fisioterapeute se persepsies en ervarings rakende beengesondheid en valle in MLM te ondersoek. In-diepte semi-gestruktureerde telefoniese onderhoude is gebruik om data in te samel van fisioterapeute wat in primêre MIV-sorg werk.

Hoofresultate

Die omvangsbepaling het 14 studies oor valle in MLM geïdentifiseer. Al die studies, behalwe een, was publikasies vanuit hoë-inkomste lande. Die prevalensie van valle in MLM en hul

seronegatiewe eweknieë was soortgelyk, maar die studies het egter meestal middeljariges tot ouer volwassenes ingesluit, in wie geriatriese sindrome alreeds mag voorkom. Aansienlike konsensus is bevind aangaande medikasiegebruik as ‘n risikofaktor, terwyl die bewyse vir funksionele- en kognitiewe gestremdhede as risikofatore wisselvallig was. Min studies het risikofaktore vir valle in MLM vergelyk met dié in ouderdoms- en geslags-vergelykbare seronegatiewe bevolkings. Tans is daar geen bewyse vir ingrypings om die valrisiko in MLM te verminder of voorkom nie.

Die primêre studie het ‘n gebrekkige bewustheid omtrent verhoogte valrisiko en verminderde beendigtheid in MLM onder fisioterapeute onthul. Fisioterapeute het as sulks nie valle of frakture aan MIV of antiretrovirale behandeling gekoppel wanneer hulle wel sulke gebeure tydens hul algemene pasiënt-ondersoeke waargeneem het nie. In retrospek kon sommige fisioterapeute egter risikofaktore wat verband hou met val by mense met MIV, herken. Huidige dienste vir val-voorkoming, soos waargeneem deur fisioterapeute, is bemerk as suboptimaal en het nie ’n pasiënt-gesentreerde benadering nie.

Gevolgtrekking

Dit mag nodig wees vir fisioterapeute om meer bewus te wees van die potensiële valrisiko en verminderde beendigtheid in MLM en om roetineweg te assesseer vir die verskynsels in ouer sowel as jonger MLM. Groter bewustheid moet ook geskep word onder ander gesondheidsorgwerkers en MLM. Intussen is meer navorsing nodig omtrent valle in jonger MLM en in sub-Sahara-Afrika, waar MIV mees algemeen, en as robuuster klades, voorkom.

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LIST OF ACRONYMS

5STS	Five-Times Sit-To-Stand
6MWD	Six-Minute Walk Distance
AIDS	Acquired Immunodeficiency Syndrome
ART	Antiretroviral therapy
BMD	Bone mineral density
cART	Combination antiretroviral therapy
CI	Confidence interval
CNS	Central nervous system
EBP	Evidence-based practice
HICs	High income countries
HIV	Human Immunodeficiency Virus
HIV-1	Human Immunodeficiency Virus Type 1
LMICs	Lower middle-income countries
MDT	Multidisciplinary team
OR	Odds ratio
PHC	Primary health care
PI	Protease Inhibitor
POR	Protective odds ratio
PLWH	People living with HIV
QoL	Quality of Life
QUS	Quantitative ultrasound
SNP	HIV seronegative participants
SPPB	Short Physical Performance Battery
STS	Sit-To-Stand
SU-HREC	Stellenbosch University Health Research Ethics Committee

WHO World Health Organisation

DEFINITION OF TERMS

Bone demineralisation: occurs when "the rate of bone resorption exceeds the rate of deposition" resulting in the "decrease or loss of bone minerals such as calcium and phosphorus;"[1] the increased bone fragility resulting in increased fracture risk.

Clade-C HIV: A sub-type of the human immunodeficiency virus (HIV) accounting for over half of HIV infections globally.[2] It is more prevalent in southern Africa and south east Asia.[3] The strains of HIV-1 clade C virus in southern Africa were found to have "a robust ability to recruit monocytes and cause neurotoxicity and cognitive deficits."[3]

Clinical Practice Guidelines: is defined as "statements that include recommendations intended to optimise patient care that are informed by a systematic review of evidence and an assessment of the benefits and harms of alternative care options."[4]

HIV: an acronym for "Human Immunodeficiency Virus." The virus destroys helper T cells of the immune system and renders a person susceptible to infections.[5]

Primary Health Care: "The essential health care based on practical, scientifically sound and socially acceptable methods and technology, made universally accessible to individuals and families in the community through their full participation and at a cost that the community and the country can afford to maintain at every stage of their development in the spirit of self-reliance and self-determination." (Alma Ata Declaration on Primary Health Care, WHO-UNICEF, 1978). It is the first point of contact for health care for most people and includes promotion of health, prevention, treatment, rehabilitation and palliative care.[6]

Risk Factor: defined by WHO as "any attribute, characteristic or exposure of an individual that increases likelihood of developing a disease or injury".[7]

Quality of Life: defined by WHO as "an individual's perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns. It is a broad ranging concept affected in a complex way by the person's physical health, psychological state, level of independence, social relationships, personal beliefs and their relationship to salient features of their environment."[8]

CHAPTER 1: INTRODUCTION

1.1 Background to the study

Sub-Saharan Africa has the biggest HIV epidemic in the world, accounting for 71% of the global burden of HIV infection in 2017.[9] The improved access to and newer regimens of combination anti-retroviral therapy (cART) have resulted in an increase in the number and life-expectancy of people living with HIV (PLWH) and reduced incidence of HIV infections.[10] Even though adherence to anti-retroviral therapy (ART) has improved both longevity and quality of life (QoL) of PLWH,[11] there is rising concern regarding the risk of falls and bone demineralisation in this population. Studies from high-income countries (HICs) report a fall prevalence in middle-aged and older PLWH ranging from 12%-41%;[12,13] while preliminary findings from a recent study in South Africa reported a prevalence of 34% among a relatively younger cohort of PLWH (median age = 36.61 years).[14] According to one meta-analysis,[15] the prevalence of reduced bone mineral density (BMD) in PLWH is twice that of seronegative controls.

These phenomena are reportedly occurring at younger-than-expected ages in PLWH,[16] presumably due to persistent systemic inflammation, immune activation, hormonal dysregulation, altered metabolism, treatment toxicity, excess co-morbidity (non-AIDS events) and clinical ageing.[17] Due to accentuated or accelerated ageing, physiological processes typically observed in ageing such as telomere shortening, and sarcopenia characterised by loss of muscle mass and strength are found to occur in HIV.[18] Reductions in BMD observed in PLWH are related to HIV infection itself (thus infection of osteoblasts), the relative high prevalence of traditional (low Body Mass Index (BMI), menopause, Vitamin D deficiency) and behavioral (smoking, alcohol consumption, sedentary lifestyle) risk factors for low BMD; as well as exposure to ART.[19] These factors increase the bone resorption activity of osteoclasts while promoting apoptosis of osteoblasts.[20]

The coexistence of falls and reduced BMD in PLWH may compound the risk of fractures;[21] and negatively impact on their mobility. This could in turn affect QoL, resulting in general functional decline, hospitalisation, institutionalisation, disability and even death.[22] Fear of falling, apparent in PLWH who fall,[14,23] may lead to further limited physical activity, independent of injury. The cost of healthcare resulting from falls and fall-related injuries is

significant.[24] The benefits of life-saving ART may be overshadowed if PLWH suffer from excess morbidity, such as falls, fractures and functional impairments.[21]

Physiotherapists' role in optimising function and QoL can do much in the prevention of falls in PLWH and reducing the harm that results.[25] The complex relationship between low BMD, falls and risk of fractures is still under research.[26] However, it has been determined that both BMD and number of falls are useful determinants of QoL.[27,28] The evidence that falling and low BMD share several risk factors suggests that the presence of one should result in investigations for the other.[27] Addressing variables of physical function such as balance impairments and muscle weakness may effectively manage challenges arising from reduced BMD, falls and fall-related fractures. For example, physical exercise in PLWH was reported to condition lower limb muscles leading to better balance control and potentially decreasing the incidence of falls.[29] Physical exercise has also been shown to promote bone health in PLWH and effectively reduce fracture risk through muscle contraction and surface impact.[30,31]

A gap still exists in the current body of knowledge regarding what physiotherapists in sub-Saharan Africa know about falls and bone demineralisation in PLWH and whether they encounter PLWH who have fallen. It is important for physiotherapists in this region to be aware of these phenomena since sub-Saharan Africa has the highest HIV prevalence and more robust strain of HIV-1 Clade-C compared to HICs.[32] Falls have become more apparent among PLWH as HIV has evolved into a chronic disease and PLWH are living longer, hence rehabilitation is more important.[33]

1.2 Significance of the study

Research on falls to date has been most extensive in geriatrics and institutionalised patients. However, the need for such research was recognised among PLWH almost two decades after the advent of ART; the first study being published in the USA in 2012.[34] A significant amount of research has since been done in HICs to indicate that reduced BMD, increased risk of falls and fractures are a cause for concern among PLWH.[20,35] As affordable ART became readily accessible in lower middle-income countries (LMICs), there was need for more research in sub-Saharan Africa to provide data and evidence to guide the reconceptualisation of HIV care into a rehabilitation framework so that PLWH not only live longer but also have improved QoL.

The broad scope of physiotherapy practice in the rehabilitation of PLWH in the era of ART is progressively being understood by physiotherapists in LMICs.[36,37] Randomised controlled

trials in Southern Africa have proved the efficacy of physiotherapy treatments including exercise programmes, manual therapy, and therapeutic taping in improving pain, cardio-pulmonary fitness, strength, neurological balance and QoL in PLWH.[38,39] However, the role of physiotherapy in health promotion and primary prevention in PLWH is still emerging.[40] Scant evidence exists for physiotherapy interventions that reduce falls[29] or promote bone health[30,31] in PLWH. Even so, the scope of physiotherapy in the context of primary HIV care is still not clearly understood by other members of the interdisciplinary team.[37] This may result in inappropriate, delayed or non-referral of PLWH who may have benefited from physiotherapy; as well as physiotherapists being side-lined from HIV care policy-making dialogues.[41] Physiotherapists need to be aware of their scope of practice in primary HIV care, particularly falls and fracture prevention, before they can promote it among other health professionals and the community at large.[37]

A literature search of studies exploring physiotherapists' awareness of falls and bone demineralisation in PLWH or falls prevention practices for this population did not yield any results. Studies regarding physiotherapists' knowledge, attitudes and practice patterns in falls prevention were in the older adults of the general population,[42–44] and stroke patients.[45] Physiotherapists' perceptions on provision of fall prevention and bone health services were explored in the context of primary care of the general population.[46–48] This is an important gap in knowledge since physiotherapists play a crucial role in falls prevention in at-risk populations.[49] An evaluation of their current knowledge and practices is an important step in ensuring conformity to best practice.[50] This study therefore aims to explore physiotherapists' awareness of accelerated bone demineralisation and falls risk in PLWH. The study additionally sought to determine the influence their awareness or lack thereof has on their current practice patterns in the assessment and management of falls in PLWH in selected regions of sub-Saharan Africa. Recommendations from this study may inform physiotherapists and other health care providers involved in the primary care of PLWH, resulting in physiotherapy being valued as an integral component of primary HIV care. It may also form the basis for knowledge translation research for physiotherapist community to conform to evidence-based practice in their care of PLWH. This will result in improved health care outcomes and improved QoL for PLWH.

1.3 Research question

The study aimed to address the following questions: Are physiotherapists in selected sub-Saharan African regions aware of the potential risk of falls and accelerated bone demineralisation in PLWH? How does their awareness or lack thereof affect their current falls risk management (if any) in PLWH?

1.4 Aim of the study

The overall aim of the study was to explore physiotherapists' awareness of accelerated bone demineralisation and falls risk in PLWH and current practice patterns for falls prevention in the care of PLWH in selected regions of sub-Saharan Africa.

1.5 Objectives

In order to achieve the above-mentioned research aim and address the research question the following objectives formed the basis of the study:

i. To describe the nature and extent of existing literature relating to falls in PLWH; and the relationship between falls and bone demineralisation in PLWH.
ii. To explore physiotherapists' awareness of bone demineralisation and falls risk in PLWH by means of in-depth interviews.
iii. To describe the presence and nature of current physiotherapy practice patterns in the assessment and management of falls in PLWH.

1.6 Rationale

The findings from this study could assist researchers, health care providers and policymakers involved in the care of PLWH to:

i. Gain an understanding of the current awareness of physiotherapists in sub-Saharan Africa of falls and bone demineralisation in PLWH. This would ascertain the need for revision of physiotherapy curricula or increased opportunities for continuous professional development.
ii. Understand the presence and nature of current physiotherapist-led falls prevention practices in PLWH

iii. Form a baseline for future research in sub-Saharan Africa regarding strategies for falls prevention and bone health in PLWH incorporated into the rehabilitation conceptual framework

iv. Assist in the development of undergraduate course curricula and quality clinical practice guidelines for falls prevention and promotion of bone health in PLWH.

1.7 Study setting

The study was carried out in four purposefully selected cities in sub-Saharan Africa: Cape Town Metropole (South Africa), Gaborone (Botswana), Harare (Zimbabwe) and Lusaka (Zambia). Randomly selected health care facilities where physiotherapists were involved in the primary care of PLWH were chosen from the urban district regions.

1.8 Study methods

The study consisted of a scoping review and the primary qualitative study.

The scoping review was guided by the methodological framework described by O'Malley & Arksey [51] to describe the nature and extent of evidence available regarding falls in PLWH and identify gaps in the existing body of evidence. The findings from the scoping review were used to clarify complex concepts arising from the primary study as recommended by Levac et al.[52]

In the primary study, an interpretative and exploratory qualitative research method with a phenomenological approach[53] was used to explore physiotherapists' perceptions and experiences regarding bone health and falls in PLWH. In-depth semi-structured telephonic interviews were used to collect data from the physiotherapists.

1.9 Structure of thesis

The thesis is presented in the following order:

Chapter 1: The *introductory* chapter of the thesis outlines the background, rationale, aims and objectives of the study together with an overview of the methods used.

Chapter 2: This chapter presents a *scoping review* of the literature on falls and bone demineralisation in PLWH (submitted for publication in a peer-reviewed journal). It describes the nature and extent of the existing body of evidence currently available to physiotherapists.

Chapter 3: A detailed description of the *methodology* used to perform the qualitative study is given in this chapter.

Chapter 4: The *results* of the qualitative study are presented in this chapter.

Chapter 5: A *discussion*, integrating the findings of the scoping review and the qualitative study, is presented in this chapter. The findings are discussed from the researcher's interpretation and in the context of existing literature. The limitations and implications of the findings for policy and clinical practice are provided.

Chapter 6: The *conclusion* is a final reflection on the study findings and presents the novel contribution this study has made to the body of evidence.

CHAPTER 2: SCOPING REVIEW

The following chapter presents an article formatted for submission to the BMJ Open. The journal's submission guidelines are outlined in Appendix A.

2.1 Title page of manuscript

Falls in People Living with HIV: a scoping review

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Word count 4916

2.2 Abstract of scoping review

Introduction: Improved access to better antiretroviral regimens has resulted in increased numbers and longevity of PLWH. However, recent research has indicated seemingly increased propensity for both falls and accelerated bone demineralisation in PLWH. The benefits of anti-retroviral drugs may be overshadowed if PLWH suffer from excess morbidity such as falls, fractures and functional impairments.

Objective: To map out the extent and nature of existing research relating to falls in PLWH and to describe the relationship between bone demineralisation and falls in PLWH.

Method: A scoping review was done of peer-reviewed studies available in English with any information referring to the definition, prevalence, assessment, risk factors and interventions for falls in PLWH. Narrative reviews were excluded. A descriptive analysis of extracted information was done.

Results: Fourteen studies on falls in older adults living with HIV were identified, with all but one study conducted in high-income countries. Prevalence of falls in PLWH ranged from 12-41%. Variable assessment tools/tests were used to assess potential risk factors, but it remains to be determined which are more predictive and appropriate for use among PLWH. Considerable agreement existed for risk factors regarding use of medications while evidence regarding functional and cognitive impairments were variable. Few studies compared risk factors for falls in PLWH with those in age and sex-matched seronegative population. There is currently no evidence for interventions to prevent or reduce falls risk in PLWH.

Conclusion: Research on falls in younger cohorts of PLWH and in sub-Saharan Africa where HIV is most prevalent and more robust clades exist. More studies need to report on data in seronegative controls to determine risk factors unique to PLWH. More intervention studies targeted at both falls prevention and promotion of bone health are required. Quality clinical practice guidelines highlighting validated assessment tools and outcome measures need to be developed.

Key words: Accidental falls, Aging, Bone demineralisation, HIV.

Strengths and limitations of the study

- The scoping review design enables a comprehensive mapping of the breadth of evidence on falls in PLWH.
- The absence of methodological quality appraisal limits the strength of this review to recommend the proposed assessment and intervention strategies. Indeed, much of the evidence came from prospective cohort studies which are prone to selection bias and bias from loss to follow-up. Antecedent-consequent bias occurs in cross-sectional studies (Level III evidence) making it difficult to determine causal relationships.[142]
- While convenient, limiting our studies to the English language may have resulted in omission of some studies and more likely those in LMIC.

2.3 Introduction

Falls are an emerging concern among people living with HIV (PLWH) because of the adverse effects on their health outcomes,[54] and is currently being increasingly investigated. Improved access to combinations of anti-retroviral therapy (cART) has increased the number and life expectancy of PLWH and reduced the incidence of HIV infections.[10] However, anti-retroviral (ARV) drug-associated neurotoxicity remains a challenge even after the advent of cART,[55] and has contributed to other negative side-effects such as bone demineralisation.[56] The seemingly increased propensity for falls and accelerated bone demineralisation in PLWH compounds their risk of fractures.[21] Mobility may be impacted in the short and longer term at younger-than-expected ages, and ultimately affect QoL.[17] The benefits of life-saving antiretroviral medications may be overshadowed if PLWH suffer from excess morbidity, such as falls, fractures and functional impairments.[21] Rehabilitation specialists have an increasingly notable role to play in the reconceptualisation of HIV care into a rehabilitation framework so that PLWH not only live longer but also have improved quality of life (QoL).[57]

Several studies have established that PLWH lose bone at an accelerated rate compared to age and sex-matched, seronegative controls, often presenting with low bone mineral density (BMD) at a younger age.[58] PLWH on ART with low BMD are at three-fold higher risk of osteoporosis which translates into clinically-relevant risk of low-energy trauma fractures.[20]

These fractures can negatively impact on physical function and can lead to increased disability. Reductions in BMD observed in PLWH may be attributed to HIV infection itself, the relative high prevalence of traditional and behavioural risk factors for low BMD; as well as exposure to ART.[19]

Research on falls to date has been most extensive in older adults of the general population, with high-quality data supporting multi-factorial risk assessments and screening to identify those at risk of falling. In this population, several fall risk factors or predictors have been identified, including sedative use, cognitive impairment, lower limb disability, balance and gait impairment.[59] Results of a Cochrane review on fall prevention interventions in community-dwelling older adults supported group and home-exercise programs and home safety interventions in reducing falls,[60] while another review[61] found strong evidence for using standardised tests (Five-Times Sit-To-Stand Test; gait speed assessment) to predict falls. It has also been recommended that BMD measurements be assessed in fallers as useful indicator of fracture risk. [27]

Falls have not been characterised in PLWH until fairly recently; the first study assessing fall prevalence and risk factors being published in the USA in 2012.[34] To date, published reviews of the scanty literature have been narrative in nature, lacking in methodological rigor and analytical evaluation of the available evidence.[52] Whereas the complex interplay between bone mineral density (BMD), HIV-1 and ART have been widely investigated (including scoping and systematic reviews),[15,20] it seems that such data have not been adequately investigated in relation to falls in PLWH. The aim of this scoping review was thus to map the extent and nature of existing research relating to falls in PLWH; specifically, in terms of describing fall definitions, assessments, epidemiology, risk factors or predictors and prevention interventions. A secondary aim was to describe the relationship between bone demineralisation and falls in PLWH. It was envisaged that the scoping review would provide insight into the breadth of evidence regarding falls in PLWH and identify areas for further research, in addition to forming the basis for knowledge translation research for rehabilitation specialists to conform to evidence-informed practice in their care of PLWH.

2.4 Methods

A scoping review was conducted according to the methodological framework developed by O'Malley and Arksey[51] and refined by Levac *et al.*[52] The six-step process includes: (i) identifying a research question; (ii) identifying relevant studies using an effective search

strategy; (iii) selecting studies fulfilling inclusion criteria; (iv) charting the data involving numeric and thematic analysis; (v) collating, summarising and reporting results. Reporting followed the PRISMA Extension for Scoping Review checklist.[62]

2.4.1 Patient and Public Involvement

The sixth optional step of the methodological framework for scoping reviews involves consultation with stakeholders.[51] Though not included in this study, PLWH should be consulted when developing clinical practice guidelines. A patient-centred approach is important by considering their concerns and involving them in the decision-making process of their treatment.[54]

2.4.2 Search Strategy

A comprehensive search of published research reports was conducted during May to June 2019. Four computerised databases (PubMed, Google Scholar, Scopus and CINAHL [EBSCO]) were accessed and the following search terms were used: ("HIV-1" OR "HIV infection") AND ("accidental falls" OR "fall risk" OR "fall assessment" OR "fall prevention"). The search strategy is included in the Appendix B. Reference lists of articles identified in the primary search were explored to identify additional relevant evidence. The search was rerun in October 2019 to ensure inclusion of recently published papers.

2.4.3 Eligibility criteria

Articles were included if they were peer-reviewed studies (quantitative and qualitative) making specific reference to falls in PLWH as an outcome. Narrative reviews were excluded. Full texts had to be available in English. No date limit, socioeconomic or geographical exclusions were applied.

2.4.4 Data charting

A data extraction sheet was developed in Excel and summaries of data from the included studies were arranged according to study design. Extracted data included first author, publication year, country, sample demographics, fall definition, fall prevalence, methods of fall risk assessment, risk factors or predictors of falls, interventions and recommendations from the studies. Any information regarding bone demineralisation in relation to falls in PLWH was also extracted. Extracted data were discussed by all reviewers for consistency and consensus. As this was a scoping review, risk of bias was not assessed.

2.4.5 Data analysis

A summary of extracted information was tabulated according to the predetermined categories (fall definition, epidemiology, risk factors, assessment and interventions) and a descriptive analysis was conducted. The findings from the included studies were presented narratively.

2.5 Results

2.5.1 Selection of studies

The initial search yielded 905 hits, of which 876 titles were excluded due to being duplicates or clearly not conforming to this review's objectives. Subsequently 29 abstracts were screened, of which 12 did not include PLWH and were thus excluded. Two more articles were retrieved via PEARLing; hence 19 full-text articles were obtained for review. Of these, 14 proved eligible for analysis (Figure 2.1).

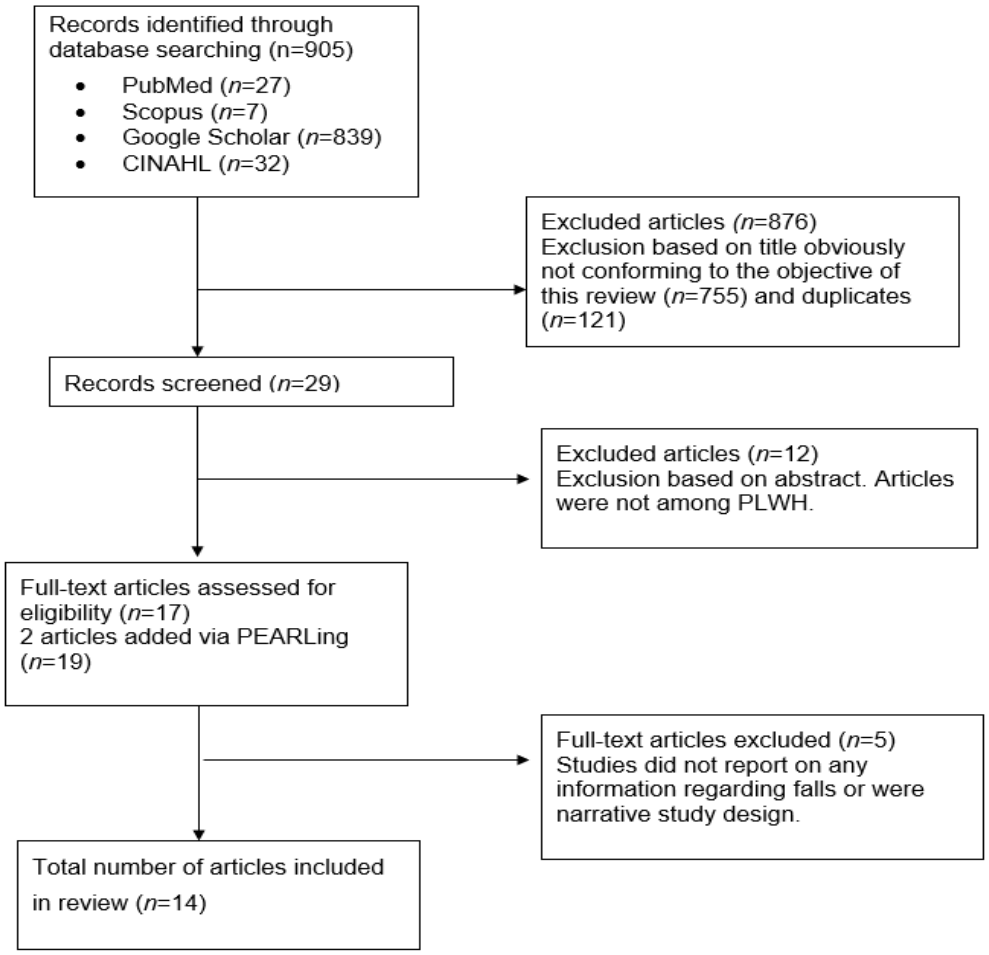

Fig. 2.1 Prisma Flow Chart showing selection of studies for inclusion in scoping review

2.5.2 Study Characteristics

The identified studies were published between 2012 and 2019 with 11 studies (79%) being published in the last five years. Only one study[63] was conducted in a low-middle-income country (LMIC), while the rest were conducted in high-income countries, mostly from the United States of America (USA) (n=12; 85.7%). Six studies (43%) used longitudinal prospective cohort design,[12,13,23,34,64,65] four studies (29%) used cross-sectional design,[63,66–68] one study was a secondary analysis of data from a longitudinal prospective cohort study,[69] one study was a longitudinal retrospective analysis of patient databases,[70] while another used qualitative methods.[54] One systematic review was also included.[71] Four studies (29%)[13,23,65,67] had samples consisting of both PLWH and HIV-seronegative participants. Six studies (43%)[12,13,34,64,66,68] had participants who were mostly or only men, ranging from 81% to 100%, while two studies (14%)[65,67] included only women. The age means or medians of the study populations were between 48 and 61years. The percentage of PLWH who were on ART varied from 61% to 100%. Table 2.1 summarises study characteristics while Table 2.2 summarises sample characteristics.

Table 2.1: Summary of study characteristics.

Study	Country	Study design	Aim	Eligibility criteria
Berner et al 2017[71]	Various	Systematic review	To synthesise the evidence of objective impairments of gait and balance associated with HIV-1 infection, and to emphasise those which could contribute to increased fall risk	Definition, prevalence, risk factors, assessment.
Erlandson et al 2012[34]	USA	Longitudinal prospective cohort study	To determine incidence of and risk factors for falls in PLWH	Definition, prevalence, risk factors, assessment, intervention.
Erlandson et al 2016 [23]	USA	Longitudinal prospective cohort study	To (1) compare fall rates in PLWH or adults at risk for HIV, (2) determine if HIV infection is an independent fall risk, and (3)	Definition, prevalence, risk factors, assessment, intervention.

			determine other fall risk factors potentially unique to HIV.	
Erlandson et al 2019[13]	USA	Longitudinal prospective cohort study	To identify fall risk factors among men with and without HIV	Definition, prevalence, risk factors, assessment, intervention.
Greene et al 2015[66]	USA	Cross-sectional study	To describe geriatric syndromes in older PLWH aged ≥50 with undetectable VL.	Definition, assessment, prevalence, intervention.
John et al 2016[68]	USA	Cross-sectional study	To perform geriatric assessments in older PLWH in San Francisco and examine the association with age and the Veterans Aging Cohort Study (VACS) index scores	Prevalence, assessment, intervention.
Kim et al 2018[69]	USA	Secondary analysis of longitudinal study data	To determine whether polypharmacy is associated with falls and fractures among PLWH and substance dependence or injection drug use	Definition, prevalence, risk factors, assessment, intervention
Richert et al 2014[12]	France	Longitudinal prospective cohort study	To assess changes in locomotor function in PLWH and to evaluate the determinants of variations in lower limb muscle performance	Prevalence, risk factors, assessment, intervention
Ruiz et al 2013[70]	USA	Longitudinal retrospective review	To investigate fall incidence and risk factors in PLWH	Definition, incidence, risk factors.
Sharma et al 2016[67]	USA	Cross-sectional study	To determine fall frequency and risk factors among middle-aged women with HIV and HIV-controls.	Definition, prevalence, risk factors, assessment, intervention.
Sharma et al 2018[65]	USA	Longitudinal prospective cohort study	To determine the longitudinal occurrence and risk factors for falls in women with HIV and	Definition, prevalence, risk factors,

			explore associations with cognition	assessment, intervention
Ssonko et al 2018[63]	Uganda	Cross-sectional study	To determine polypharmacy prevalence, associated factors and whether polypharmacy was associated with adverse effects among older PLWH on ART	Risk factors, assessment
Tassiopoulos et al 2017[64]	USA	Longitudinal prospective multicohort study	To examine associations between frailty and fall risk among PLWH	Definition, prevalence, risk factors, assessment, intervention
Womack et al 2018[54]	USA	Qualitative study	To understand perceptions of HIV+ individuals who had fallen regarding what caused their falls, prevention strategies that they used, and the impact of falls on their lives	Risk factors, intervention

Table 2.2: Summary of sample characteristics

Study	Description of sample	PLWH									SNP			
		N	Age (yrs.) Median (IQR)	M (%)	F (%)	Time since diagnosis (Years) Median (IQR)	On ARV (%)	PLWH with VL<LDL % (plasma HIV-1-RNA)	Current CD4+ count (cells/µL)	Nadir CD4+ count (cells/µL)	n	Age (yrs.) Median (IQR)	Male (%)	Female (%)
Erlandson et al. 2012[34]	PLWH aged 45 to 65 years, receiving ART from academic hospital's infectious diseases clinic.	359	52±0.3†	85	NR	NR	100	95% (<200c/mL)	594±16†	NR				
Erlandson et al. 2016[23]	PLWH and SNP (men and women) from the Hearing and Balance Substudy of MACS and WIHS.	233	49.7 (43;55)	NR	47	NR	69	69% (<200c/mL)	534*	NR	303	54.9 (48;62)	NR	18
Erlandson et al. 2019[13]	PLWH and SNP men aged 50 to 75 years from the Bone Strength Substudy of the MACS.	279	61.1 (55.6;64.2)	100	0	NR	100	91% (<50c/mL)	NR	36% (<200) 73% (>500)	379	62.4 (58.5;66.8)	100	0
Greene et al. 2015[66]	PLWH from SCOPE cohort aged ≥50 years, on ART with VL<LDL.	155	57 (54;62)	94	NR	21(16;24)	100	NR	567 (398;752)	174 (51;327)				

John et al. 2016[68]	Older PLWH aged ≥50 years at two San Francisco-based HIV clinics.	359	57	85	12.5	NR	100	82% (<40c/mL)	52% (>500)	NR				
Kim et al. 2018[69]	PLWH with substance dependence or injection drug use, from Boston ARCH Cohort study.	250	50 (44;56)	62	NR	NR	88	72% (<200c/mL)	NR	NR				
Richert et al. 2014[12]	Adult PLWH from the ANRS CO3 Aquitane Cohort from six public hospitals in south-western France.	178	48 (43;56)	81	NR	12(6;18)	89	84% (<500c/mL)	506 (340;715)	245 (151;371)				
Ruiz et al. 2013[70]	Patient records of PLWH from an academic urban HIV clinic with history of fall in prior 12 months.	32	48.19*	25	75	9.38*	NR	31 379 c/mL*	342.2*	NR				
Sharma et al. 2016[67]	PLWH and SNP from WIHS with available falls data.	1 412	48*	0	100	NR	87.8	65.4% (<20c/mL)	589 (385;808)	274 (146;462)	650	NR	NR	NR
Sharma et al. 2018[65]	PLWH and SNP from WIHS with available falls data and attending semi-annual study visits.	1 816	48.9 (42.8;54.6)	0	100	NR	88.3	63.4% (<20c/mL)	588 (385;781)	280 (161;411)	566	47.1 (39.9;53.8)	NR	NR
Ssonko et al. 2018[63]	PLWH aged ≥50 years attending an outpatient	411	NR but aged	41.8	58.2	NR	93	NR	NR	NR				

	HIV/AIDS care centre.		50 and over.											
Tassiopoulos et al. 2017[64]	PLWH (men and women) aged ≥40 years from the ACTG.	967	51(46;56)	81.1	18.9	NR	100	NR	NR	NR				
Womack et al. 2018[54]	PLWH (men and women) from an HIV primary care clinic.	21	55±6†	43	57	19 (1;33)	NR	NR	NR	NR				

* mean † mean± standard deviation

Abbreviations: ACTG- AIDS Clinical Trials Group; ANRS- Agence Nationale de Recherches sur le Sida et les Hépatites Virales; ARCH- Alcohol Research Collaboration on HIV/AIDS; IQR- Inter-quartile range; MACS- Multi-center AIDS Cohort Study; NR- not reported; SCOPE- Observational Study of the Consequences of the Protease Inhibitor Era; SNP- seronegative participants; VL<LDL- viral load less than lowest detectable level; WIHS- Women's Interagency HIV Study

2.5.3 Definition of "fall"

Despite slight variations in terminology, all fall definitions included components of the falls being 'unintentional/unexpected' and 'coming to a lower level'. The most comprehensive definition of a fall was that used in three studies (21%);[13,65,67] using descriptions a patient would understand ('slip or trip'), including falls resulting in furniture contact but excluding falls from major medical events (e.g. stroke) or overwhelming external hazard (e.g. hit by truck or pushed). Four studies (29%)[23,66,69,70] did not exclude falls resulting from acute medical events or external forces in their definition; of these, only one study[69] provided motivation for their inclusion of falls caused by external hazard. In determining whether polypharmacy was associated with falls in PLWH, some medications could increase falls due to both external and non-external causes. Half of the studies[13,54,64–67,69] distinguished injurious falls from non-injurious (benign) falls by determining falls that resulted in participants requiring medical attention or resulting in fractures. Six studies (43%)[13,23,34,64,65,67] defined a recurrent faller as having more than one fall in the previous year. Three studies (21%)[12,54,63] did not report on their definition of a fall.

2.5.4 Epidemiology of falls

Ten studies (71%) reported on prevalence of falls in PLWH (Table 2.3). The first prevalence study on falls in PLWH reported that 30% of middle-aged PLWH (45-65 years) sustained at least one fall in the previous year and that 18% sustained two or more falls.[34] Subsequent studies reported frequencies for any fall ranging from 12% – 41%. Only one study[70] reported on the incidence of falls (16 x 1000 patients/year) that occurred in the previous year from a retrospective review of PLWH's medical records. Four studies reported on recurrent falls ranging from 7% – 25%.[23,34,64,67]

Differences in fall rates between PLWH and the seronegative controls were found to be insignificant in the four studies that included seronegative participants,[13,23,65,67] even after adjusting for covariables including age.

2.5.4.1 Time period of recall of falls

Eight studies (57%) assessed falls retrospectively using self-reported history of falls within a specified period.[12,23,34,64,66–69,72] Of these, five studies used a recall period comprising the prior 12 months[12,23,34,66,68,69] and three studies used the prior six months.[64,65,67] Only one study collected real-time (within 24 hours) fall reports prospectively over a two-year period.[13]

Table 2.3: Summary of fall prevalence reported in included studies

Study	Method of fall history collection		PLWH				SNP			
		Time frame assessed for falls	Number of participants (n)	Overall fall prevalence (%)	Prevalence for single fall (%)	Prevalence for recurrent falls (%)	Number of participants (n)	Overall fall prevalence (%)	Prevalence for single fall (%)	Prevalence for recurrent falls (%)
Berner et al. 2017[71]*										
Erlandson et al. 2012[34]	Retrospective recall	1 year	359	**30**	12 (F=14%)	18 (F=26%)				
Erlandson et al. 2016[23]	Retrospective recall	1 year	303	**24**	11	13	233	**18**	9	9
Erlandson et al. 2019[13]	Prospective reporting tool (within 24 hrs.).	2 years	279	**41**	21	20	379	**39**	22	17
Greene et al. 2015[66]	Retrospective recall	1 year	155	**25.8**	NR	NR				
John et al. 2016[68]	Retrospective recall	1 year	359	**40.7** (50-59yrs.=38.5%) 60-80yrs.=45.5%)	NR	NR				
Kim et al. 2018[69]	Retrospective recall	1 year	250	**16** (M=51%)	NR	NR				
Richert et al. 2014[12]	Retrospective recall	1 year	178	**12**	NR	NR				

Ruiz et al. 2013[70] †	Retrospective review of patient databases.	1 year	2000							
Sharma et al. 2016[67]	Retrospective recall	6 months	1412	**18.6**	9.2	9.4	650	**18.3**	8.3	10
Sharma et al. 2018[65]	Retrospective recall	6 months	1816	**41**	15.5	25.4	566	**42**	18	24
Ssonko et al. 2018[63]*	Retrospective recall	12 months	411							
Tassiopoulos et al. 2017[64]	Retrospective recall	6 months	967	**18**	11 (M=80.2%; F=19.8%)	7 (M=72.1%; F=27.9%)				
Womack et al. 2019[54]*	Retrospective recall	2 years	21							

* prevalence not reported † incidence reported

Abbreviations: F- female, M- male, NR- not reported

2.5.5 Assessment of falls and risk factors

2.5.5.1 Measures for assessing falls and risk factors

Comprehensive medical assessments were done to evaluate specific risk factors for falling as part of a post-fall assessment in five studies,[13,23,34,65,67] or as part of an overall geriatric assessment in two studies.[66,68] Falls were also assessed as an outcome in three studies[63,64,69] which sought to determine association between falls and specific risk factors such as frailty and polypharmacy.

All but two studies[70,71] subjectively assessed fall history. Five studies[13,23,64,65,67] used a self-reporting questionnaire. Review of patient databases were also done to verify medications, comorbidities and obtained laboratory data on HIV-specific markers including CD4+ count and viral load. Various standardised assessment tools and objective tests were used across studies to assess falls and related factors during both the subjective and objective assessments (Table 2.4).

Table 2.4: Summary of assessments tests/tools for falls and related factors used in included studies

Key Area	Test/ Tool	Berner et al. 2017[71]	Erlandson et al. 2012[34]	Erlandson et al. 2016[23]	Erlandson et al. 2019[13]	Kim et al. 2018[69]	Richert et al. 2014[12]	Ruiz et al. 2013[70]	Sharma et al. 2016[67]	Sharma et al. 2018[65]	Ssonko et al. 2018[63]	Tassiopoulos et al. 2017[64]	Womack et al. 2019[54]
Subjective Assessment													
Subjective History	History of falls*		✓	✓	✓	✓	✓		✓	✓	✓	✓	✓
	Fear of Falling								✓				
	Cause of falls				✓								✓
	Resulting injury or fractures				✓	✓			✓	✓		✓	✓
	Review of medications and polypharmacy		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
	Review of chronic diseases and comorbidities		✓	✓	✓	✓[a]		✓	✓	✓	✓[a]	✓	✓
	History of alcohol, smoking and illicit substance abuse		✓	✓	✓	✓			✓	✓		✓	
	Subjective cognitive complaints								✓	✓			
Environmental hazard assessment (assessed subjectively)	Lighting, wet/slippery surface, uneven surface, obstacle, step/curb, pets.				✓								
HIV specific variables	Duration of infection		✓		✓		✓	✓					✓
	ART use			✓	✓	✓	✓		✓	✓	✓		
Objective Assessment													
Vitals	Orthostatic blood pressure				✓				✓	✓			
Sensation	120-Hz tuning fork				✓								
Laboratory testing	Haemoglobin, CD4 T cell count, HIV-1 RNA viral load, cholesterol.		✓	✓	✓	✓		✓	✓	✓			
Standardised Objective Tests													
Balance	Berg Balance Scale (BBS)	✓											
	Tandem stand	✓	✓		✓								
	Single leg stand (SLS)	✓					✓						

	Forward Reach	✓			✓								
	Timed Up and Go Test (TUGT)	✓					✓						
	The Five Times Sit to Stand (5STS)	✓	✓		✓ †		✓						
	Dynamic posturography	✓											
Gait	4m walk (fast or preferred)		✓	✓									
	400m walk	✓	✓									✓	
	Six-minute walk distance (6MWD)	✓					✓						
Standardised Questionnaires/Scores													
Mental health and cognitive capacity	Depression (CES-D)			✓	✓				✓	✓			
	Cognitive impairment										✓[b]	✓[c]	
Physical function	Functional impairment (VACS Index Score)		✓										
	Balance (ABC survey)				✓								
	Physical activity			✓[d]	✓[e]								
	Frailty (Fried Frailty Scores)		✓		✓						✓‡	✓	
Debilitating Pain	Pain Scale		✓										

*NB. Two cross-sectional studies by Greene et al., John et al. [66,68] measured falls as part of geriatric assessments. Any other risk factors measured were not linked to falls as causality could not be claimed, hence the studies were excluded from this table. Both studies had assessed history of falls through subjective report.

† Modified to 10STS ‡Used a 40-item questionnaire; a=CCI; b=FMMSE; c=A5001 Neuroscreen; d=SF survey, e=IPAC

Abbreviations: ABC- Activities-Specific Balance Confidence; CCI- Charlson Comorbidity Index; CES-D- Centre for Epidemiological Studies-Depression; FMMSE- Folstein's Mini Mental State Examination; IPAC- International Physical Activity Questionnaire; SF- Short Form; VACS-Veterans Aging Cohort Study

2.5.6 Risk factors for falls in PLWH

Five longitudinal studies,[13,23,34,65,70] one cross-sectional study[67] and one qualitative study[54] had the primary objective of determining fall risk factors among PLWH. Seven studies[13,23,34,64,65,67,69] provided odds ratios regarding the associations between risk factors and falls in PLWH. Odds ratios, for the risk factors that were significantly associated with falls (any fall, single fall and recurrent falls) in PLWH ($p \leq 0.05$) were plotted in Figure 2.2.

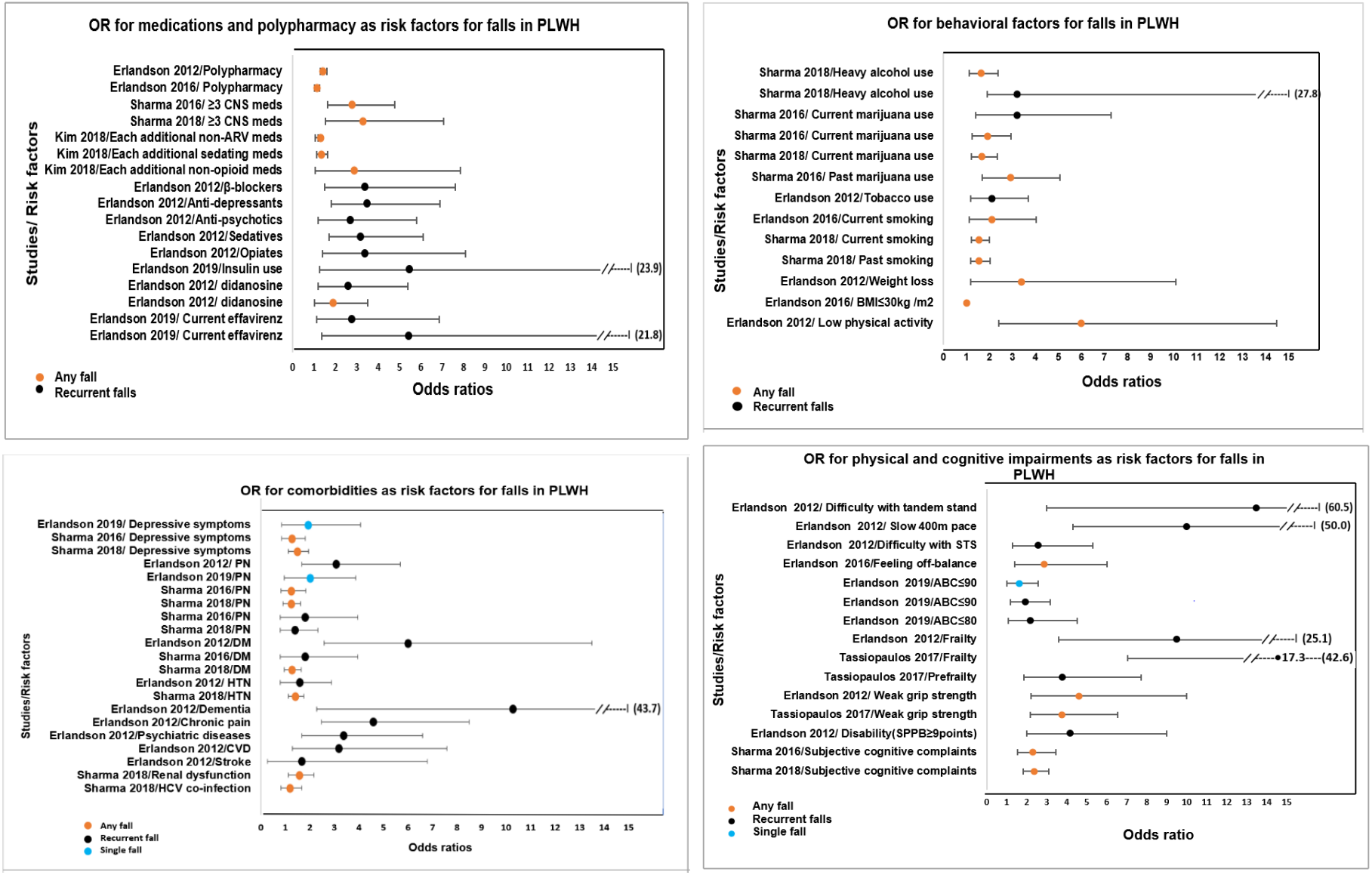

Fig. 2.2 Odds ratios for risk factors significantly associated with falls in PLWH

2.5.6.1 Polypharmacy and medications

Nine studies (64%) reported on polypharmacy as a risk factor for falls in PLWH; six studies (43%)[23,34,65,67,69,70] reported significant associations (Fig. 2). Additionally, participants in one qualitative study[54] reported use of multiple medications as a cause for their falls. Two studies (14%)[13,63] reported polypharmacy as not significantly associated with falls.

Five studies (36%)[13,34,65,67,69] reported significant associations between different medications and falls (Fig. 2). Insignificant odds were reported for each additional non-sedating or opioid drugs (OR1.31; 95%CI:0.64-2.67).[69] Four studies reported protective odds ratios for HAART use [13,23,65,67] especially current PI use (POR0.40; 95%CI:0.2-0.81; P=0.011).[23] Longer duration on ART was protective of injurious fall (OR0.41; 95%CI:0.23-0.74; P=0.014) in one study.[13]

2.5.6.2 Physical function and cognitive impairments

Six studies[13,23,34,64,65,67] proved significant associations between falls and functional and cognitive impairments (Fig. 2). One study[12] did not provide odds ratios but reported significant association between any fall and poor sit-to-stand (STS) (P=0.01) and six-minute walk distance (6MWD) tests ($P<10^{-2}$), with the timed-up-and-go test (TUGT) being marginally significant (P=0.05).

One study[64] reported insignificant association between single falls and weak grip strength (aOR1.38; 95%CI:0.82-2.34) and gait speed (aOR0.61; 95%CI:0.36-1.01). One study[13] also reported insignificant odds ratios for poor balance measurements. Although three studies[63,65,67] showed significant association between cognitive impairments and falls in PLWH, one of these studies[65] found that the results were attenuated after adjusting for comorbid illness. Another study[64] reported neurocognitive impairments in 29.4% of recurrent fallers versus 14.1% of non-fallers.

2.5.6.3 Comorbidities and chronic diseases

All but two[12,71] of the identified studies assessed comorbidities and chronic diseases in their participants. Two studies[34,70] reported significant association between falls and multimorbidity.

Four studies[13,34,65,67] found significant association between falls and specified chronic diseases; neuropathy being cited in all four studies. Another study[64] identified peripheral

neuropathy as a potential confounder for the association between falls and frailty in PLWH. In one qualitative study,[54] PLWH reported peripheral neuropathy in addition to opportunistic infections, spinal stenosis, arthritis, stroke, hepatic encephalopathy as being causes of their falls. Only one study[23] failed to find an association between peripheral neuropathy and falls and attributed it to their relatively younger cohort being potentially better able to compensate for neuropathies or possibly less sensitive tests being used to determine peripheral neuropathy. In three studies each, diabetes[34,65,67] and depressive symptoms[13,65,67] were also frequently cited as risk factors for falls in PLWH.

2.5.6.4 Behavioural factors

Six studies[13,23,34,54,65,67] assessed behavioural risk factors for falls in PLWH; four studies reported significant odds ratios (Fig 2.). In one qualitative study[54] participants reported substance abuse as a cause of their falls. One study[13] reported protective odds for greater physical activity and falls with fractures (OR0.23; 95%CI: 0.08-0.72; P=0.011).

2.5.6.5 Demographic factors

Significant odds ratios were reported for older age[65,67] (aOR1.29; 95%CI:1.11-1.49),[65] (aOR2.00; 95% CI:1.11-3.59 age ≥60 vs. <39)[67], white race (OR1.39; 95%CI:1.08-1.78; P=0.011)[65] and being female (OR2.5; 95CI:1.3-4.8).[34] However two studies[23,34] found that age was not a significant predictor of falls (OR1.0; 95CI:0.96-1.1; P≥0.30),[34] (OR1.32; 95CI:0.9-1.92; P=0.14).[23]

2.5.6.6 HIV-related variables

Ten out of the fourteen included studies (71%) assessed viral load in their participants; one study reported on persons with higher HIV-1 RNA viral loads having greater fall frequencies.[23] Four studies[34,65,67,70] found no association between current or nadir CD4+ cell count and falls. Clinical AIDS diagnosis was also not associated with falls in two longitudinal studies.[23,65]

2.5.7 Comparison of risk factors for falls between PLWH and seronegative population

Of the four studies including seronegative controls, two studies[13,65] compared risk factors for falls between the groups. One study[13] found falls in relation to pets to be more significant among PLWH while use of illicit substances was more commonly associated with falls among

SNP. Sharma et al (2018)[65] found similar risk factors between the groups: depressive symptoms (aOR1.70; 95%CI:1.33-2.16; p=0.0001 for PLWH; aOR1.61; 95%CI:1.12-2.32; p=0.01 for SNP) and peripheral neuropathy (aOR1.44; 95%CI:1.12-1.84; p=0.004 for PLWH; aOR1.63; 95%CI:1.10-2.41; p=0.015 for SNP). This study also found subjective cognitive complaints and hypertension to be significantly associated with falls in SNP.

2.5.8 Intervention for fall prevention

No intervention studies were found. However, many recommendations were found among studies regarding potentially effective falls prevention strategies for PLWH – these are listed in Table 2.5 under the section "Intervention".

2.5.9 Bone mineral density and fall-related fractures

Bone mineral density was not reported in any of the studies. Rather, data were mostly presented in the context of fall-related fractures. Five studies[13,64,65,67,69] reported a prevalence of fall-related fractures ranging from 3.8% – 8%. Three of these studies had controls; one study[67] showing a markedly higher prevalence of fall-related fractures in post-menopausal SNP (9.2% SNP vs. 3.8% PLWH) while two studies[13,65] showed similar (6%) or slightly higher (4.7% PLWH vs. 3.1% SNP) prevalence in PLWH. One qualitative study[54] reported that five out of 21 participants (23.8%) sustained fall-related fractures.

Although not statistically significant, one study[13] reported that diabetes medications (OR 3.19 [0.94,10.88], p=0.064) and detectable HIV-1 RNA viral load (OR 4.48,[0.77,25.99], p=0.094) were associated with an increased risk of fall-related fractures, while high physical activity was found to be protective (OR 0.23, [0.08, 0.72], p=0.011).

2.5.10 Recommendations from the studies

Several recommendations for assessment and management of fall risk, as well as for future studies were identified in the included studies (Table 2.5).

Table 2.5: Summary of recommendations from included studies

Area	Recommendations
Assessment	Falls risk should be routinely assessed as part of care of PLWH,[34] to identify modifiable risk factors for falls including locomotor impairments which can be targeted as areas of fall prevention.[67,71]
	Collecting real-time fall characteristics e.g. circumstances, cause and injury can help identify targeted areas for interventions in fall prevention by identifying falls with poor outcomes.[13]
	During subjective assessments assess for complaints of light-headedness, dizziness, feeling off-balance.[23]
	Recommended tests include the 5STS for balance assessment,[70] the VACS Index score for functional impairment,[68]Fried score or simple tests of gait speed or grip strength for frailty assessment,[64]
	Assessment and careful consideration should be given to PLWH presenting with peripheral neuropathy.[64]
Interventions	Falls risk reduction among PLWH should be resonant with those of the general population, with additional consideration to issues specific to this population such as ART adherence and physical activity.[13]
	A multipronged approach was proposed in addressing each of the multiple risk factors identified during the individualised assessment.[34]
	Regular medication review should be done to eliminate unnecessary drugs with side-effects that may intensify the risk of falls.[13,23,34,69]
	Comorbidities that put one at high risk of falls should be identified and treated.[66] One study specified peripheral neuropathy as a comorbidity that should be assessed and treated.[68]
	While no specific exercise regimen were investigated, general recommendations were made regarding physical exercise and balance training to improve locomotor function.[12,23,34]
	PLWH suggested physical therapy and avoidance of extrinsic fall risk factors as effective fall prevention strategies.[54]Specific strategies to address extrinsic fall risk factors included appropriate footwear, sufficient lighting and avoiding distractions while walking.[13]
	Counsel PLWH regarding safety around pets, behavioural modification regarding substance abuse and low physical activity.[13]
Future research	Develop interventions that are specific to needs and concerns of PLWH; multidisciplinary approach should be considered.[54]
	Investigate safety and efficacy of multifactorial fall reduction interventions (used successfully in older adults) in PLWH.[23]
	Identify underlying mechanism of falls in PLWH in order to identify effective intervention strategies.[65]
	Investigate the extent to which poor locomotor function contributes to fracture risk in PLWH.[12]
	Evaluate effect of physical exercise programs, led by kinesiologists or physiotherapists, in primary or secondary prevention care of PLWH.[12]

	Longitudinal studies to determine whether incidence and consequence of falls is greater in women living with HIV.[67]

2.6 Discussion

We present the results of our scoping review of thirteen primary studies and one systematic review reporting on falls in PLWH. There is indication of increasing awareness of falls as a concern in PLWH considering the recency of published articles. All but three of the 14 included studies were based in the USA, which may affect the generalisability of results to other contexts especially sub-Saharan Africa where most and more robust clades of HIV infection exist. However, we were able to present a comprehensive map of the breadth of evidence available regarding falls and bone demineralisation in PLWH.

2.6.1 Definition

The studies that reported their definition of fall had two homogenous components; being unexpected or unintentional and coming to rest on a lower level. However, definitions used in the studies were varied with some excluding falls from disease-related causes and external forces. It is possible that by making such exclusions, falls relevant to this population were missed. One Cochrane review[73] of case definitions of falls recommended a standardised, non-exclusive fall definition; “an unexpected event in which the participant comes to rest on the ground, floor or lower level” and for patients to understand, terminology such as ‘slipped, tripped or losing balance’ should be used to describe falls.[73] Using a standardized definition in future studies will enhance generalisability in comparing prevalence statistics between countries and studies.

2.6.2 Epidemiology of falls in PLWH

The prevalence of falls in PLWH was found to approximate that of their seronegative counterparts.[13,23,65,67] In these studies, middle-age and older participants were included. Therefore, factors related to ageing may have influenced the prevalence of falls in the seronegative participants as well. One Ph.D. thesis[74] showed that falls were a problem in a relatively younger cohort of PLWH (median age of 36.61 years) living in a rural district of South Africa. A higher prevalence of falls in PLWH compared to the SNP was reported (34% PLWH vs. 16% SNP; p=0.038). The prevalence of falls among younger PLWH may be useful

in determining whether higher risk of falls occurs earlier in their life course when compared with age-matched seronegative counterparts.

All studies were conducted in HIC where participants had access to good health care and effective health promotion strategies.[75] For example, lower rates reported by Erlandson et al.[23] and Sharma et al.[67] were attributed to volunteer bias of participants with access to health care agreeing to participate in the study, indicating how better adherence and access to treatment can result in better fall outcomes in PLWH. However, the higher burden of risk factors which are mediating variables of falls and ageing in PLWH (including coexisting comorbidities, opportunistic infections, malnutrition, and poor ART compliance),[76] may indicate that the situation could be very different in LMIC settings. The risk profiles of participants in in LMIC with lower socio-economic factors and sub-optimal health systems may differ considerably. It could be that strains of HIV-1 Clade C virus, epidemic in southern Africa, are more robust and having a greater effect on the CNS. [32,77] Perhaps this phenomenon should be investigated in LMIC settings.

The prevalence of falls reported in the studies included in this review could have been compromised by the possible recall-bias in reporting falls retrospectively. Varying time intervals over which participants were asked to recall their falls were used with varied prevalence rates being reported. The optimal time period to obtain accurate recall of fall history remains to be determined, although the one-year recall period seems to be more precise.[16,78] Even so, researchers reportedly favour prospective recall methods considering that participants may forget or underreport their falls.[78] Only one of the included studies[13] collected falls data prospectively and reported a relatively higher prevalence rate of 41% compared to all but one studies which used a one-year recall period and reported rates below 30%. More studies collecting fall data prospectively may be useful in determining fall prevalence. Advancements in technology could see sensors and computerised interactive response technology being used to record falls more accurately and prospectively.

2.6.3 Assessment

Most included studies screened for falls risk using the approach used in the general population by checking fall frequency and context in the previous year,[79] but varied questionnaires were used. This resulted in some studies omitting important details such as fear of falling, duration of HIV infection, characteristics and cause of falls. One narrative review[16] of assessment of

falls in PLWH recommended that the same assessments used in geriatrics be applied to PLWH, and incorporating HIV-related factors.

Although standardised tools were used appropriately, they were often varied. For example, whilst some studies used the Fried Score to assess frailty[13,34,64], one study used a different questionnaire.[63] Controversy also existed regarding the use of the VACS Index score, already validated for use among PLWH, to assess physical function. Common balance and gait assessment tools used in a few of the studies included the Berg Balance Scale (BBS), Functional Reach Test, Timed Up and Go test (TUGT) and 6MWD, but it remains unclear which tool is the most predictive. Some of the tests are time-consuming and tedious and may not be suitable to PLWH or to LIC settings which are commonly understaffed. Validation of specific assessments tailored to PLWH and the African context are needed.

Additionally, none of the included studies reported on assessment of osteoporosis risk as recommended in high quality clinical practice guidelines for falls-risk management.[80] This is very important for fragility fracture prevention in PLWH because of their high risk of reduced BMD, which also further predisposes them to falls.[21] Assessment of visual impairments, a significant predictor of falls in the older general population,[81] was also omitted in the included studies. Yet high prevalence of HIV-associated ocular disease have been reported in PLWH.[82]

While a falls risk assessment is individualised, there is need for clinical practice guidelines which indicate the risk factors to be assessed and which tools/scores are more predictive and more appropriate for use among PLWH. Local consensus processes may be done to agree on which measures to use for PLWH and knowledge translation strategies such as use of champion leaders, printed materials and interactive education sessions to increase use of standardised tests may be implemented.[83]

2.6.4 Risk factors

Very few studies compared whether risk factors for falls in PLWH were similar to risk factors for age and sex-matched seronegative populations. However, the trend in the available studies indicated that most risk factors for falls in PLWH were not associated with falls in SNP. More studies are needed to make a comparison of risk factors for falls in PLWH and SNP to determine risk factors unique to PLWH.

The body of evidence is consistent for most risk factors for falls in PLWH. More precise estimates of relatively higher odds ratios, ranging between two and four, indicate more

affirmative evidence for use of medications as risk factors for falls in PLWH (Fig.2.2). The burden of comorbidities including cardiovascular diseases and mental health disorders in PLWH has been well-described.[84] Multimorbidity associated with chronic pain, disability and poor health-related QoL may require that PLWH take multiple drugs. Drug-drug interactions and potential side-effects of these medications may result in further decline in physical function and falls.[85] While encouraging adherence to ART, it is important for physicians to continuously review patients' medications and avoid overprescribing.

Although the odds ratios were lower than for medications (mostly ranging between one and two), considerable overlap also existed for risk factors regarding chronic diseases such as depression, diabetes and neuropathies which have been found to be higher in this population (Fig. 2.2).[86] Sakabumi et al[87] supported the latter because PLWH with peripheral neuropathy were more susceptible to balance problems than HIV-uninfected persons.

Evidence for functional and cognitive impairments as risk factors for falls in PLWH was variable. Odds ratios from studies claiming balance impairments and frailty to be strong predictors of falls among PLWH had wide confidence interval ranges indicating low precision possibly due to small sample size (Fig. 2.2). Some studies failed to find significant association; for example, one study came to a contradictory conclusion that frailty should not be investigated as a risk factor for falls in PLWH.[70] However, this study appeared overambitious in its claims considering it had not been designed to evaluate frailty as a risk factor for falls. More studies involving larger sample sizes are needed to determine whether balance and cognitive impairments are indeed risk factors for falls in PLWH.

Although HIV serostatus was not found to be predictive of falls, risk factors unique to this population included non-adherence to ART and use of specific ART regimens such as efavirenz, didanosine and ritonavir-boosted proteases inhibitors. Controversy seems to exist regarding detectable viral load as a risk factor for falls in PLWH. One recent study[13] reported a novel finding that detectable viral load was associated with recurrent falls in women living with HIV whereas four previous studies had found no association between detectable viral loads and falls.[34,65,67,70] This raises the importance of health care providers being proficient in encouraging early diagnosis and ART adherence among PLWH. On the other hand, the risk factor of nadir CD4+ T cell count is no longer relevant since recent WHO HIV/AIDS guidelines[88] recommend that ART start at time of diagnosis.

2.6.5 Interventions

The review found that there is currently no evidence for interventions to prevent or reduce fall risk in PLWH. One study recommended that the safety and efficacy of multifactorial fall reduction interventions in PLWH be investigated.[23] Multifactorial interventions address the identified modifiable risk factors and involve a multidisciplinary approach. However new evidence suggests that these multifactorial interventions may not be effective, proposing multiple component interventions (a combination of interventions regardless of identified risk factors, most combinations involving an exercise program) as an alternative.[89]

Only one study, not included in the review, was found in which exergaming, a virtual reality based exercise program was reported to improve balance and thus reduce fear of fall and fall risk in PLWH.[29] More research to determine optimal exercise programs to promote bone health and modify fall related risk factors , thereby reducing risk of fall-related fractures is needed.

2.7 Recommendations for future research from scoping review

More studies are required on younger cohorts living with HIV in LMIC settings especially sub-Saharan Africa where most and more robust clades of HIV infection exist.

More research is needed to determine the effect of reduced BMD on risk of falls in PLWH. It has been determined that PLWH may be at higher risk of bone demineralisation[20] and falls but no studies have linked these two phenomena.

Interventions to reduce and prevent falls in PLWH is still an area lacking research. Targeted interventions should also promote bone health in order to address the risk of fall-related fractures in PLWH.

More studies reporting on data in the seronegative controls are needed to determine whether indeed falls are a problem in PLWH. It could be that the risk factors and consequences for falls in PLWH are in fact the same for the general population.

2.8 Chapter summary

The scoping review provided a comprehensive and encompassing review of emerging literature on falls in PLWH and demonstrated a scarcity of high-level evidence regarding assessment and intervention strategies for falls reduction among younger cohorts of PLWH. This provides

grounds for future high-quality research and preliminary material for further investigation by health researchers especially in sub-Saharan Africa where HIV is endemic. Future next steps include development of quality clinical practice guidelines for falls assessment and prevention in PLWH or inclusion in current HIV guidelines, implementation of knowledge-translation strategies to aid health care providers in evidence-informed practice. This will contribute to improved health outcomes and QoL for PLWH as well as reduce the burden on healthcare systems.

2.9. Declaration by the candidate

The nature and scope of my contribution to the scoping review (Chapter 2) were as follows:

Nature of contribution	Extent of contribution (%)
Conceptualisation and writing of manuscript, literature search, data extraction and analysis, evaluation of included studies, data interpretation and final editing.	75%

The following co-authors have contributed to the scoping review (Chapter 2):

Name	e-mail address	Nature of contribution	Extent of contribution (%)
Prof. Quinette Louw	qalouw@sun.ac.za	Supervisor: Conceptualisation, research inputs, editorial suggestions and proofreading.	10%
Dr Karina Berner	kberner@sun.ac.za	Co-supervisor: literature recommendations, research inputs, editorial suggestions and proofreading.	10%

Signature of candidate: **M.Y. Charumbira**

Date: **November 2019**

2.10 Declaration by co-authors

The undersigned hereby confirm that:

i. The declaration above (section 2.8) accurately reflects the nature and extent of the contributions of the candidate and the co-authors to the scoping review (chapter 2)

ii. No other co-authors contributed to the scoping review (Chapter 2) besides those specified above (section 2.8) and

iii. Potential conflicts of interest have been discussed with interested parties and necessary arrangements have been made to use material in the scoping review (Chapter 2).

Signature	Institutional affiliation	Date
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CHAPTER 3: METHODOLOGY OF QUALITATIVE STUDY

3.1 Chapter introduction

This chapter outlines the study methodology. Key aspects highlighted include the study design, setting and population, sampling procedures, data instruments, data collection, data analysis, ethical considerations, and methodological rigor.

3.2 Study design

A qualitative study was done as little was known about physiotherapists' falls prevention knowledge and practice in the primary care of PLWH in Southern Africa. Studies have identified PLWH as being at high risk of falls and resultant fractures because of reduced BMD. Qualitative research can be used to clarify unexpected or very significant connections already made in a quantitative study. This study sought to gain an additional perspective on the issue by considering what physiotherapists in Southern Africa knew about reduced BMD and falls risk in PLWH and how this affected their management thereof. Qualitative research enables researchers to draw out the thoughts and feelings of participants,[90] hence an in-depth understanding of physiotherapists' current practice was obtained.

3.2.1 Methodological Orientation and theory

The interpretive phenomenological approach (hermeneutics) which is participant-orientated and describes the meaning and significance of experiences in the participants' world was used.[91] Phenomenology and grounded theory both explore participants behaviour using interviews or focus groups, but phenomenology additionally attempts to explain *how* participants experience their world.[90] The researcher aims to listen to the 'hidden voices' of the participants and understand phenomena from the way they appear to the participants.[92] Physiotherapists were interviewed about their "lived experiences" in the care of PLWH in order to find out how knowing about bone demineralisation and falls risk affected their management of falls.[53] Because the researcher had some knowledge and expertise in falls prevention and bone health in PLWH, the researcher had the scope to try and understand the participants' experiences from their perspective.[90] This method had the advantage that the researcher could adjust to new issues and ideas as they emerged and contributed to the development of new theories.[53]

3.3 Study setting

3.3.1 Geographical regions for this study

The research was conducted in the capitals cities of four sub-Saharan African countries (Botswana, South Africa, Zimbabwe and Zambia), chosen because the researcher could conveniently access participants and was familiar with the health care systems. Botswana, South Africa and Zimbabwe are in Southern Africa while Zambia is an East African country (Figure 3.1).

Fig. 3.1 Map showing countries and capitals included in study.[93]

All four countries are low-middle income countries (LMIC).[94] Eastern and Southern Africa are worst affected by the HIV epidemic, with over 53% of PLWH globally residing in these regions in 2017.[95] The Global Burden of Diseases, Injuries and Risk Factors Study 2016 (GBD 2016) revealed observed disability-adjusted life years (DALYs) that far exceeded expected DALYs due to HIV/AIDS and was the leading cause of disease burden in all four countries.[96] Table 3.1 highlights the most recent HIV statistics according to 2016 estimates.[96,97] The Joint United Nations Programme on HIV/AIDS (UNAIDS) fast-track 90-90-90 strategy to improve diagnosis and treatment by 2020 has effectively reduced the incidence of HIV and AIDS-related mortality resulting in increased HIV prevalence.[98] For example, the most recent

estimates for South Africa show that 7.52 million people lived with HIV in 2017 (compared to 7.06 million in 2016) while the rate of change of new infections between 2007 and 2017 decreased by 5.7%.[99]

Table 3.1: Overview of HIV prevalence and disease burden according to 2016 estimates

Country	Total Population (millions)	Number of PLWH	HIV adult prevalence (15-49 years)	Adults on ART %	Ratio of observed DALYs to expected DALYs due to HIV*
Botswana (3rd highest HIV prevalence after Lesotho and Swaziland)	2.2	360 000	21.9	84	166.06
South Africa (biggest HIV epidemic in the world)	56.5	7.06M	18.9	56	287.36
Zimbabwe (6th highest HIV prevalence in the world)	13.5	1.3M	13.5	74	133.99
Zambia (7th highest HIV prevalence in the world)	16.6	1.2M	12.4	67	112.98

*DALYs- Disability adjusted life years, a measurement of health loss due to disease burden calculated as a total of years of life lost (YLL) due to premature mortality + years lived with disability (YLD). A higher observed DALYs to expected DALYs ratio indicates a greater disease burden.

The capitals of the four selected countries were chosen considering that most health professionals prefer to be employed in and surrounding urban areas,[100] thus providing a bigger sampling frame from which to select participants.

3.3.2 Physiotherapy services in study setting

Most physiotherapists in the selected countries are employed in the tertiary, secondary and urban district hospitals with fewer being employed in rural district hospitals and primary health care clinics.[101,102] Only South Africa has physiotherapists employed in a few rural district

hospitals and primary health clinics but these are mostly new graduates fulfilling mandatory community service.[102] Physiotherapy services to rural district hospitals and primary health clinics may be catered for through outreach programmes and if these are not available, patients must travel to the nearest referral hospital. Three of the four countries offer physiotherapy graduate degrees at various higher learning institutions, while Botswana does not.[103] As a result, Botswana physiotherapists are trained in high-income countries such as Ireland and Australia, where HIV/AIDS is not given clinical priority.

3.3.3 Setting of data collection

Data were collected via structured telephonic interviews. The researcher, based in Cape Town, South Africa, held interviews with each participant at a pre-appointed time that would not interrupt their practice. Both the interviewer and interviewee were in closed, quiet rooms free of disruptions. Ensuring that no one was within ear shot while the interview was being conducted, enabled the interviewee to give honest answers even if they may not have been considered socially acceptable.

3.3.3.1 Presence of non-participants

Non-participants were not allowed into the rooms of the interviewer nor interviewee whilst interviews were being conducted for privacy and confidentiality.

3.4 Study population and sampling

3.4.1 Study population

The population comprised qualified physiotherapists currently practicing in primary care facilities or hospitals in Cape Town Metropole, Gaborone, Harare and Lusaka urban districts who were frequently involved in the care of PLWH whether in in-patient and out-patient settings.

3.4.1.1 Inclusion criteria:

- Physiotherapists who were currently practising and registered with the physiotherapy profession bodies of their respective countries.
- Physiotherapists who had worked for at least two years in primary care, public facilities or hospitals where they were frequently involved in the primary care of PLWH.

3.4.1.2 Exclusion criteria:

- Physiotherapists who were working abroad and not working clinically in the countries under study.
- Physiotherapists who refused to participate.

3.4.2 Sampling Method

Purposive (also known as judgement sampling) was used to select physiotherapists who would potentially provide "information rich" responses. This approach was considered pragmatic in terms of making the most effective use of limited resources.[104] The names and contact numbers of public PHC facilities located in the cities of Cape Town Metropole, Gaborone, Harare and Lusaka were obtained from the respective Department of Health directories. The researcher randomised the list for each city using the automated function in Microsoft Excel. This ensured that each facility had an equal chance of being selected and reduced possible bias by the researcher choosing particular facilities. The facilities were contacted via telephone, starting from the top of the randomised list from each city to identify physiotherapists who met the inclusion criteria and were willing to participate in the study. This was done until the researcher had five or six participants from each city. Invitations to participate in the study were sent via e-mail in which the nature and purpose of the study was fully explained, and written consent requested (Appendix C). Participants who returned their signed consent forms were contacted to arrange for an interview within a month's timeframe. Only those who conformed to the eligibility criteria were able to participate in the study.

3.4.3 Sample Size

Purposive sampling methods place primary emphasis on data saturation by continuing to sample until no new significant information can be obtained.[104] The researcher continued to recruit participants until data saturation was achieved. It was proposed *a priori* that a maximum of 5-6 participants per country would be interviewed. This agrees with the recommended typical sample size for a phenomenological study.[53]

3.4.4 Non-participation

The number of non-participants and reasons for non-participation was documented and included in the study results (Chapter 4).

3.5 Instrumentation

3.5.1 Development of interview schedule

The content of the interview schedule (Appendix D) was informed by similar qualitative studies of rehabilitation specialists' perceptions or knowledge, attitudes and practices of falls prevention in primary care settings.[48,105] These studies were regarding falls in older adults of the general population. None were found on falls prevention in PLWH. The questions in the interview schedule were designed to address physiotherapists' care of the PLWH instead of the geriatric population. Open-ended questions were used to obtain a plethora of rich information as they allowed respondents to explain their views and feelings, and to answer in their own words. The interview questions aimed to explore participants' experiences of caring for PLWH by determining seeking a description of the presentation of their patients living with HIV: age group, functional limitations and access to ART. Participants were also asked why they thought PLWH had a higher risk of falls and bone demineralisation. Other questions were regarding their current fall prevention management. The interview schedule was developed in English since this was the official language of all four countries and physiotherapy training was given in English language.

No pilot interview was conducted. However, reflection after the initial three interviews of data collection, with the assistance of a study supervisor who was familiar with the study objectives, resulted in the addition of questions that helped probe into the participants' current falls prevention practices. These questions were applied to successive interviews. For example, questions regarding participants' experiences in fall prevention for community-dwelling PLWH were added because most participants dwelt on hospitalised PLWH only. Participants were also probed regarding their awareness of cognitive impairments in PLWH since none had proffered that information, yet it was important to determine physiotherapists' awareness of their role in mental health of PLWH. Questions were also added regarding the adequacy of their undergraduate and postgraduate training regarding fall prevention for PLWH. Even so, new issues that arose in some interviews were addressed in subsequent interviews.

3.5.1.1 Description of sample

Demographic data on participants were obtained prior to the interview as part of the vetting process. This included length of formal training on falls prevention, years of experience as physiotherapist, and area in which they were currently working.

3.6 Data collection procedure

Qualitative data were collected through semi-structured in-depth interviews carried out over speaker phone since participants were distributed over a wide geographical area. The disadvantages of conducting interviews telephonically, instead of face-to-face, included the interviewer not being able to observe the reactions of interviewees, difficulty building rapport with interviewees and the telephone costs incurred.[106] The researcher considered using Skype, which would have allowed viewing by webcam. However, this would have brought on the challenge of poor network connections, resulting in unclear communication. In fact, poor network connection remained a challenge even when using telephonic communication and was mostly overcome by getting an alternative line or repeatedly calling until a clear line was established. Semi-structured interviews were more costly and time-consuming than questionnaires, not only in carrying out the interview, but also in analysing the data collected. The advantage was that the interviewer was able to explain questions for participants to have a better understanding of what was being asked of them. The semi-structured interviews offered flexibility in being able to follow-up issues of interest raised during the discussion while maintaining consistency and standardisation of questions asked. This made it easier to compare responses obtained in different interviews. The individual nature of the interview allowed the interviewer to delve deeply into social and personal matters that the participants may not have revealed in a group setting. The interviewer was aware of the potential for introducing bias by asking leading or emotive questions that could have led interviewees into giving desired responses.

3.6.1 Interview procedures

The participants received a reminder of the interview the day before to confirm the appointment. Writing materials and interview documents were prepared ahead of time. Recording was also practiced prior to the interview.

Verbal consent to make electronic recordings of the interview was obtained from each participant before beginning the interview. The participants were also informed of a second researcher's presence during the interviews for quality assurance and additional notetaking. The interviewer followed the interview schedule. The iterative nature of the qualitative research process in which preliminary data analysis coincided with data collection resulted in amendments to the interview schedule as the researcher gained more perspective on the subject.[107] Questions that were not effective at eliciting the necessary information were

excluded and new ones developed. Furthermore, the interviewer was prepared to divert from the prepared itinerary during the interview. The digressions were very productive as they followed the interviewee's interest and knowledge.[107] The interviewer asked probing questions to obtain deeper understanding or clarification on key points raised. She avoided asking leading questions but aimed to direct the interviewees to share as much information as possible in their own words. The interview ended with interviewees being asked if they had additional comments. Issues that the researcher had not considered or was not aware were brought to her attention.

3.6.1.1 Audio Recordings

All interviews were recorded electronically. None of the interviewee declined consent for recording or requests recorder to be switched off during parts of interview. Had this occurred, the interviewer would have had to take concise notes noting the interviewee's exact words. This requires skill in being selective of key points and maintaining high levels of concentration so as not to miss out on any important information. Unique study IDs were allocated to the electronic recordings and any names of participants removed. The electronic recordings were safely stored in a password protected file on the researcher's laptop and a back-up file copied onto a hard drive kept under lock and key together with a contact summary form to contact participants who had consented to give qualitative feedback.

3.6.1.2 Notes

The interviewer took shorthand notes during the interview in which she noted key points and non-verbal cues such as tone of voice, reluctance or emphasis expressed by interviewee during discussions. A second interviewer, often a study supervisor who was familiar with the study objectives, was present during most interviews to take comparative notes and assist in noting any questions that had not been addressed during the interview. The researcher kept a reflective diary to write her thoughts down after each interview and new issues to be pursued in the following interviews. These notes were used during data analysis to gain deeper insight into the context of recorded data.

3.6.1.3 Duration

The in-depth interviews took between 20-30 minutes to complete. The researcher considered the participants' comfort and busy schedules and kept interviews as brief as possible but still allowing for in-depth responses.

3.6.2 Reflexive Analysis

Qualitative research acknowledges that each researcher brings a unique perspective to the study. Reflexive analysis was done to improve confirmability of the study by the researcher acknowledging any influence or personal biases that may have affected the results of the study.

3.6.2.1 Personal Characteristics of Interviewer

The researcher was a key instrument in the study by carrying out the interviews and may be viewed as part of the data collection tools. The interviewer's cultural background, professional experience, qualifications and personality affect the relationship built with participants; these have to be stated explicitly to allow readers to contextualise the work.[90] The researcher is a qualified physiotherapist with 9 years of clinical experience in two of the countries under study: Zimbabwe and Botswana. She had personal experience of caring for PLWH with high risk of falls and already realised the impact falls have. She had some experience of qualitative research from her Honours Degree. She expanded on her qualitative research skills by enrolling on a qualitative research short course (Atlas.ti®) at Stellenbosch University during 2018.

3.6.2.2 Relationship with Participants

The interviewer aimed to build rapport with interviewees by building trust and respect as colleagues. She communicated a willingness to learn from the participants and respected the information they shared. She acknowledged the power that the participants had on how much information they were willing to divulge and tactfully endeavoured to get the interviewees to talk in a non-threatening manner.

3.6.2.3 Participant knowledge of Interviewer

The interviewer revealed her identity as a physiotherapist through the information sheet sent to prospective participants via e-mail. She also introduced herself by name at the beginning of the interview. This enabled the participants to be comfortable in using scientific or rehabilitation terminology in their responses.

3.7 Data analysis

3.7.1 Transcription

After each interview, the interviewer completed notes taken during the discussion and were compared with notes taken by the second interviewer. Electronic recordings of interview sessions were listened to and transcribed verbatim. The way in which utterances were made in

addition to what was said offered valuable information hence a record of emphasis, speed, tone of voice, timing and pause was captured. The researcher sought the assistance of professional transcribers but also checked for accuracy. This was done by comparing transcriptions to electronic recordings several times over. The researcher followed the suggestion by Sutton & Austin[90] and transcribed five interviews herself to develop this skill as well as allow for immersion in the data. Six random transcriptions were also checked for accuracy by the two study supervisors. Transcribing is a time-consuming process; requiring at least three hours per one hour of talk and up to 10 hours per one hour of talk with a finer level of detail.[108] The researcher thus allowed enough time for transcription in her project plan.

3.7.2 Return of transcripts

Transcripts were returned to participants via electronic mail for comments and/or corrections to ensure that transcribed accounts reflected what they had said. Transcribing was an interpretive process so the transcriber may have understood the responses differently from what the participants meant. Checking by participants improved credibility.

Two participants gave clarification on missing data that resulted from unclear telephone lines. Another participant made a grammatical correction on the spelling of “Moss” to “Morse” in reference to the fall risk assessment tool used by nursing staff.

3.7.3 Derivation of themes

Inductive analysis was done by reading the transcripts several times and going underneath what the participants were saying to understand issues from their perspectives.[90] Inductive analysis is useful when existing theory or research is limited. It allows the researcher to be immersed in the data and allow themes and categories to emerge from the data.[109] Thematic analysis was a useful method for comparing the perspectives of different research participants, and generating unanticipated insights.[110] It was an iterative and reflective process and involved constant moving back and forward between phases of data collection and analysis. By continuously reflecting on the objectives of the study, relevant information was selected to create meaningful patterns. It was also important to go beyond the participants’ literal words to try and understand the meaning behind what was voiced.

3.7.4 Number of data coders

The supervisor and co-supervisor did an independent analysis of six randomly selected transcripts to identify their own themes and categories and compared with those found by the primary researcher. This checked for trustworthiness. The researcher protected the identity of the participants from these colleagues. These codes were compared, discussed and merged to create a codebook (Appendix G). Disagreements were resolved by discussion until consensus was achieved. Transcripts coding was continued by the primary researcher using the computer assisted qualitative analysis software (Atlasi.ti.8®) for Microsoft Windows.

3.7.5 Software

Common themes were established into units of meaning or codes using a computer software called Atlas.ti.8®. Using Atlas.ti.8® saved time and made the procedure more systematic.

3.7.6 Description of code tree

The narratives from the interviews were read repeatedly so that the researcher familiarised herself with the breadth and depth of the content. Theoretical and reflective thoughts that developed through immersion in the data were documented.[110] The researcher's reflective diary was also consulted during coding for information which provided deeper insight and context to the data such as participants sounds, laughter or hesitation. Thematic analysis was done using interpretive content analysis procedures for theme development, care being taken not to overlook seemingly minor or non-common issues. Categories were defined for each code, into which data could be easily assigned. The researcher was rigorous in ensuring that data was assigned to the appropriate code and category although some data could fall under more than one category. This required objectivity and neutrality on the part of the researcher. Atlas.ti® automatically highlighted prominently coded data. Comparisons and conclusions based on the information from the coding frames were made. The meanings of the various themes in the context of study aims were also discussed with the supervisor and co-supervisor.

In following the interpretive paradigm, the researcher used the perceptions and experiences of the participants to construct and interpret her own understanding from the gathered data.[111] Connections between themes were used to understand physiotherapists' awareness of bone demineralisation and falls risk management in caring for PLWH.

3.7.7 Quality assurance

Trustworthiness was established by checking for credibility, transferability, dependability and confirmability in the following ways:

3.7.7.1. Credibility

Data collection triangulation was done by comparing electronic recordings, transcribed data and interviewer's notes. Peer debriefing was done regularly with supervisors and other postgraduate students to get feedback on the research process. Member checking in which participants were contacted to provide feedback on the data and its interpretation was also done to ensure credibility. The researcher also compared her findings to comparable studies with similar aims as identified in her scoping review.

3.7.7.2 Transferability

This refers to the generalisability of the findings should they be applied to other contexts or general populations. The researcher provided thick descriptions by including participants' quotations and subjective explanations in reporting the findings (Chapter 4) so that those who seek to transfer the findings can judge transferability for themselves.[110]

3.7.7.3. Dependability

The researcher ensured regular discussions between herself and her supervisors, who conducted an audit trail to assess consistency between data presented and the findings. The supervisors ensured they were able to follow the researcher's decision trail and arrive at comparable and not contradictory conclusions.[110] The researcher provided electronic recordings, transcripts and a reflexive journal to aid them in the audit process. A reflexive journal or diary was used to keep record of daily activities concerning research, decisions influencing how the study was carried out and personal reflections of values, interest and insights.

3.7.7.4 Confirmability

This checks whether the researcher's interpretations and findings were derived from the experiences and perspectives of the informants, rather than the preferences of the researcher. The researcher's biases were minimised by using open questions during the interview and reporting on a wide range of perspectives. The research process and findings were regularly discussed with the supervisors and an audit trail process carried out.

3.8 Reporting

The researcher followed the criteria included in Consolidated Criteria for Reporting Qualitative Research (COREQ), a 32-item check-list, to report important aspects of the research process, study methods, findings, analysis and interpretations.[112] Participant quotations were used to illustrate the findings and identified each quotation with a participant number.

3.9 Ethical considerations

3.9.1 Clearance and permission to conduct study

Ethical approval for the study was granted by the Health Research Ethics Committee (HREC) at Stellenbosch University (Reference Number: S18/07/137) (Appendix E). Permissions were also granted from the respective physiotherapy or health research regulatory bodies including Botswana Ministry of Health and Child Wellness (HPDME13/18/1), Western Cape Department of Health through the National Health Research Database (NHRD), (WC_201809_034), University of Zambia Health Research Ethics Committee (ID:20181204086) and the Medical Rehabilitation Practitioners Council of Zimbabwe (Appendix F).

3.9.2 Informed consent and autonomy

Selected physiotherapists were sent invitations via e-mail to participate in the study. The e-mail contained a participant information page and the informed consent pages. The participant information page explained the purpose and procedures of the study. It also indicated that participation was entirely voluntary and informed them of their right to withdraw from the study at any time without penalty. The contact details of the principal investigator and the HREC were given should participants have had any queries regarding the study or questionnaire. Only the physiotherapists who returned signed informed consents were contacted to arrange for structured interviews. The participants received their personal copy of signed informed consent document. Separate verbal consent was also sought to allow electronic recording of interviews. The participant could request that some of the information not be used.

3.9.3 Confidentiality

Privacy and confidentiality were ensured throughout the study. Interviews were carried out in a private locked room in which non-participant were not allowed to enter while interviews are proceeding. Transcribed data were codified and contained no personal particulars. All

electronic recordings were kept in a password secured folder and only listened to in private by researchers. These will be immediately destroyed after attainment of degree qualification.

3.9.4 Beneficence

Following the principle of beneficence, participants were made aware that they may have access to findings of the study on request. This will aid in improving their practice and care of patients as the study referred to evidence-based guidelines. Participants also received a R200 voucher as incentive to participate in the study.

3.9.5 Non-maleficence

No foreseeable direct/indirect risk were expected as a result of the study. However, the researcher was prepared to refer participants for psychological support should the interview have created undue stress or raise psychological complications. The power relationship between the interviewer and interviewee was always respected. A willingness to learn from the participant was expressed. No demotions or loss of employment occurred as a result of information divulged.

3.10 Chapter summary

A phenomenological study design was done using a qualitative research method. Semi-structured interviews were performed with 21 purposively sampled physiotherapists who were frequently involved in the care of PLWH for at least two years in four Southern African countries. The interviewer adhered to ethical principles including informed consent, autonomy and confidentiality. Rigor was achieved through data saturation, member checking and audit trail. The results of the study are reported in Chapter 4.

CHAPTER 4: RESULTS OF QUALITATIVE STUDY

The study aimed to explore physiotherapists' awareness of falls and bone demineralisation in PLWH and their perceptions about their current fall prevention practices. This chapter aims to present a thick description of the participants responses during the in-depth interviews.

4.1 Sample characteristics

A total of 30 physiotherapists were invited to participate in this study. Seven physiotherapists declined to participate due to fear of not being able to provide enough information regarding the subject while one declined due to lack of time. Two physiotherapists who had given consent to participate could not be contacted on the scheduled appointments despite follow-up.

A total of 21 interviews were conducted over a period of seven months. Data saturation was achieved when only variations on themes already identified were being expressed without new ideas or themes emerging. The researcher did not have to recruit more participants because enough information was obtained to identify core elements of the investigated phenomenon.

Table 4.1 provides an outline of the participants' sociodemographic descriptions. The majority (81%) of participants were female physiotherapists and most (62%) worked in general or referral hospitals (secondary and tertiary level) where they saw both out-patients and in-patients from an allocated ward. One physiotherapist (5%) worked at a primary health care clinic which served in an out-patient setting. The average years of experience in caring for PLWH was 8.9 years ranging from 3 years to 19 years.

Table 4.1 Summary of participants' characteristics

Variable		Number (n=21)	Percentage (%)
Gender	Male	4	19
	Female	17	81
Work setting	General or Referral Hospital	13	62
	District Hospital	6	29
	Military Hospital	1	5
	Primary Health Clinic	1	5
Cities (Countries)	Gaborone (Botswana)	6	29
	Cape Town Metropole (South Africa)	4	19
	Lusaka (Zambia)	6	29
	Harare (Zimbabwe)	5	24
Professional Qualification	BSc. Physiotherapy	17	81
	MSc. Physiotherapy	4	19
Age in years (mean±SD; IQR)		33.76±4.22; 26-43	
Years of professional experience (mean±SD; IQR)		9.67±4.22; 3-19	
Years of caring for PLWH (mean±SD; IQR)		8.90±4.34; 3-19	

4.2 Main findings: Participation-derived themes

Inductive coding using Atlas.ti® resulted in 51 initial codes being identified (see codebook in Appendix G). These were reduced to 22 categories and arranged into 4 themes (Table 4.2). The four themes emerging from the data included:

- Inadequate awareness of falls risk and bone demineralisation
- Physiotherapists inadequately equipped regarding falls prevention in PLWH

- Health care system deficiencies
- Opportunities for change

These themes and categories are discussed below, followed directly by the most representative verbatim supporting quotes.

Table 4.2: Themes and categories identified from interviews

Themes	Categories
Inadequate awareness of falls risk and bone demineralisation in PLWH	• Physiotherapists' (un)awareness of falls risk in PLWH • Physiotherapists' (un)awareness of bone demineralisation in PLWH • MDT's (un)awareness of falls risk in PLWH • Physiotherapists sometimes not aware of PLWH's serostatus
Physiotherapists inadequately equipped with knowledge and skills for fall prevention in PLWH	• Inadequate undergraduate training • (No) screening/assessment tools available • (No) clinical practice guidelines available • (No) routine assessment of falls risk done by physiotherapists • No primary falls prevention strategies • Inadequate referral to MDT by physiotherapists
Health care system deficiencies	• Unclear role descriptions for falls risk prevention • Fragmented delivery of care • Inaccessible/No facilities for BMD measurement • Shortage/Inaccessible assistive devices • Inadequate professional development opportunities • Inefficient data capturing systems

	• Lack of community re-integration programs
Opportunities for change	• Equal professional development opportunities for physiotherapists • Development of fall risk management guidelines • Education of MDT • Revision of undergraduate curriculum • Community awareness

Abbreviations: BMD- bone mineral density; MDT- multidisciplinary team

4.2.1 Theme 1: Inadequate awareness of falls risk and bone demineralisation in PLWH

This theme describes physiotherapists' and other health professionals' poor awareness of falls risk and bone demineralisation in PLWH. Most participants communicated a lack of awareness regarding why PLWH could possibly have a high risk of falls. They were not aware of the effect that ART or HIV infection itself could have on bone.

4.2.1.1. Physiotherapists' (un)awareness of falls risk in PLWH

Most physiotherapists expressed that they were not aware of the potentially inherent falls risk that could be present in PLWH.

'Mm… Aah… let's see HIV, why they would be at risk of falling? It would mean that maybe their balance is affected, cognition is affected, maybe their bones and muscles are weak (laughs)… I'm not sure why they would be susceptible to falling really.' Participant 1, female, 31 years, Botswana, military hospital.

'It's difficult for me to explain that question directly…but specifically to say that this person is HIV positive hence they have this risk of falls, I haven't really observed that.' Participant 14, female, 43 years, Zambia, referral hospital.

i. Falls associated with older adults of general population

Most participants recognised falls as a geriatric condition that is not particularly characteristic in PLWH.

'I haven't had anyone who falls because of HIV…I mostly assess falls for old people.' Participant 16, male, 34 years, Zambia, referral hospital.

'…because mostly when we are talking about falls, we are talking about it in the elderly…but never have you ever heard an emphasis being put on falls with people living with HIV.' Participant 21, female, 30 years, Zimbabwe, referral hospital.

ii. Physiotherapists have not been on the lookout for falls in PLWH

A few physiotherapists revealed that they had never thought of assessing falls in PLWH but still expressed some level of uncertainty towards these phenomena being evident in PLWH.

'It is something that I have not really looked into that I have never really thought about. It is something that I would need to really look into and see whether it is actually a significant thing.' Participant 3, female, 42 years, Botswana, referral hospital.

'…it is something that maybe probably I overlook or we as a profession we overlook…' Participant 21, female, 30 years, Zimbabwe, referral hospital.

In retrospect, some who had not been initially aware of falls and bone loss in PLWH were able to conclude that falls and accelerated bone loss could be a problem in PLWH.

'I only realised after you sent me the document and I went through and then it only clicked, and it sort of made perfect sense.' Participant 5, female, 31 years, Botswana, district hospital.

iii. Minority of physiotherapists aware of falls occurring in PLWH

However, less than a third (n = 6) of the physiotherapists, mostly from Botswana and South Africa, did recognise the problem of falls and fear of falling in PLWH. Falls were observed both in community dwelling PLWH as well as those who were hospitalised, with variable fall rates ranging from 5% – 60%.

'I had about 5-10% of my patients coming in as poly, as neuropathies related to HIV so yes they would have history of falls, they would have, actually one of the reasons why they had to

come in is because they had a fall…' Participant 6, female, 30 years, Botswana, referral hospital.

'…a lot of them do have problems of falling… Some even have, we'd we get falls reports straight from the ward…where the patient was not identified as a risk of falls and now they feel all strong and ready to walk and they get out of bed and now they fall…'I'd say it's a huge percentage, huge percentage probably 4 out of 10 patients.' Participant 5, female, 31 years, Botswana, district hospital.

'Yes, (falls) is also a problem that is not uncommon… so I will say, maybe fifty to sixty percent (of PLWH)'. Participant 9, female, 32 years, South Africa, district hospital.

iv. Some physiotherapists aware of risk factors for falls in PLWH

A few physiotherapists were aware of the risk factors for falls in PLWH, mostly attributing it to balance impairments (due to impaired sensation and loss of proprioception), frailty, muscle wasting, dizziness, non-adherence to ART and comorbidities such as depression, tuberculosis, cerebral meningitis, stroke, hypertension, Kaposi Sarcoma and peripheral neuropathy.

'I think that, as I've said, the ones that I have seen, their falls have been associated with peripheral neuropathy, impairment of balance and complications of stroke.' Participant 11, male, 27 years, Zambia, general hospital.

'There might be a risk there because when we were talking about HIV especially if they have any other co-morbidities then yes their treatment failure, then they are bedridden they have no muscle strength, paraesthesia, I think that predisposes them to falls quite a bit.' Participant 21, female, 30 years, Zimbabwe, referral hospital.

v. Few physiotherapists awareness of the consequences of falls

Two of the 21 physiotherapists were aware of the negative impact of falls on the lives of PLWH. They mentioned consequences such as fear of falling and fall-related fragility fractures.

'…a lot of them have this fear of falling...We have had I think patients who often say that they have had falls at home and if they had had a previous fall then they are generally more afraid that it will happen again.' Participant 7, female, 37 years, South Africa, district hospital.

'I have had a few who have come (with history of falls)…then you would find they either trip easily around the house or they fall and then where you least expect them to have a fracture or bone injuries and then you would find they'd sustain that compared to the normal population that would probably walk away from such a fall with no major injuries.' Participant 17, female, 37 years, Zimbabwe, referral hospital.

4.2.1.3 Physiotherapists' (un)awareness of bone demineralisation in PLWH

Most physiotherapists were also not aware of the effect of HIV infection or ARVs on increased risk of bone demineralisation in PLWH. They were aware of other side effects of ART such as lethargy, paraesthesia and myalgia but not accelerated bone loss.

'Yes some of my patients have presented with just general complaints after starting ARV's maybe, ja they are feeling tired they are feeling weak and also like general joint pain or body pains as well ja, but I can't say generally it is with the bones I think it is just with the general, maybe I think sometimes it is muscular. I can't say that it has been on their bones no.' Participant 8, female, 34 years, South Africa, primary health clinic.

'I don't have enough understanding on that aspect. I only know that ART can have an effect on the nerves… On the nerves, yes, I know, but on the bones, I am not so much sure.' Participant 11, male, 27 years, Zambia, general hospital.

Some felt that it would require a bit of research to compare the differences in BMD of PLWH and seronegative patients, something they do not have the time nor facilities to commit to.

'…when it comes to bone density and that I can't lie we haven't taken the time to check their bone density and compare the difference in them…' Participant 14, female, 43 years, Zambia, referral hospital.

However, three participants supported the fact that ARVs or HIV infection itself can have a negative impact on BMD, having observed osteoporotic bones on X-rays of PLWH. A few cases of pathological fractures in PLWH were also reported.

'I think they do have a negative effect because I have seen most of the changes that we see in our patients especially if they have been on ARVs for a long time, they end up with osteoporotic

bones…but they are abiding to their ARV treatment, so I am thinking it is the ARVs that are actually affecting them, not the disease…they do present like on x-rays to have…osteoporotic bones, so they are at risk.' Participant 3, female, 42 years, Botswana, referral hospital.

'Yes, I do remember especially the one with the hip... so she came presenting with a lot of hip pain. On taking the X-ray, the doctors realised that she had pathological fracture of the neck of femur and then other bone weakening in that particular femur as well and they did a bit more scans and realised she had a lot of other fractures in the ribs...' Participant 20, female, 38 years, Zimbabwe, referral hospital.

Some participants attributed bone loss in PLWH to effects of prolonged bed rest rather than effects of ART or HIV infection itself.

'The patients that are bed- ridden for a long time, maybe they are tetraplegic or paraplegic, you'll find there is loss of minerals in bones and after a long time in some cases, not vey commonly, you'll find the patients getting pathological fractures here and there, but being related to their HIV status, I have not done any extra input or research in that regard.' Participant 14, female, 43 years, Zambia, referral hospital

4.2.1.4 Multidisciplinary team's unawareness of falls risk in PLWH

Many physiotherapists noted that members of the MDT did not recognise the problem. Doctors were singled out for not referring PLWH adequately for physiotherapy management of falls. The doctors reportedly referred patients to physiotherapy for management of mobility problems without giving clear indication of falls as a problem because, allegedly, they wouldn't have screened for falls. The physiotherapists would recognise the patients' risk of falls during their generic assessment.

'Oh (pause), you know what is happening. I think they do, I don't know if they refer because the person has a mobility problem or it's because of risk but sometimes they do refer to us for neuro, neurorehabilitation or for mobility so I don't if it's because of they have a risk of falling because it's not like they could have done a risk assessment you get… It's just that it doesn't come out clearly…that… it's a patient with risk of fall.' Participant 2, female, 33 years, Botswana, district hospital.

'I don't think we would ever get referral from a doctor saying that please assist this patient with mobilisation because he is high risk of falling. That very rarely happens, I am going to go with one percent of referrals.' Participant 7, female, 37 years, South Africa, district hospital.

'Not really as falls being the problem no. They have been sent to us with other conditions. Maybe falls comes in as you are assessing them and everything, but not basically being sent for falls no.' Participant 15, female, 33 years, Zambia, referral hospital.

However, the nurses were significantly more aware of the problems of falls in hospitalised patients because they were the ones who screened for falls in all patients prior to admission and spent more time with the in-patients.

'…I haven't really had any experience of the doctors coming to me and saying that this patient is at risk of falling, but definitely from nursing they can identify because they do spend a lot more time with the patients.' Participant 10, female, 26 years, South Africa, district hospital.

4.2.1.5 Physiotherapists not aware of PLWH's serostatus

A few physiotherapists shared that patients were sometimes unaware of their HIV status because of not routinely testing for HIV. Therefore, the physiotherapists would not always associate presenting comorbidities and impairments with HIV or ART during assessment.

'Unfortunately, there is still an issue with people coming forward only when they are presenting as sick so they would find out at the same time as finding out…all those other conditions that's when they would also find out that they are actually HIV positive. We still have a big problem with people coming in late for medical diagnosis.' Participant 6, female, 30 years, Botswana, referral hospital.

Sometimes patients who were aware of their seropositive status did not reveal it to their physiotherapists, especially when the therapist did not inquire about it.

'…we treat people who are open about their status and there are patients who are not open about their status.' Participant 13, male, 34 years, Zambia, referral hospital.

'My experience for treating people with HIV is like I would be treating other conditions not really HIV…so at times I wouldn't like really ask how long the patient has been living with

HIV it is something that I just know in the background and not really enquire about.' Participant 18, female, 35 years, Zimbabwe, referral hospital.

4.2.2 Theme 2: Physiotherapists' inadequately equipped with knowledge and skills in fall prevention in PLWH

Most physiotherapists reported that they did not feel well equipped with the knowledge nor the skills required to effectively screen for or prevent falls in PLWH. They reported on the following factors.

4.2.2.1 Inadequate undergraduate training

Most participants reported that the physiotherapist's role in the care of PLWH was not adequately covered in their undergraduate course curricula. As a result, skills such as falls risk prevention and improving bone health in PLWH were not imparted to them.

'...we focused more on the pathology of it and then the functional part was basically about mobilising the patient because the patient is weak you know what I mean, but not going into depth… so I think it was… just patching the surface and not going into more detail about what the effect of HIV can be on a patient.' Participant 7, female, 37 years, South Africa, district hospital.

'I don't recall very clearly going into the details of it…I have seen there has been quite a few articles on the research of HIV management in the physiotherapy field, but I cannot recall touching on it so in-depth as an undergraduate.' Participant 9, female, 32 years, South Africa, district hospital.

Of note were participants from Botswana who received training in high-income countries such as Australia and Ireland where HIV was not endemic. Very little focus was given on rehabilitation in HIV care during their pre-licensure training. They were obligated to learn about their role in HIV care upon returning to their country of origin.

'At my training? We did one page of HIV training. I studied at Australia; they didn't tell much on HIV. It was my first time seeing it when I started working in Botswana, so I just learnt

through experience and asking colleagues.' Participant 4, female, 37 years, Botswana, district hospital.

'I did my training in Ireland, Dublin and HIV was like a very small section. We didn't really pay much attention on HIV and mostly my training was more into pathology…' Participant 5, female, 31 years, Botswana, district hospital.

4.2.2.2 No screening/assessment tools available

Most physiotherapists reported not having any rehabilitation-specific generic falls assessment tools available in their facilities to guide them in their provision of care to any patient, let alone tools specific to PLWH. It was left to individuals' discretion to decide which tool to use for assessment of falls in PLWH. However, the nurses were reported to have screening tools for fall risk.

'Usually it's not us who do the screening. It's usually done in the wards by the nurses but we don't have anything in place to use to assess risk of falls but there should be. There are a couple of tools that could be put in place but currently we are not using anything… Actually, there is nothing in my department so it's up to an individual to look for what works best for them.' Participant 5, female, 31 years, Botswana, district hospital.

'I will be honest and just say that we don't use a specific outcome measure tool…where you can calculate, you know, in an objective manner their risk of falling but I think the nursing management they have a specific form which they use.' Participant 9, female, 32 years, South Africa, district hospital.

The Berg Balance Scale was the most commonly mentioned outcome measure used for assessment of balance, which the physiotherapists carried out as part of their generic assessment without specifically assessing for falls.

'The only thing that I use is a Berg balance scale, that's the only tool that I use to assess for that.' Participant 1, female, 31 years, Botswana, military hospital.

'To be very honest...I know there are tools, but I have not used them but for a quick assessment I would say I would look at their balance and sit-to-stand, balance especially dynamic without specifically using a tool.' Participant 20, female, 38 years, Zimbabwe, referral hospital.

4.2.2.3 No clinical practice guidelines available

The majority of the physiotherapists reported that they did not have any physiotherapy-specific clinical practice guidelines regarding care of PLWH or falls management for any patient (which would include PLWH).

'...hela (but) for us as a department, we do not have any guidelines on falls management yeah.' Participant 2, female, 33 years, Botswana, district hospital.

'...there is no specific policy to say physiotherapy but there is a general guideline on the management of HIV. But not something which is strictly let's say where we can start, let me just look at this referring to my profession alone, no.' Participant 12, male, 30 years, Zambia, general hospital.

Two physiotherapists from Botswana reported having Standard Operating Procedures (SOP) in place to reduce the risk of falls in the hospital. Some hospitals in Botswana were undergoing accreditation and reportedly had functioning risk committees that oversaw the development of hospital risk reduction policies including prevention of falls within the hospital. These policies were not specific to physiotherapists so departmental guidelines were generated from the hospital guidelines. However, these were not validated for use among PLWH.

'Yes. Recently actually with the hospital trying to embark on COHSASA (Council for Health Services Accreditation of Southern Africa) accreditation we have developed an SOP…and as a risk management committee, under the risk management committee of the hospital they have a guideline (which) outlines everything from prevention of falls, management of falls, and before a fall…and after a fall has happened and evaluation of falls, measures in place that need to be put around to curb the risk of falls in the hospital, so we do have a guideline.' Participant 6, female, 30 years, Botswana, referral hospital.

'The hospital developed some SOPs on falls management, so we use the hospital guidelines…' Participant 3, female, 42 years, Botswana, referral hospital.

4.2.2.3 No routine assessment of falls risk done by physiotherapists

Because they were not aware that PLWH had a high risk of falls or bone demineralisation most participants did not routinely assess for falls risk in this population. They prioritised other conditions that PLWH presented with for physiotherapy management.

'No. The patients that I have seen, we specifically don't look for that. You'll find there are maybe other factors.' Participant 14, female, 43 years, Zambia, referral hospital.

The physiotherapists were not carrying out multifactorial risk assessments, especially in patients who have not presented with complaints of falls, even though they were able to identify patients with balance impairments during traditional assessments. Very few physiotherapists subjectively asked about falls history in PLWH.

'Oh we haven't been, I haven't been doing that much, you know assessing the risk of fall, really unless if it's in the elderly patients, perhaps at the end of neuro rehabilitation just as a screen to see if this patient needs more rehabilitation or not, but in general we don't really assess so much of the risk factors.' Participant 2, female, 33 years, Botswana, district hospital.

'No, I haven't been focusing on that...I only focus on the falls when I am treating them. We do the generals and then you want to prevent the falls because you know they might fall when you are treating them but not subjectively as asking the person whether the person has been having falls before or something happened.' Participant 21, female, 30 years, Zimbabwe, referral hospital.

One physiotherapist expressed concern regarding the high workload that would result if she did her own routine assessment and preferred to only assess fall risk in patients who had been referred by the doctors.

'...we don't screen our patients in the ward because then literally every single patient in the hospital would get some form of physiotherapy and then we are looking at four hundred patients getting physio on a daily basis which we do not have the capacity to do, so unfortunately we do work on a purely doctor referral basis and then from there we will do an assessment and then obviously do a full subjective history and objective history which would, which would be our way of finding out what their falling history would be.' Participant 7, female, 37 years, South Africa, district hospital.

Some physiotherapists reported indirectly assessing for falls during traditional subjective history and objective assessment of balance and gait.

'From a subjective history that you get from the patient and from objective assessment, maybe assess the balance, the gait of the patients, assess the patients whilst they are walking.' Participant 18, female, 35 years, Zimbabwe, referral hospital.

'There is objective assessment. Then falls usually falls on the functional part. That is where we have this specific information which talks about what are they using for movement, do they have any problems in movement, how do they move and all that.' Participant 15, female, 33 years, Zambia, referral hospital.

One participant working at a Zimbabwean referral hospital reported not being able to carry out environmental hazard/home assessments for patients.

'…we don't have that facility where we are able to do home assessments in person.' Participant 19, female, 35 years, Zimbabwe, referral hospital.

4.2.2.4 Inadequate primary falls prevention strategies

Most participants reported that they did not have any primary prevention strategies but focused more on secondary prevention for patients who have already experienced falls.

'I don't think we have anything in place for falls prevention. I think we only start treatment when we find that someone is been falling a lot.' Participant 4, female, 37 years, Botswana, district hospital.

'To be honest we only focus on the fracture most of the time ja. But on the prevention of falls…it is rare to look at that aspect...' Participant 11, male, 27 years, Zambia, general hospital.

Common secondary prevention strategies employed in their current management of falls in PLWH included balance retraining, muscle strengthening, recommending and training use of assistive devices. (Figure 4.1).

Fig. 4.1 Word cloud showing participants' current management for falls in PLWH

Examples of management strategies are highlighted in the quotes below.

'We would identify what contributed to falls. Most of them, some we'll give walking aids and do the proprioception training, balance training and muscle strengthening…' Participant 4, female, 37 years, Botswana, district hospital.

'I have to recommend for assistive devices after determining what, what causes the fall.' Participant 13, male, 34 years, Zambia, referral hospital.

4.2.2.5 (Inadequate) referral to multidisciplinary team by physiotherapists

Some physiotherapists were aware of the need to involve the MDT in their management of falls risk. MDT members mentioned included dieticians, ophthalmologists, psychologists, social workers and occupational therapists. However, two participants did not see the relevance of referring to other health care professionals once the patient had been referred to them.

'From what I recall we would be the end point…' Participant 17, female, 37 years, Zimbabwe, referral hospital.

'Inasmuch as I know people refer these patients to me so that I prevent the falls. I get referrals and then I address the issue. I don't refer to anyone else cause they would have been passed onto me.' Participant 20, female, 38 years, Zimbabwe, referral hospital.

4.2.3 Theme 3: Health care system deficiencies

Participants' accounts revealed factors that may indicate deficiencies in the quality, efficiency and equity of the health care system that affected their management of falls risk and bone demineralisation in PLWH. Figure 4.2 shows how some of the quotations align with the WHO health care system framework.[113]

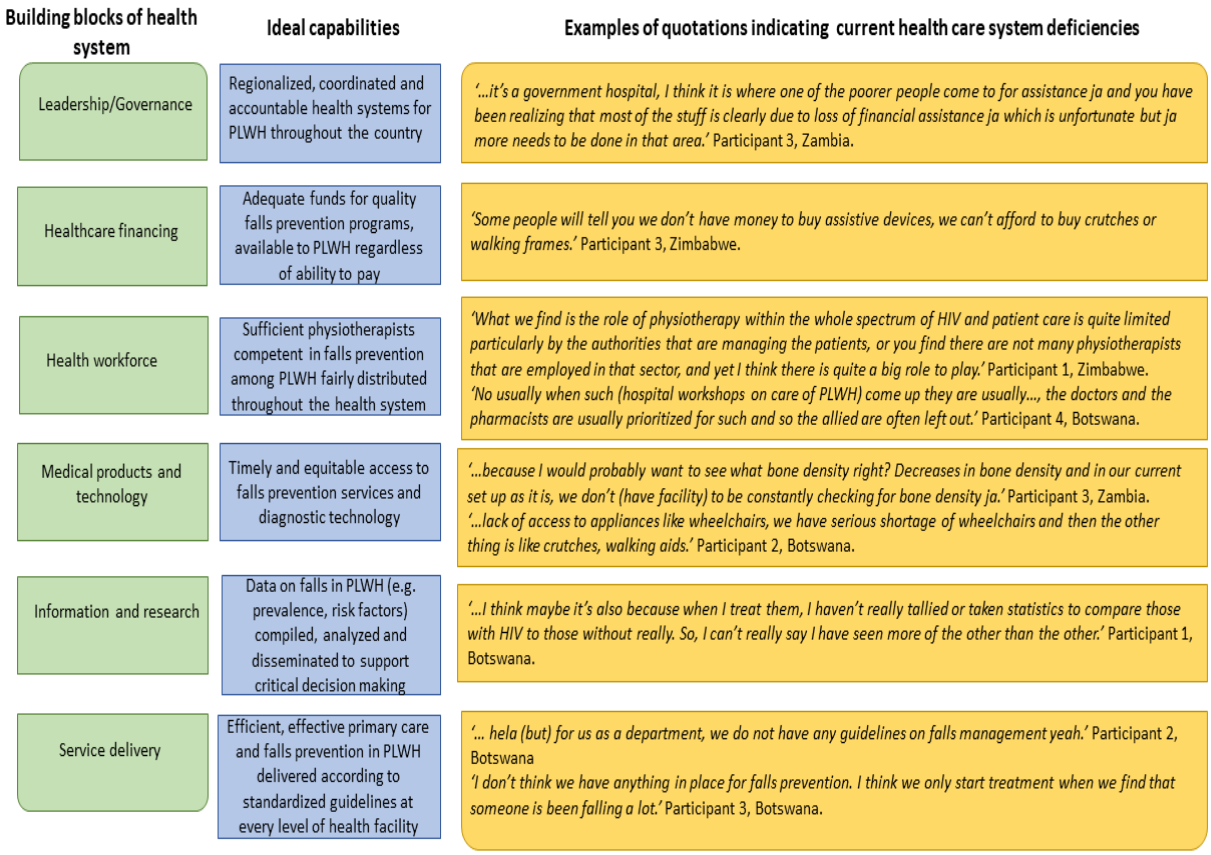

Fig. 4.2 Examples of quotations highlighting health system deficiencies (Adapted from WHO health Systems Framework).

4.2.3.1 Unclear role descriptions for falls risk prevention

One participant pointed out the lack of clear-cut role descriptions for involvement of physiotherapists in the care of PLWH. The physiotherapists complained of being side-lined in the care of PLWH.

'What we find is the role of physiotherapy within the whole spectrum of HIV and patient care is quite limited particularly by the authorities that are managing the patients, or you find there are not many physiotherapists that are employed in that sector, and yet I think there is quite a big role to play.' Participant 17, female, 37 years, Zimbabwe, referral hospital.

4.2.3.2 Fragmented service delivery

Concerns were also raised regarding the referral system between members of the MDT that could contribute to reducing falls risk in PLWH. The doctors remained the gatekeepers to the patients. The nurses could not refer to other members of the MDT even though they were mandated to identify patients at risk of falls.

'In our hospital the nurses are not allowed to refer to the allied health…but I am sure that the nurses do pick up the concern…they can verbally raise the concern with us and then we will advise them to speak to the doctor who will then refer the patients to us.' Participant 9, female, 32 years, South Africa, district hospital.

Some of the specialist services were not available at their hospitals or clinics for physiotherapists to refer patients to.

'…we refer to social workers because we don't…have a readily accessible psychology, psychological clinic so social work it's one way to get them to get counselling psychological intervention...' Participant 2, female, 33 years, Botswana, district hospital.

The doctors reportedly discharged patients before they had achieved sufficient mobility status and are at high risk of falls.

'…in the ward that I am working in, I am looking at just the sickness pneumonia so I'm just doing my chest physio and things like that. And as soon as the person is cleared medically and stable, they should get discharged whether they are able to walk or not. More or less that is what the hospital does.' Participant 19, female, 35 years, Zimbabwe, referral hospital.

4.2.3.3 Inaccessible/No facilities for BMD measurement

Absence of dual energy x-ray absorptiometry (DXA), considered the gold standard for measurement of BMD, was reported as a deterrent to physiotherapists' ability to assess the risk of bone demineralisation in their patients. Most reported using X-rays as their main diagnostic tool for osteoporosis with limited use of computer topography due to its high cost.

'Really, I can't tell about that one because like we are here; there is not so much of a well-established service that screen their bone, the health of their bone…so we don't have that

system that is in place but so it is difficult for me to really answer that one.' Participant 2, female, 33 years, Botswana, district hospital.

'…we normally use x-rays… CT scans are rarely done… unless it is a special case.' Participant 11, male, 27 years, Zambia, general hospital.

'…because I would probably want to see what bone density right? Decreases in bone density and in our current set up as it is, we don't (have facility) to be constantly checking for bone density ja.' Participant 13, male, 34 years, Zambia, referral hospital.

4.2.3.4 Shortage/Inaccessible assistive devices

Shortage of assistive devices at the hospitals or primary care facilities presented a challenge in falls risk reduction. In some cases, the patients could not afford to buy the prescribed assistive devices.

'…lack of access to appliances like wheelchairs, we have serious shortage of wheelchairs and then the other thing is like crutches, walking aids.' Participant 2, female, 33 years, Botswana, district hospital.

'Some people will tell you we don't have money to buy assistive devices, we can't afford to buy crutches or walking frames.' Participant 19, female, 35 years, Zimbabwe, referral hospital.

4.2.3.5 Inadequate professional development for physiotherapists

Unequal opportunities for professional training was reported. Most health facilities prioritised the training of medical doctors in the provision of care to PLWH. Limited opportunity existed for physiotherapists professional training or workshops.

'Personally, I haven't gone to any of those workshops specifically, but I know that they are running., It's mostly for medical doctors… it's one of the training that I have been trying to get onto for a very long time.' Participant 6, female, 30 years, Botswana, referral hospital.

'Apparently here in Zimbabwe, maybe that is where this overlooking thing comes up because really when they do their HIV workshop, they don't incorporate rehab staff or the physios. Participant 21, female, 30 years, Zimbabwe, referral hospital.

In her 12 years of experience, one participant also expressed not having opportunities for professional training on falls prevention or care of PLWH.

'No not that I can recall. No, I mean I am sure someone else might answer yes but from my personal experience no I don't, I don't recall having many of those opportunities no.' Participant 7, female, 37 years, South Africa, district hospital.

4.2.3.6 Inefficient data capturing systems

Inefficient capturing of statistics also prevented physiotherapists from being able to notice trends among PLWH.

'...I think maybe it's also because when I treat them, I haven't really tallied or taken statistics to compare those with HIV to those without really. So, I can't really say I have seen more of the other than the other.' Participant 1, female, 31 years, Botswana, military hospital.

4.2.3.7 Lack of community re-integration programs

Another deficiency in the health care delivery system is failure to ensure community reintegration of patients and ensuring social and financial support. This negatively impacted on the quality of care that the physiotherapists provided to PLWH.

'The other issue it's families, like support from their homes, some lack support from home… Like those with potential to regain mobility they need social support, of which they don't get, so they end up bed-ridden and stuff like that so those are the some of the factors that even limits or worsens their lack of mobility.' Participant 2, female, 33 years, Botswana, district hospital.

'...it's a government hospital, I think it is where one of the poorer people come to for assistance ja and you have been realising that most of the stuff is clearly due to loss of financial assistance...' Participant 13, male, 34 years, Zambia, referral hospital.

4.2.4 Theme 4: Opportunities for change

This theme described the several recommendations to improve falls risk awareness among physiotherapists as well as better equip physiotherapists in falls risk prevention.

4.2.4.1 Equal opportunities for physiotherapists' professional development

All the participants recognised the need to take heed of the emerging and potentially serious problem of falls and bone demineralisation in PLWH. Participants suggested more training workshops and continuous professional development courses to raise awareness among physiotherapists in this area.

'…it is something that we really have to like take note of, be aware of like when we do our assessments it is something that I really need to improve on myself…We really have a great role to play in people with HIV/AIDS to reduce the falls.' Participant 18, female, 35 years, Zimbabwe, referral hospital.

'Yes, there if there could be more workshops and teaching about how to take care of these people because like you said about bone density, it never touched my mind to read about bones and bone density and all those, but this time I will just have to go in detail and learn about it… I haven't… paid more attention to that and because no patients have been sent specifically or I haven't assessed patients specifically for falls...' Participant 15, female, 33 years, Zambia, referral hospital.

Most physiotherapists expressed a keen interest in the best evidence regarding the most appropriate assessment tools for falls risk assessment in PLWH.

'…if there is a tool that could be used I would love it if you could share it with us such that we could use it in parts of our practice when we are assessing patients who we think could possibly meet that criteria or patients who have got a history of many falls, …' Participant 7 , female, 37 years, South Africa, primary district hospital.

'…since I haven't been using a specific tool to assess the risk, but I feel there is a need for me to be using those tools to identify the risk, that's how I can make it better.' Participant 20, female, 38 years, Zimbabwe, referral hospital.

4.2.4.2 Development of fall risk management guidelines

The development of guidelines and policies targeted for physiotherapists' management of falls risk in PLWH was recommended. Such guidelines will guide the physiotherapists on the most appropriate and predictive tools and outcomes to use in assessment of PLWH.

'I think maybe one thing that can help is maybe I think there is a lot of poor guidelines regarding the management of patients living with HIV…(which) have resulted in… for lack of better word poor management of such people. Deliberate policy is what (is) needed… even the other question about the tool, even myself I don't know the tool, really if which one exactly. We just do it out of experience and say this one, there may be a chance...' Participant 12, male, 30 years, Zambia, general hospital.

4.2.4.3 Education of multidisciplinary team

Education of other health professionals was regarded as important so that PLWH would be adequately referred for the needed health care services. Again, the doctors were singled out as being important recipients of the education regarding the scope of physiotherapy practice in primary HIV care as well as fall and fracture prevention.

'I think a lot of people, particularly our doctors… don't think it is part of our scope of, no I am saying that wrong. Not that it is not part of our scope of practice… it would be an opportunity for us to obviously educate our doctors about it as well because I do not think it is widely known or widely investigated for sure…' Participant 7 , female, 37 years, South Africa, primary district hospital.

4.2.4.4 Revision of undergraduate curriculum

It was deemed important to revise the physiotherapy undergraduate curriculum to ensure in-depth coverage of care of PLWH with emphasis on the rehabilitation framework.

'…I just don't think that it gets, it gets investigated enough in practice as students… I almost would recommend to, to let it be let it get started at foundation level, at student level so that they are made aware of it…' Participant 7, female, 37 years, South Africa, district hospital.

4.2.4.5 Community awareness

A few participants also suggested that the community be educated regarding the risk of falls and bone demineralisation so that they would bring it to the attention of their health care providers rather than regard falls as a normal consequence of their disease. The importance of

primary prevention was mentioned so that falls risk is identified and prevented in PLWH rather than waiting to manage the consequences of falls in patients who have already fallen only.

'I think it is important for us to focus on primary prevention, of the things…we need to be more involved in primary community awareness raising and community (at) earlier stages, prevention before cure… There is no cure obviously but it's better to deal with prevention of complications rather than management of complications at a later stage which involves bone demineralisation which lead to people coming in with problems of falls and falls risk is also a fracture risk and fracture risk is a health risk because you already have other complications …making the life of an HIV positive patient even more complicated …' Participant 6, female, 30 years, Botswana, referral hospital.

'It's (patient education) important because at the end of the day patients they spend more time at home than they spend in the hospital…so if we can educate them more there will be a better outcome plus I know an informed patient has got a better outcome…compared to a patient who is not informed.' Participant 12, male, 30 years, Zambia, general hospital.

The caregivers also needed to be informed because they provided the social and financial support to PLWH and were recognised as important stakeholders in fall and fracture prevention for PLWH. They realised that lack of financial support was one of the issues uniquely impacting PLWH.

'…training and awareness of the caregivers because what happens is, it is the care-givers who provide. The patients themselves are empty-handed, they don't have resources, so in the end they won't come.' Participant 13, male, 34 years, Zambia, referral hospital.

4.3 Chapter summary

Most participants expressed a lack of awareness of falls risk and bone demineralisation in PLWH. Due to this lack of awareness, physiotherapists did not necessarily link falls or fractures to HIV or ART when they did observe such events during their general patient assessments. However, when thinking about previous patients, some physiotherapists were able to recognise risk factors linked to falls in those with HIV.

The majority of physiotherapists did not routinely assess for falls in PLWH, mostly regarding falls assessment to be more suited to elderly patients. They lacked adequate knowledge and skills for falls prevention in PLWH because these were not imparted to them during prelicensure training, neither did they have equal opportunities for continued professional development. Participants from Botswana presented a unique scenario in that they received undergraduate training in HICs where HIV is not given priority. Therefore, even if their hospitals had initiatives towards falls prevention, the physiotherapists seemed not to be involved because they did not recognise the importance.

The recommendations given showed there is a need for revision of the physiotherapy undergraduate programme to include aspects of care of PLWH including falls and bone health. There is also need for more professional training opportunities for both physiotherapists and other health professionals in this regard. Health system deficiencies also need to be addressed to involve physiotherapists at primary care level and improve accessibility of assistive devices and social support systems to PLWH.

CHAPTER 5: DISCUSSION

5.1 Chapter introduction

This chapter contains a detailed discussion based on the perspectives of physiotherapists working in four selected sub-Saharan African countries on falls and bone demineralisation in PLWH, as well as their current falls prevention strategies. The data will be compared with findings from the scoping review (Chapter 2) and other relevant literature and the significance of the findings explored.

5.2 Main aim and findings

The scoping review (Section 2.3) with studies mostly from HICs and in middle-aged to older PLWH, found fall rates to approximate those of seronegative controls. Currently, there is insufficient evidence on prevalence of falls in sub-Saharan Africa and other LMICs, save for preliminary findings from one South African study[14] indicating a 34% fall rate in a relatively younger cohort of PLWH. Few studies reported on data in seronegative controls to determine non-HIV related risk factors unique to PLWH. Reasonable consensus exists that HIV-related variables such as current CD4+ cell count, HIV duration or clinical AIDS diagnosis are not associated with falls, although higher or detectable levels of viral load remains debatable. Strong associations were found between falls in PLWH and use of multiple, sedative medications and comorbidities, which are highly prevalent in sub-Saharan African countries. There is currently no high-level evidence for physiotherapy-led interventions to prevent falls or bone demineralisation in PLWH.

The qualitative study contributes to the limited body of knowledge regarding physiotherapists' perspectives and experiences of caring for PLWH in view of the problem of falls and bone demineralisation that is potentially inherent in this vulnerable population. The results indicate that physiotherapists have inadequate awareness of falls or fragility fractures as a problem in PLWH, while those who observed such events in PLWH failed to link it to HIV or ART. Despite the plethora of information regarding the effects of ART and HIV on BMD in PLWH, including systematic and narrative reviews,[15,20] most physiotherapists were not aware that ART or HIV infection could result in accelerated bone loss in PLWH. Mostly regarding falls as a geriatric condition, physiotherapists did not routinely assess for falls in PLWH; neither did they have primary fall prevention strategies in their current practice. An in-depth inquiry by

means of semi-structured interviews offered detailed explanations of factors shaping participants' perceptions about their knowledge, skills and attitudes when caring for PLWH.

5.3 Significance of findings

The findings from this study have several implications for clinical practice and health professions education.

5.3.1 The need for more evidence on rehabilitation management of falls and bone loss in PLWH

One of the most overarching themes raised was physiotherapists' lack of knowledge about aspects of falls assessment, risk factors and prevention strategies in PLWH. They attributed this to inadequate undergraduate training and unequal opportunities for CPD. Findings from the scoping review (Section 2.4.5) revealed that much of published literature on falls or bone loss in PLWH lacked a rehabilitation focus; instead having a biomedical approach. Thus, some physiotherapists' responses could have been drawn from their knowledge on falls that was taught in another context, such as gerontology.

Myezwa et al.[114] investigated the physiotherapy undergraduate curricula of eight South African academic institutions and recommended revision of the undergraduate curriculum to include aspects of care of PLWH and for rehabilitation professionals working with PLWH to keep up to date with current evidence. However, the evidence from which physiotherapy educators can draw on in revising course curricula may be virtually non-existent.[115] In mapping the extent and nature of evidence regarding rehabilitation interventions in PLWH, Steven et al.[116] highlighted that only 9.1% were in LMICs. Exercise was the dominant intervention for impairments and activity restrictions but of these, none pertained to fall or fracture prevention. A recent systematic review revealed a paucity of high-level evidence regarding the effects of exercise on BMD in PLWH;[117] while the scoping review in this thesis (Section 2.4.5) reported a lack of intervention studies for fall prevention in PLWH – especially in sub-Saharan Africa. There is no evidence-based practice without evidence. Thus, more research is needed on the rehabilitation context of care of PLWH with regards to falls and bone demineralisation. This is especially important in sub-Saharan Africa, where a greater HIV burden exists, to ensure that the results are relevant to this setting. This evidence may also be used to educate other HIV care providers.

5.3.2 The need for increased physiotherapists' alertness to falls and bone demineralisation among PLWH

The study results indicate the need for physiotherapists to be more anticipatory of the risk of falls and bone demineralisation when assessing PLWH including younger persons. Most physiotherapists in this study were generally not aware of falls as a potential problem in PLWH, rather associating falls with the elderly general population. They therefore did not routinely assess for falls in this population. No comparable studies were identified on awareness of falls in PLWH. However, the literature suggests that physiotherapists seem to be more aware of falls in other health conditions. For example, one survey of Belgian physiotherapists found that 84.6% were aware of falls as a problem in stroke patients. In older adults, varied percentages of physiotherapists routinely assessed for falls risk; one survey [44] reporting higher percentage (85%) while another survey[118] reported lower percentage (37%). This study's scoping review (Section 2.3.4) indicated the problem of falls in middle-aged to older PLWH. The finding that fall rates were similar to their seronegative counterparts may be attributable to ART allowing them to age with HIV. It was proposed that falls may prevalent in younger cohorts of PLWH due to the different socio-demographic profile of PLWH in LMICs; one recent South African study[14] attesting to this possibility. Hence, while Greene et al[16] recommended routine screening for falls in all PLWH who are 50 years and older, physiotherapists may need to look out for falls in both younger and older PLWH especially in LMICs.

In this study, most participants' responses were inclined towards hospitalised PLWH. By considering physiotherapists working in PHC settings for inclusion in this study, it was expected that most responses would concern community-dwelling PLWH. Comments about community-dwelling PLWH would mostly emerge after further probing. This finding could hold several implications. First, it could mean that less falls actually occur in community-dwelling PLWH compared to hospitalised PLWH. This could hold untrue because compared to hospitalised PLWH, community-dwelling persons may have greater exposure to external factors contributing to falls (e.g. outdoor falls resulting from uneven terrain and vigorous activity).[119] Second, it may be that the physiotherapists were less aware of falls occurring in community-dwelling PLWH. This second possibility may be attenuated by a third reason, namely that people who fall may not report benign falls in which no injury resulted to health care providers. Therefore, physiotherapists need to pay attention to falls prevention among community-dwelling PLWH considering that PLWH may not report the falls without being asked specifically. Indeed, one Cochrane review reported the effectiveness of identification

and interventions for fall-risk in community-dwelling older adults by reducing falls by 24%.[60]The need for physiotherapists to be wary of falls in PLWH is further augmented by the finding that physicians rarely referred patients specifically for falls management. Chou et al.[120] reported referral of patients with unsteady gaits to physiotherapy as a facilitator to falls risk management. In fact, guidelines for preventing falls in older persons recommend routine assessment of falls for persons with unsteady gait and/or fear of falling, not just those with history of fall in the previous year. A recent systematic review[71] concluded that PLWH may have gait impairments reflective of fall-related parameters in older persons. A study identified from the scoping review (Section 2.3.10) suggested that rehabilitation principles applied in older adults for falls management may be extrapolated to PLWH. This in effect places the responsibility on physiotherapists to routinely screen for falls in all PLWH referred for mobility, even though there is still a gap in evidence for fall and fracture prevention in this population.

5.3.3 Gaps in current falls prevention practices

Several gaps in the current fall prevention practices were identified.

5.3.3.1 Lack of primary falls prevention strategies

Findings from this study revealed that the physiotherapists were more engaged in secondary fall prevention practices after PLWH had experienced a fall, while primary prevention practices were mostly lacking. Kalula et al.[121] reported on the absence of fall prevention and education programs in South Africa; and South Africa's National Development Plan 2030 acknowledged fall prevention as one of the issues that has not been given sufficient attention. A similar problem seems to exist in other southern African countries as indicated by a lack of published evidence on falls prevention. Considering that multimorbidity presents more complex issues in PLWH, perhaps falls prevention is not prioritised. Attention may only be paid to those presenting with complaints of fall, more commonly injurious falls requiring clinical attention.

Fall prevention practices mentioned by the participants in this thesis included prescribing walking aids, balance and proprioception retraining, and strengthening exercises and were done mostly in patients who had already experienced a fall. Post-fall assessment is important in identifying the cause of prior falls and prevention of further falls.[122] Nevertheless, there is a need for physiotherapists to be more actively engaged in health promotion for PLWH. Risk screening for falls and education of community regarding prevention has been found to be more

beneficial because complications of falls such as injuries, fractures, fear of falling and disability are avoided.[123]

5.3.3.2 No use of standardised screening tools and outcome measures

Several study participants did not use standardised screening tools or outcome measures to identify and assess PLWH at risk of falls, most of them citing lack of knowledge about appropriate tools. Physiotherapists' inconsistent use of screening tools for falls has been documented. For example, although 56.9% of the physiotherapists in one Belgian survey[45] acknowledged the need for risk of falling to be evaluated at the beginning of treatment, only 32.3% used standardized outcome measures in screening for falls among their stroke patients. A few study participants cited the Berg Balance Scale (BBS) and tandem stand as outcome measures in their assessment of balance. The use of outcome measures is important in evaluating treatment progression as well as demonstrating the effectiveness of physiotherapy interventions to relevant stakeholders and policymakers. A systematic review and meta-analysis[124] to assess the most predictive tool for risk of falls in the elderly concluded that the BBS and Mobility Interaction Fall (MIF) chart had high predictive validity but recommended the use of a combination of assessment tools depending on the setting. For example, a combination of the BBS (high specificity) and Timed Up and Go (TUG) test (high sensitivity) may be used to improve diagnostic accuracy of risk of falls in community-dwelling persons. The review also found that the BBS and TUG test were more commonly used in community-dwelling setting, while the STRATIFY (St Thomas's Risk Assessment Tool in Falling Elderly patients) and Hendrich II Fall Risk Model were used for hospitalized elderly patients. More research is needed to validate these tools for PLWH who are in hospitalized or community-dwelling settings.

With regards to screening for BMD loss, most study participants were not able to access Dual-energy X-ray absorptiometry (DXA), a tool most predictive in identifying patients at high fall risk because of bone density loss.[27] The physiotherapists mostly relied on less precise X-rays; perhaps because they were more available and less expensive. One study[125] demonstrated that the calcaneal quantitative ultrasound (QUS) is a feasible alternative to DXA in screening BMD in PLWH, and Berner et al[14] used it successfully in a resource-limited setting. Perhaps primary health facilities can consider investing in this 'cost effective, portable and ionizing-radiation free tool'[20] to enable PLWH to be routinely screened for BMD loss.

5.3.4 Gaps in health system affecting falls prevention practices

A strong patient-centred health system is essential for the management of the health needs of the community including PLWH. Findings from the present study indicated challenges from deficiencies within the health system including fragmented service delivery, shortage of competent human resources and budgetary constraints which affected the physiotherapists' quality of fall prevention practices. In HICs, physiotherapy-led interventions which may include fall prevention have been adapted to the primary care context; but not without challenges.[46,47,126] Barriers to sustainability of these programs included cost implications, shortage of staff, lack of rebate, inadequate venues and lack of transport to bring patients to the venues. Figure 5.1 shows some of the strategies derived from this study that can help fulfil the goals or outcomes of strengthening health systems adapted to the WHO Health Systems Framework.[113]

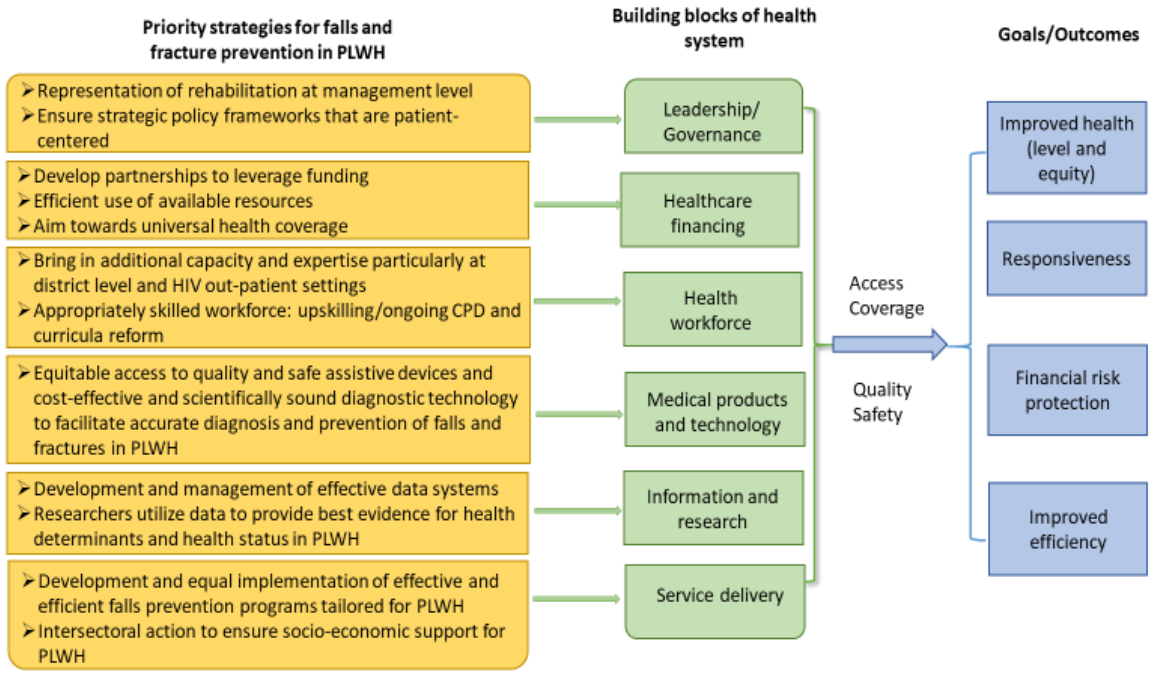

Fig. 5.1 Priority strategies for strengthening health systems to facilitate falls and fracture prevention in PLWH adapted to the WHO Health Systems Framework

Additional implications for clinical practice, research and policy-making resulting from identified gaps in the health systems are discussed below.

5.3.4.1 The need for quality clinical practice guidelines

Differences existed between countries regarding the availability of clinical practice guidelines (CPG) or standard operating procedures (SOP). Botswana hospitals were actively engaged in a quality improvement and accreditation process run by a non-for-profit organization, COHSASA (Council for Health Services Accreditation of Southern Africa).[127] Hence, hospital risk management committees were putting forth efforts to develop and implement generic SOPs for falls prevention within the hospital. However, it was up to physiotherapy departments to adapt these guidelines to physiotherapy practice and the majority seemed not to have done so. All the same, falls prevention for community dwelling PLWH was lacking. The primary care facilities in South Africa, Zambia and Zimbabwe were reported as not having any generic falls prevention guidelines in place even at hospital level. Lack of CPG can result in mismanagement of patients which impacts negatively on their QoL.[128] Phelan et al[59] developed guidelines on assessment and management of fall risk in primary care settings; these can be adapted to provide guidance in care of PLWH. Implementation of these guidelines may guide physiotherapists in making better clinical decisions informed by best evidence resulting in improved health outcomes for PLWH.[129]

Our study demonstrated the benefits of the hospital accreditation system, although not an objective of this study. Quality improvement initiatives in Botswana fostered the development of quality CPG, as best evidence was used to guide the formulation of core outcome measures and standards of health care practice.[128] Perhaps all countries could benefit from the hospital accreditation system which bench-marks against recognized standards of practice.

5.3.4.2 Health care finance

Some participants voiced their concern regarding PLWH not being able to access falls prevention services due to cost or unavailability. Economic costs of falls prevention services associated with purchase of assistive devices, attendance fee and transport costs were a common barrier to implementation of falls prevention services cited in over two thirds of studies included in one systematic review.[130] Although much healthcare funding has been dedicated to HIV care in LMIC,[131] significant proportions have been allocated to virological control of HIV through ART scale-up, voluntary male circumcision, prevention of mother-to-child transmission, universal testing and immediate treatment programmes.[132] A shift in focus may be required to improving QoL of PLWH. There may be a need to build an investment case for falls prevention in PLWH for concerned stakeholders to prioritise funding in this area.

5.3.4.3 The need for more information and research on falls in PLWH

Physiotherapists highlighted poor capturing of statistical data on falls occurring in PLWH as another gap in the health system affecting falls prevention in PLWH. Data in patient health records collected during routine health care facilitates contextual clinical research.[133] For example, the scoping review (Section 2.6.2) indicated the need for studies on falls prevalence among PLWH in SSA. Prevalence data would be important in defining the burden of falls among PLWH in SSA and understanding the current need for falls prevention services. Policy makers will be able to plan financial and resource needs accordingly. The information and research on falls in PLWH may also be important in training physiotherapists and other health care professionals in falls prevention for PLWH.

5.3.4.4 The need for capacity development regarding falls prevention

The study brought to light the gaps in knowledge that physiotherapists require to optimally prevent or reduce falls in PLWH. Most were not aware of the link between falls, reduced BMD and fractures that could result from HIV itself or use of ART. Although most physiotherapists were able to identify some risk factors for falls in PLWH, important risk factors identified from this study's scoping review (Section 2.3.6) such as polypharmacy, use of multiple CNS-active medications and cognitive impairments were omitted. It is important to be able to identify all modifiable risk factors to effectively link with effective interventions.[44] A survey[43] found that Nigerian physiotherapists similarly had a lower awareness of use of multiple medications as a risk factor for falls among the elderly population. The same authors attributed the low awareness of standardised fall prevention strategies among the physiotherapists to lack of emphasis on models, frameworks and theories during pre-licensure training more common in low to medium income countries. This is a plausible explanation for our similar findings because most participants expressed how their undergraduate training mostly focused on the pathology of HIV rather than rehabilitation frameworks. These findings could be used in designing continuing education programs and undergraduate course modules to include comprehensive coverage of fall and fracture prevention in PLWH.

5.3.4.5 The need to promote scope of physiotherapy practice among other health professionals

This study found that some members of the MDT were often unaware of the scope of physiotherapy practice in terms of primary HIV care including falls and fracture prevention. Figure 5.2 summarises the issues that were highlighted in this study that may have resulted from MDT being unaware of how physiotherapists contributed to the various aspects of care.

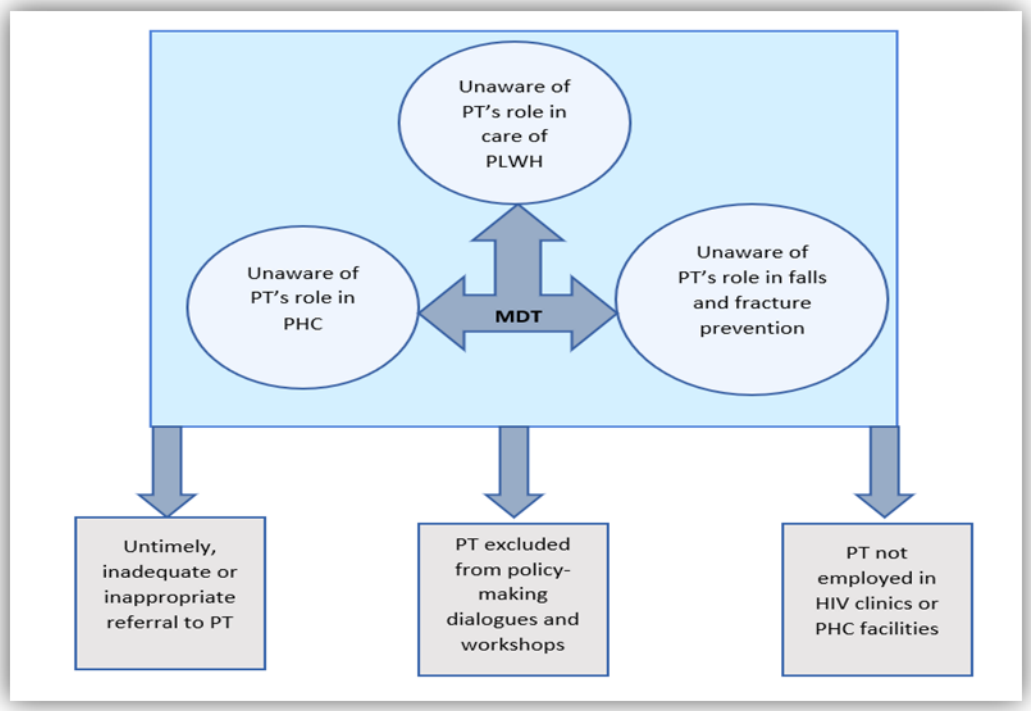

Fig. 5.2 Factors surrounding unawareness of physiotherapists' (PT) scope of practice by other members of multidisciplinary team (MDT)

Role in care of PLWH

Lack of other health professionals' knowledge about physiotherapists' role in HIV care may result in the profession being misunderstood or undervalued.[41] It could be the reason why physiotherapists and other rehabilitation specialists were often side-lined from HIV workshops and policy dialogues as was found in this study. Similar concerns were reported by rehabilitation professionals in Kenya and Zambia;[37] outlining some rehabilitation roles in HIV care that were overlooked: encouraging drug adherence, identifying impairments resulting from HIV infection or ART, offering psychosocial counselling, promoting self-management strategies, promoting mental health and advocating for rights of PLWH or with disabilities. An understanding of professional roles within teams can be acquired through interprofessional

collaboration during undergraduate education.[134] Practicing clinicians may be educated by means of courses, workshops, team meetings, grand rounds and research publications.[135] In collaboration with other rehabilitation professions, physiotherapists should imprint their hallmark in primary HIV care.[41] This may lead to their inclusion in HIV policy and programme development. Issues such as fall and fracture prevention may then be integrated into priority programs and HIV guidelines.

Role in primary health care

Lack of other health professionals' knowledge about physiotherapists' role in PHC was evident in the proportion of physiotherapists involved in this study who were employed in primary health care settings. In fact, only one of the physiotherapists was employed at an outpatient HIV clinic while less than a third worked in primary district hospitals. Cobbing et al[41] highlighted the shortage of physiotherapy posts in many South African government institutions, despite many physiotherapists being unemployed and despite the demand for rehabilitation, mainly because the profession is undervalued. The same concerns were raised by rehabilitation providers in Kenya and Zambia, who explained how their preventative role was disregarded; rehabilitation often being viewed as a "dumping ground" after other treatment had failed.[37]

Notwithstanding, physiotherapists' role in PHC seems to be more appreciated in high-income countries. DeBoer et al[40] reported positively on healthcare professionals' awareness of the preventative role of physiotherapy in an interprofessional outpatient HIV care setting, including falls prevention and prevention of secondary complications and pain. Besides provision of physical treatment, physiotherapists' contribution to psychosocial aspects of health of PLWH was recognized. Suggested methods that physiotherapists can use promote their role in PHC include making educational visits to HIV out-patient clinics, as well as canvassing on social media platforms.[40] If physiotherapists are engaged at primary level of HIV care, there may be improved focus on primary falls and fracture preventions.

Role in falls and fracture prevention

Not knowing what physiotherapists do for falls prevention may have contributed to physicians inadequate or inappropriate referral of PLWH to physiotherapy as mentioned by a few physiotherapists in this study. An inadequate referral pathway was similarly reported in one South African study,[136] in which doctors explained that sometimes they did not refer to PLWH to physiotherapy because they doubted the effectiveness of physiotherapy interventions in the

management of HIV-related conditions. This may have resulted from their undergraduate curriculum having been curative-centric.[136] Hence, their treatment focus would be medical, affording PLWH little opportunity for rehabilitation.[137] Increasing physicians awareness of the role of physiotherapy in fall and fracture prevention may facilitate effective referral practice.

Another study in Ireland[48] also found that rehabilitation professionals rarely received specific referrals for falls prevention from general practitioners, but nurses referred adequately. However, in the present study, participants reported that nurses were not allowed to refer to rehabilitation professionals although they were the ones responsible for screening and identifying patients at high risk of falls. This could be due to the traditional hierarchical structures or fear that nurses will refer inappropriately.[138] This disjointed pathway of care often results in poor health outcomes for the patients. Moving away from physician-centric models of PHC to team models,[139] and allowing PHC nurses as first-line practitioners to directly refer patients to other HIV care providers may result in increased and timely referral of PLWH for falls and fracture prevention.

5.3.4 6 Need for patient-centred approach to fall prevention

Physiotherapists articulated the need to empower PLWH and their caregivers with knowledge regarding falls. Equipping patients with self-management strategies is crucial to patient-centred management of any chronic condition.[140] Learning about risk factors for falls and available resources for falls prevention will motivate PLWH to draw on the health care system and take ownership of their health needs.[33] PLWH may recognise the importance of informing their health care providers about any falls, including those that may not have resulted in injuries requiring medical attention. Involving PLWH in the decision-making process can help them have a voice during their treatment and discharge planning sessions, requesting fall-related services as needed. This may help address a concerning issue raised by some participants in which some patients were discharged without ensuring safe mobility status. They will now be aware that this will predispose them to falls at home.

A stronger health system results in a significant increase in the years lived with disability (YLDs) paralleled by a greater the need for rehabilitation.[141] Quoting Cobbing et al.:[33] “while ART may add years to life, rehabilitation can add life to years.” PLWH are particularly challenged with stigma, episodic disability, loss of social support and financial constraints.[33,137] Physiotherapists play a crucial role in re-integrating PLWH into communities

and need to liaise with other members of the MDT to ensure patient-centred continuum of care for PLWH, in effect improving their QoL. The findings from this study can inform planning of future falls prevention services within a more effective, efficient and equitable health system.

5.4 Strengths and limitations

To the researcher's knowledge this is the first study that explores the experiences of physiotherapists in sub-Saharan Africa regarding awareness of falls and bone demineralisation in PLWH as well as their perceptions regarding current falls prevention.

The scoping review enabled a comprehensive mapping of the breadth of evidence on falls in PLWH. However, the absence of methodological quality appraisal limited the strength of the study to recommend the proposed assessment and intervention strategies for falls prevention. Limiting inclusion of studies published in English study may have resulted in omission of some studies especially those in LMICs.

The qualitative study used purposive sampling to gain perspectives of physiotherapists working in primary care of PLWH. However, physiotherapists in Zimbabwe and Zambia were mostly employed in secondary and tertiary hospitals, while a disproportionate number of physiotherapists in South Africa worked in the private sector. The researcher restricted her participants to the public sector but included the input of physiotherapists employed at general and referral hospitals because they were still the first line of contact for rehabilitation and would be the same physiotherapists who would need to implement falls prevention programs in the community perhaps by means of outreach visits to primary hospitals and HIV clinics. By doing so the study gained additional information with regards to falls that occur in PLWH who are hospitalized. Perhaps maximum variation sampling would have better suited this population and allowed the researcher to assess differences in patterns of experience from physiotherapists engaging with PLWH at different levels of care.

Sampling bias may have been introduced by considering physiotherapists working in urban districts of the selected cities. Physiotherapists working in rural district hospitals may have presented different experiences due to different health system structures and having patients with a different socio-demographic profile. Therefore, the results of this study may not be generalized to physiotherapists in rural primary HIV care settings.

Financial resources limited our ability to travel to each country and conduct face-to-face interviews with the physiotherapists in their work settings. While telephonic interviews still allowed for the researcher to gain deeper insight on her objectives by probing for quality responses, face-to-face interviews would have allowed for clearer, uninterrupted interviews as well as more insight by observing body language and visual cues. The researcher may have gained useful information about any fall prevention strategies from an observation of the physiotherapists' work setting that may have not been brought up during the interview.

Although the researcher took several measures to ensure validity and reliability of findings, she was aware that response bias may have still existed from participants trying to give socially acceptable answers to portray themselves as competent professionals. Some participants declined the invitation to participate in the study because they felt they did not have enough knowledge about the subject so our sample may have been biased towards a more knowledgeable sample.

Providing incentives to our participants improved the rate of physiotherapists willing to engage in the study during their personal time.

5.5 Recommendations for future research

Recommendations for further research from the scoping review have been discussed in Section 2.6 of this thesis. These include more studies on younger cohorts and in LMICs especially sub-Saharan Africa. More studies are required to determine non-HIV related risk factors unique to PLWH as well as the effect of reduced BMD on falls in PLWH. Interventions that target both falls reduction and promotion of bone health need to be investigated in this population.

Further studies should consider the perceptions of PLWH with regards to the current falls and fracture care they are receiving from physiotherapists. The patients themselves are important stakeholders to consider when developing and implementing policies and guidelines that are to benefit them. It is also important to determine their awareness of the potential risk of falls and bone demineralisation and the negative outcomes associated with these phenomena. This study's scoping review indicated the possibility of falls being a problem in younger cohorts of PLWH, but younger PLWH may not consider themselves to be at risk of falls and fragility fractures. One qualitative study[54] carried out in a well-resourced setting provided insight into the PLWH's perceptions of the cause of their falls, how they managed their falls and the impact of falls in their lives. These perspectives may be different for PLWH living in poorly resourced settings.

Further research is needed to establish the magnitude of certain problems highlighted in our study by quantification of data. For example, a quantitative survey would determine what proportion of physiotherapists lack an awareness of falls and bone demineralisation in PLWH and therefore whether there is a need to employ interventions to raise an awareness among physiotherapists. A comparison between data from the different countries would be simplified, making it possible to target interventions in the most affected areas first.

5.6 Chapter summary

The scoping review identified the need for more research regarding falls and fracture prevention in younger cohorts of PLWH, much so in sub-Saharan Africa where the most prevalent and more robust clades of HIV exist.

The qualitative study found that physiotherapists were not aware of falls and bone demineralisation as a problem in PLWH and did not routinely assess and address fall risk factors. Physiotherapists must be convinced that falls and accelerated bone loss are a priority issue among PLWH and devote more time in assessing falls risk and educating PLWH about fall prevention. The role of the physiotherapist in falls prevention for PLWH includes promoting healthy living and preventing falls in community dwelling PLWH, which is better fulfilled in the primary care context. Therefore, physiotherapists need to be part of the multidisciplinary team employed in primary care facilities including HIV out-patient clinics and primary health care centres.

CHAPTER 6: CONCLUSION

The aim of the thesis was achieved as the extent and nature of existing literature on falls in PLWH was mapped while the level of physiotherapists' awareness of falls and bone demineralisation in PLWH was determined. The presence and nature of the current fall prevention practices among physiotherapists in the selected sub-Saharan countries were well described.

The scoping review demonstrated a scarcity of high-level evidence regarding assessment and intervention strategies for falls reduction among younger cohorts of PLWH in sub-Saharan Africa and other LMICs where HIV is endemic. The relationship between falls and bone demineralisation in PLWH is not well described. Non-HIV-related risk factors for falls in PLWH are yet to be determined.

The qualitative study showed that most physiotherapists were not aware of falls as a potential problem in PLWH, mostly associating the phenomenon with the older adults of the general population. Concurrently, most physiotherapists were not able to observe trends of accelerated bone loss in PLWH due to unavailability of appropriate diagnostic tools such as DXA or QUS in their facilities as well as inefficient hospital information systems. As a result, they did not routinely assess for falls or BMD in PLWH. A few who observed falls and osteoporosis in PLWH during traditional assessments did not attribute these phenomena to HIV or ART perhaps due to being unaware of the patients' serostatus or their lack of knowledge about the potential risk of falls and bone loss in PLWH.

Current services for falls prevention as perceived by the physiotherapists were sub-optimal and lacked a patient-centred approach. The contextual factors affecting the implementation of falls prevention strategies in primary HIV care included inadequate undergraduate training; other health professionals lack of awareness of physiotherapists' role in primary HIV care including falls prevention and promotion of bone health; and health system deficiencies.

The study highlighted that physiotherapists need to be more aware of the potential risk of falls and bone demineralisation in PLWH and routinely assess for these phenomena in both older and younger PLWH. The physiotherapists need to promote their role in primary HIV care among other health professionals especially the doctors who are currently viewed as the gatekeepers to primary care of PLWH. The study supports the need to advocate for employment of more physiotherapists in primary health care facilities. Meanwhile, more research is evidently needed regarding falls in PLWH and the effects of BMD loss on falls in PLWH,

especially in sub-Saharan Africa. This evidence may form the basis for revision of undergraduate rehabilitation curricula and CPD courses needed to improve awareness among physiotherapists and other health professionals involved in primary HIV care. Education of PLWH regarding the potential risk of falls and bone demineralisation will also be effective in reducing falls and fragility fractures in this population.

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ADDENDUM

Appendix A: BMJ Open submission guidelines

Research submissions should have a clear, justified research question.

All articles should include the following:

- **The article title should include the research question and the study design**. Titles should not declare the results of the study.
- **A structured abstract** (max. 300 words) including all the following where appropriate:

  - **objectives:** clear statement of main study aim and major hypothesis/research question
  - **design:** e.g. prospective, randomised, blinded, case control
  - **setting:** level of care e.g. primary, secondary; number of participating centres. Generalise; don't use the name of a specific centre, but give geographical location if important
  - **participants:** numbers entering and completing the study; sex and ethnic group if appropriate. Clear definitions of selection, entry and exclusion criteria
  - **interventions:** what, how, when and how long (this can be deleted if there were no interventions)
  - **primary and secondary outcome measures:** planned (i.e. in the protocol) and those finally measured (if different, explain why) – for quantitative studies only
  - **results:** main results with (for quantitative studies) 95% confidence intervals and, where appropriate, the exact level of statistical significance and the number need to treat/harm. Whenever possible, state absolute rather than relative risks
  - **conclusions:** primary conclusions and their implications, suggest areas for further research if appropriate. Do not go beyond the data in the article
  - **where applicable, trial registration:** registry and number (for clinical trials and, if available, for observational studies and systematic reviews)

- **An Article Summary, placed after the abstract, consisting of the heading 'Strengths and limitations of this study'**, and containing up to five short bullet points, no longer than one sentence each, that relate specifically to the methods. They should not include the results of the study.
- **The original protocol for the study**, as a supplementary file.
- **A funding statement** preferably worded as follows. Either: 'This work was supported by [name of funder] grant number [xxx]' or 'This research received no specific grant from any funding agency in the public, commercial or not-for-profit sectors'. You

must ensure that the full, correct details of your funder(s) and any relevant grant numbers are included.

- **A competing interests statement**. See the BMJ Author Hub for details on what to include as competing interests.
- **Articles should list each author's contribution individually at the end**; this section may also include contributors who do not qualify as authors.
- **Any checklist and flow diagram for the appropriate reporting statement**, e.g. STROBE (see below).
- **A patient consent form:** any article that contains personal medical information about an identifiable living individual requires the patient's explicit consent before we can publish it. We will need the patient to sign our consent form, which requires the patient to have read the article. This form is available in multiple languages.
- **A data sharing statement**, such as: "Technical appendix, statistical code, and dataset available from the Dryad repository, DOI: [include DOI for dataset here].
- **Word count,** we recommend your article does not exceed 4000 words, with up to five figures and tables. This is flexible but exceeding this will impact upon the paper's 'readability'. Authors are encouraged to submit figures and images in colour – there are no colour charges. We require that you upload your figures as separate files rather than embedding them in the manuscript.
- **Supplementary and raw data** can be placed online alongside the article although we prefer raw data to be made publicly available and linked to in a suitable repository (e.g. Dryad, Fig Share). We may request that you separate out some material into supplementary data files to make the main manuscript clearer for readers.

We also recommend, but do not insist, that the discussion section is no longer than five paragraphs and follows this overall structure (you do not need to use these as subheadings): a statement of the principal findings; strengths and weaknesses of the study; strengths and weaknesses in relation to other studies, discussing important differences in results; the meaning of the study: possible explanations and implications for clinicians and policymakers; and unanswered questions and future research.

Following the lead of The BMJ and its patient partnership strategy, *BMJ Open* is encouraging active patient involvement in setting the research agenda. As such, we require authors of Research Articles to add a Patient and Public Involvement statement in the Methods section.

Reporting patient and public involvement in research

BMJ encourages active patient and public involvement in clinical research as part of its patient and public partnership strategy. To support co-production of research we request that authors

provide a Patient and Public Involvement statement in the methods section of their papers, under the subheading 'Patient and public involvement'.

We appreciate that patient and public involvement is relatively new and may not be feasible or appropriate for all papers. We therefore continue to consider papers where patients were not involved. Please note that this practice is only applicable for Research Articles, Study Protocols, and Cohort Profiles.

The Patient and Public Involvement statement should provide a brief response to the following questions, tailored as appropriate for the study design reported (please find example statements here):

- At what stage in the research process were patients/the public first involved in the research and how?
- How were the research question(s) and outcome measures developed and informed by their priorities, experience, and preferences?
- How were patients/the public involved in the design of this study?
- How were they involved in the recruitment to and conduct of the study?
- Were they asked to assess the burden of the intervention and time required to participate in the research?
- How were (or will) they be involved in your plans to disseminate the study results to participants and relevant wider patient communities (e.g. by choosing what information/results to share, when, and in what format)?

If patients were not involved, please state this.

In addition to considering the points above we advise authors to look at guidance for best reporting of patient and public involvement as set out in the GRIPP2 reporting checklist.

If the Patient and Public Involvement statement is missing in the submitted manuscript, we will request that authors provide it.

Reporting guidelines

The guidelines listed below should be followed where appropriate. Please use these guidelines to structure your article. Completed applicable checklists, structured abstracts and flow diagrams should be uploaded with your submission; these will be published alongside the final version of your paper e.g. PRISMA-ScR for reporting of scoping reviews.

Appendix B: Search strategy for scoping review

SEARCH STRATEGY

PubMed

(HIV-1 OR HIV infection OR HIV/AIDS) [All fields]

AND

("accidental fall*" OR "fall risk" OR "fall assessment" OR "fall prevention") [All fields]

Filter: English Language

Hits= 27 (13 relevant full text articles identified)

Scopus

(HIV-1 OR HIV infection OR HIV/AIDS) [Title-Abstract-Keyword]

AND

("accidental fall*" OR "fall risk" OR "fall assessment" OR "fall prevention") [Title-Abstract-Keyword]

Filter: Document type: Article

English Language

Hits= 7 (1 relevant full text and not duplicate identified)

CINAHL

(HIV-1 OR HIV infection OR HIV/AIDS) [Title-Abstract-Keyword]

AND

("accidental fall*" OR "fall risk" OR "fall assessment" OR "fall prevention") [Title-Abstract-Keyword]

Filter: Review articles and Research articles

Hits=32 (all duplicate or non-relevant)

Google scholar

HIV AND accidental fall*

Hits= 839 (all duplicate or non-relevant)

Appendix C: Participant leaflet and Informed consent form

Participation Leaflet

Study Title: Physiotherapists' Awareness of Bone Demineralisation and Falls Risk in People Living with HIV and their Perceptions of Management of Falls.

Protocol version Number: 001

Reference Number: _____

Dear Participant,

You are invited to participate in a survey of physiotherapists' awareness of bone demineralisation and falls risk in people living with HIV (PLWH) in selected regions of Southern Africa and their current management. This study is being done by Ms. Maria Yvonne Charumbira a Master in Physiotherapy student at University of Stellenbosch under the supervision of Prof. Q.A. Louw. This study has been approved by the Health Research Ethics Committee at Stellenbosch University and will be conducted according to the ethical guidelines and principles of the international Declaration of Helsinki, South African Guidelines for Good Clinical Practice and the Medical Research Council (MRC) Ethical Guidelines for Research. It is very important that you take time to read and understand fully the information presented here below.

What is the purpose of the study? The impact of falls in PLWH has not been fully explored in Southern Africa. This study aims to understand whether physiotherapists in selected regions of Sothern Africa know about reduced bone mineral density and risk of falls in PLWH and establish what their current practices are in the management of falls in this key population. A total of 20-24 physiotherapists will be randomly selected from primary care facilities in Cape Town Metropole, Harare, Gaborone and Lusaka to participate in the study.

What are the study procedures? What will I be asked? If you consent to participating in the study, you will take part in an interview over telephone in which you are requested to honestly answer a few questions on what you perceive your awareness of bone demineralisation and falls risk in PLWH to be and what your current practices are when assessing and managing falls risk in PLWH. The interview is expected to take 20-30minutes. You may be contacted within two weeks following the interview for feedback on the correctness of the information we collected from you.

What are the risks or inconveniences of this study? We will arrange to hold the interview at a time that is most convenient to you and that will not interfere with your work schedule. There are no foreseeable direct/indirect risks involved in participating in this study. Information obtained will not be used against you in any way.

What are the benefits of the study? There is no direct remuneration for information obtained. However, you may receive the results of the study upon request. Information obtained from the study will highlight areas of improvement regarding falls prevention in PLWH. You will also receive a R200 gift card or voucher.

How will my personal information be protected? All information that you shall give shall be deidentified. Results from this study may be published or presented in clinical meetings. All raw data will be destroyed immediately after this study is completed.

What are my rights? Your participation in this study is entirely voluntary and you are free to decline to participate. You may withdraw from the study at any time or not answer any question without any penalty.

When will study be completed? It is proposed that the study will be submitted by the end of 2019.

Should you need any clarification or access to the study results do not hesitate to contact the researchers on the contacts below:

Ms. Maria Yvonne Charumbira, Stellenbosch University, yvonne.kamuti@gmail.com, +27718930298

Prof Q.A. Louw, Stellenbosch University, qalouw@sun.ac.za

Alternatively, you may contact the Research Ethics Committee of Stellenbosch University on +2721-938 9207 if you have any concerns that have not been adequately addressed by the researcher.

Informed consent form

I have read all the above information and have fully understood the explanation. I have been offered to answer any of my questions concerning the procedures involved in the study and have been given a copy of this form to keep.

----------	----------	----------
Participant's Name (Please Print)	**Participant's Signature**	**Date/Time**
----------	----------	----------
Name of Participant's Witness	**Witness' Signature**	**Date/Time**
----------	----------	----------
Name of Person obtaining consent	**Signature**	**Date/Time**

Appendix D: Interview schedule

Demographic details (obtained via email or WhatsApp)

1. Age
2. Educational Background
3. Work experience
4. Workplace

Interview Questions

1. Tell me about your experience of treating PLWH. (How long? Proportion of total patient load? Which age group do most of them belong?
2. What are the key functional problems your patients living with HIV present with? What do patients say are their functional limitations?
3. What are the cognitive problems they present with? (Besides depression?)
4. What are the differences in presentation of patients on and not on ART?
5. What is your understanding and/or awareness of the risk of falling that PLWH have?

   5.1 Why do you think there is this inherent risk of falling associated with HIV?
6. What is your understanding of the effect of ARDs on (i) bones and on (ii) movement in PLWH?
7. Have any of your patients LWH presented with complaint of falls? Pathological fractures? (What are the most common reasons?) What about falls in community dwelling PLWH?
8. How do you assess for falls in your routine care of PLWH?

   8.1 Which screening tool do you use to identify PLWH who you suspect are at high risk of falls?

   8.2 What determines your choice of tool?
9. What are you currently doing for falls prevention in your delivery of care to PLWH?
10. Which Clinical Practice Guidelines for Falls Prevention do you refer to?

11. Which health care professionals do you refer your patients to for further falls risk prevention?
12. What post-graduate training on falls prevention/ care of PLWH have you received? What training workshops/opportunities are available on falls prevention in PLWH? Was emphasis put on functional limitations or was the focus on pathology of HIV in your undergraduate training?
13. Any recommendations regarding what physiotherapists need to do improve care of PLWH considering their high risk of falls and reduced BMD?
14. Is there anything else you would like to add?

Appendix E: Stellenbosch University Health Research Ethics Approval

UNIVERSITEIT STELLENBOSCH UNIVERSITY

Health Research Ethics Committee (HREC)

Approval Notice

New Application

STELLENBOSCH UNIVERSITY
Health Research Ethics Committee
15 OCT 2018
STELLENBOSCH UNIVERSITEIT
Gesondheidsnavorsing Etiekkomitee

17/08/2018

Project ID :7688

HREC Reference #: S18/07/137

Title: Physiotherapists' Awareness of Bone Demineralization and Falls Risk in People Living with HIV and their Perception of Falls Risk Management

Dear Ms Maria Charumbira,

The **Response to Stipulations** received on 16/08/2018 19:44 was reviewed by members of **Health Research Ethics Committee 2 (HREC2)** via **expedited** review procedures on 17/08/2018 and was approved.

Please note the following information about your approved research protocol:

Protocol Approval Period: **This project has approval for 12 months from the date of this letter.**

Please remember to use your **Project ID [7688]** on any documents or correspondence with the HREC concerning your research protocol.

Please note that the HREC has the prerogative and authority to ask further questions, seek additional information, require further modifications, or monitor the conduct of your research and the consent process.

After Ethical Review

Please note you can submit your progress report through the online ethics application process, available at: Links Application Form Direct Link and the application should be submitted to the HREC before the year has expired. Please see *Forms and Instructions* on our HREC website (www.sun.ac.za/healthresearchethics) for guidance on how to submit a progress report.

The HREC will then consider the continuation of the project for a further year (if necessary). Annually a number of projects may be selected randomly for an external audit.

Provincial and City of Cape Town Approval

Please note that for research at a primary or secondary healthcare facility, permission must still be obtained from the relevant authorities (Western Cape Departement of Health and/or City Health) to conduct the research as stated in the protocol. Please consult the Western Cape Government website for access to the online Health Research Approval Process, see: https://www.westerncape.gov.za/general-publication/health-research-approval-process. Research that will be conducted at any tertiary academic institution requires approval from the relevant hospital manager. Ethics approval is required BEFORE approval can be obtained from these health authorities.

We wish you the best as you conduct your research.

For standard HREC forms and instructions, please visit: Forms and Instructions on our HREC website https://applyethics.sun.ac.za/ProjectView/Index/7688

If you have any questions or need further assistance, please contact the HREC office at 021 938 9677.

Yours sincerely,
Francis Masiye,
HREC Coordinator,
Health Research Ethics Committee 2 (HREC2).

National Health Research Ethics Council (NHREC) Registration Number:

Page 1 of 2

REC-130408-012 (HREC1)·REC-230208-010 (HREC2)

Federal Wide Assurance Number: 00001372
Office of Human Research Protections (OHRP) Institutional Review Board (IRB) Number: IRB0005240 (HREC1)·IRB0005239 (HREC2)

The Health Research Ethics Committee (HREC) complies with the SA National Health Act No. 61 of 2003 as it pertains to health research. The HREC abides by the ethical norms and principles for research, established by the World Medical Association (2013). Declaration of Helsinki: Ethical Principles for Medical Research Involving Human Subjects; the South African Department of Health (2006). Guidelines for Good Practice in the Conduct of Clinical Trials with Human Participants in South Africa (2nd edition); as well as the Department of Health (2015). Ethics in Health Research: Principles, Processes and Structures (2nd edition).

The Health Research Ethics Committee reviews research involving human subjects conducted or supported by the Department of Health and Human Services, or other federal departments or agencies that apply the Federal Policy for the Protection of Human Subjects to such research (United States Code of Federal Regulations Title 45 Part 46); and/or clinical investigations regulated by the Food and Drug Administration (FDA) of the Department of Health and Human Services.

Appendix F: Permissions from health professions or research regulatory bodies

Botswana

PRIVATE BAG 0038
GABORONE
BOTSWANA
REFERENCE:

REPUBLIC OF BOTSWANA
MINISTRY OF HEALTH AND WELLNESS

TEL: (+267) 363 2500
FAX: (+267) 391 0647
TELEGRAMS: RABONGAKA
TELEX: 2818 CARE BD

REFERENCE NO: HPDME 13/18/1 **07th May 2019**

Health Research and Development Division

Notification of IRB Review: **New application**

Maria Yvonne Charumbira
15 Kleintuin Weg, Edgemead,
Capetown, 7441, South Africa

Dear Maria Yvonne Charumbira

Protocol Title: **PHYSIOTHERAPISTS' AWARENESS OF BONE DEMINERALISATION AND FALLS RISK IN PEOPLE LIVING WITH HIV AND THEIR PERCEPTIONS OF FALLS RISK MANAGEMENT VERSION 001.**

HRU Approval Date:	07 May, 2019
HRU Expiration Date:	06 May, 2020
HRU Review Type:	Expedited Review
HRU Review Determination:	Approved
Risk Determination:	Minimal risk

Thank you for submitting new application for the above referenced protocol. The permission is granted to conduct the study.

This permit does not however give you authority to collect data from the selected sites without prior approval from the management. Consent from the identified individuals should be obtained at all times.

The research should be conducted as outlined in the approved proposal. Any changes to the approved proposal must be submitted to the Health Research and Development Division in the Ministry of Health for consideration and approval.

Furthermore, you are requested to submit at least one hardcopy and an electronic copy of the report to the Health Research, Ministry of Health and Wellness within 3 months of completion of the study. Approval is for academic fulfillment only. Copies should also be submitted to all other relevant authorities.

Continuing Review

In order to continue work on this study (including data analysis) beyond the expiry date, submit a Continuing Review Form for Approval at least three (3) months prior to the

protocol's expiration date. The Continuing Review Form can be obtained from the Health Research Division Office (HRDD), Office No. 7A.7 or Ministry of Health website: www.moh.gov.bw or can be requested via e-mail from Mr. Kgomotso Motlhanka, e-mail address: kgmmotlhanka@gov.bw As a courtesy, the HRDD will send you a reminder email about eight (8) weeks before the lapse date, but failure to receive it does not affect your responsibility to submit a timely Continuing Report form

Amendments

During the approval period, if you propose any change to the protocol such as its funding source, recruiting materials, or consent documents, you must seek HRDC approval before implementing it. Please summarize the proposed change and the rationale for it in the amendment form available from the Health Research Division Office (HRDD), Office No. 7A 7 or Ministry of Health website: www.moh.gov.bw or can be requested via e- mail from Mr. Kgomotso Motlhanka, e-mail address: kgmotlhanka@gov.bw . In addition submit three copies of an updated version of your original protocol application showing all proposed changes in bold or "track changes".

Reporting

Other events which must be reported promptly in writing to the HRDC include:

- Suspension or termination of the protocol by you or the grantor
- Unexpected problems involving risk to subjects or others
- Adverse events, including unanticipated or anticipated but severe physical harm to subjects.

If you have any questions please do not hesitate to contact Mr. K. Motlhanka at kgmmotlhanka@gov.bw, Tel +267-3632751. Thank you for your cooperation and your commitment to the protection of human subjects in research.

Yours sincerely

Ms S. Mosweunyane
for /PERMANENT SECRETARY

MINISTRY OF HEALTH
RESEARCH DIVISION
2019 -05- 07
P/BAG 0038
GABORONE
REPUBLIC OF BOTSWANA

TELEPHONE: 3621400
FAX: 3973776
PLOT NO. 1836
HOSPITAL WAY

REPUBLIC OF BOTSWANA

PRINCESS MARINA HOSPITAL
P. O. BOX 258
GABORONE
BOTSWANA

REF: PMH 5/79 I **17th May 2019**

TO: Ms. Maria Yvonne Charumbira
University of Stellenbosch
Francie van Zijl Drive
Tygerberg
7505
Capetown
South Africa

Dear Madam,

In response to your request to carry out a study titled ***"Physiotherapist's awareness of bone demineralization and falls risk in people living with HIV/AIDS and their perception about falls risk management"*** in our Physiotherapy Department, you are hereby informed that it is feasible to go ahead with the study provided:

(1) You get approval from the appropriate bodies/committees and furnish us with such e.g. Princess Marina Hospital Research and Ethics Committee etc.

(2) You get approval from the physiotherapists themselves.

(3) Demonstrate/show the benefits our institution including Physiotherapy Department will receive from the study e.g. inform us on the results etc.

Yours Sincerely,

Molopo Molopo (Mr.)
Chief Physiotherapist
Head of Department
Princess Marina Hospital Physiotherapy

South Africa

Western Cape Government
Health

Health impact assessment
Health research sub-directorate
Health.Research@westerncape.gov.za
tel: +27 21 483 0866: fax: +27 21 483 9895
5th Floor, Norton Rose House, 8 Riebeek Street, Cape Town, 8001
www.capegateway.gov.za)

REFERENCE: WC_201809_034
ENQUIRIES: Dr Sabela Petros

Stellenbosch University

Tygerberg Campus

Francie van Zijl Drive

Parow Valley

Cape Town

7505

For attention: Mrs Maria Yvonne Charumbira, Prof Quinette Louw

Re: **Physiotherapists' Awareness of Bone Demineralization and Falls Risk in People Living with HIV and Their Perceptions of Falls Risk Management.**

Thank you for submitting your proposal to undertake the above-mentioned study. We are pleased to inform you that the department has granted you approval for your research.

Please contact the following people to assist you with any further enquiries in accessing the following sites:

Khayelitsha District Hospital	**Dr Moses Witbooi**	**021 360 4386**
Alexandra Hospital	**Ms Joy Harding**	**021 503 5009**
False Bay Hospital	**Dr Wendy Waddington**	**021 782 1121**
Wesfleur Hospital	**Dr Ziefred McConey**	**021 571 8052**
Bishop Lavis CDC	**Sr Rachel Carelse**	**021 934 6051**
Delft CHC	**Dr Sheron Forgus**	**021 954 2237**

Kindly ensure that the following are adhered to:

1. Arrangements can be made with managers, providing that normal activities at requested facilities are not interrupted.
2. By being granted access to provincial health facilities, you are expressing consent to provide the department with an electronic copy of the final feedback (**annexure 9**) within six months of completion of your project. This can be submitted to the provincial Research Co-ordinator (Health.Research@westerncape.gov.za).
3. In the event where the research project goes beyond the *estimated completion* date which was submitted, researchers are expected to complete and submit a progress report (**Annexure 8**) to the provincial Research Co-ordinator (Health.Research@westerncape.gov.za).
4. The reference number above should be quoted in all future correspondence.

Yours sincerely

MS A VAN DEN BERG

ACTING DIRECTOR: HEALTH IMPACT ASSESSMENT

DATE: 2018/12/11

Zambia

UNIVERSITY OF ZAMBIA HEALTH SCIENCES RESEARCH ETHICS COMMITTEE

P. O. Box 50110
Lusaka,
Zambia
IRB no: 00011000

IORG no: 0009227

Tel: +260953078410
Tel: +260977925304
Email: unzahsrec@gmail.com
FWA no: 00026270

Protocol ID: 20181204086

22nd October 2018

Maria Yvonne Charumbira
Stellenbosch University
Department of Physiotherapy
Faculty of Health Sciences and Medicine
Cape Town, 8000
South Africa

Dear Ms. Charumbira,

Re: Ethics Approval of Protocol ID Number 20181204086

I write to inform you that your study entitled ***'Physiotherapists' Awareness of Bone Mineral Demineralization and Falls Risk in People Living with HIV and their Perceptions of Falls Risk Management'***, submitted by you as the principal investigator to our research ethics committee has been reviewed under the normal review process and has been approved.

Note that the study approval duration is for one year after which you may renew the protocol. Your renewal date is 21st October 2019.

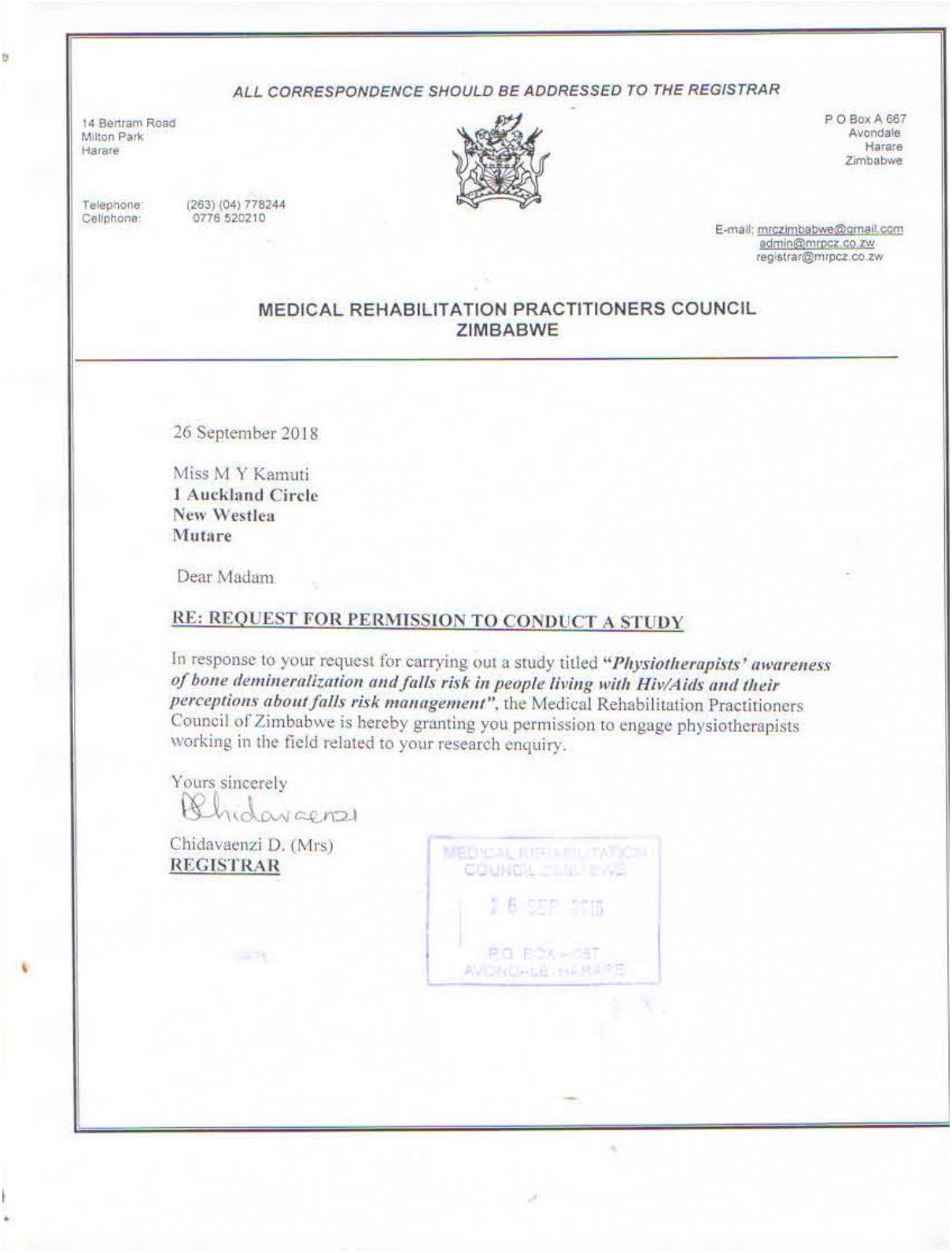
The research ethics committee expects to be informed about the progress of the study, any adverse events occurring in the course of the study, any revision of the protocol and participant information sheet/informed consent form and ask to be provided a copy of your final report.

Yours faithfully,

Sody M. Munsaka, BSc, MSc, PhD
CHAIRPERSON

UNIVERSITY OF ZAMBIA HEALTH SCIENCES RESEARCH ETHICS COMMITTEE
IRB no: 00011000 IORG no: 0009227 FWA no: 00026270

Zimbabwe



ALL CORRESPONDENCE SHOULD BE ADDRESSED TO THE REGISTRAR

14 Bertram Road
Milton Park
Harare

P O Box A 667
Avondale
Harare
Zimbabwe

Telephone: (263) (04) 778244
Cellphone: 0776 520210

E-mail: mrczimbabwe@gmail.com
admin@mrpcz.co.zw
registrar@mrpcz.co.zw

MEDICAL REHABILITATION PRACTITIONERS COUNCIL
ZIMBABWE

26 September 2018

Miss M Y Kamuti
1 Auckland Circle
New Westlea
Mutare

Dear Madam

RE: REQUEST FOR PERMISSION TO CONDUCT A STUDY

In response to your request for carrying out a study titled ***"Physiotherapists' awareness of bone demineralization and falls risk in people living with Hiv/Aids and their perceptions about falls risk management"***, the Medical Rehabilitation Practitioners Council of Zimbabwe is hereby granting you permission to engage physiotherapists working in the field related to your research enquiry.

Yours sincerely
Chidavaenzi

Chidavaenzi D. (Mrs)
REGISTRAR

MEDICAL REHABILITATION COUNCIL ZIMBABWE
26 SEP 2018
P.O. BOX A667
AVONDALE HARARE

NB. The researcher is still registered with Medical Rehabilitation Practitioners Council of Zimbabwe (MRPCZ) in her maiden name Kamuti.

Appendix G: Code book

APPENDIX

CODE BOOK

Code	Grounded	Code Groups	Comments
CPD on falls Mx/+	1	Aware of falls in PLWH	Physiotherapist have had access to training on falls prevention
Aware of BMD loss in PLWH	4	Aware of BMD loss in PLWH	Physiotherapists are aware of bone demineralisation occurring in PLWH
Aware of co-morbidities in PLWH	27	Aware of falls in PLWH	Physiotherapists are aware of the comorbidities that could contribute to falls in PLWH
Aware of fall-related fractures	5	Aware of BMD loss in PLWH	Physiotherapists are aware of fall-related fractures occurring in their patients living with HIV
Aware of functional risk factors	23	Aware of falls in PLWH	Physiotherapists are aware of the functional risk factors present in PLWH
Aware of risk of falls in PLWH	8	Aware of falls in PLWH	Physiotherapists are generally aware of risk of falls in PLWH
BMD loss in PLWH: prolonged bed rest	1	Unaware of BMD loss in PLWH	Physiotherapists only linked BMD loss with prolonged bed rest and not effect of ART or HIV
Cases of pathological fractures in PLWH	4	Aware of BMD loss in PLWH	Physiotherapists aware of fragility/ low trauma fractures in PLWH that may occur as a result of bone loss
CPG/-	5	PT not adequately equipped for falls Px	Physiotherapists do not have clinical practice guidelines available to them on falls prevention and/or care of PLWH
CPG/+	2	PT equipped for fall Px	Physiotherapists have clinical practice guidelines available to them on falls prevention and/or care of PLWH
Current falls Ax/+	12	PT equipped for fall Px	What physiotherapists are currently doing to assess falls in PLWH
Current falls Mx/+	22	PT equipped for fall Px	What physiotherapists are currently doing to prevent falls in PLWH
Doctor is gatekeeper to patients	2	Health system deficiencies	Doctors solely control who of multidisciplinary team sees PLWH
Doctors referral of PLWH for falls/-	7	Unaware of risk of falls in PLWH	Doctors do nt refer PLWH to physiotherapists specifically for falls prevention
Effect of ARV on function	3	Aware of risk of falls in PLWH	Physiotherapists aware of potential effects of ART on function in PLWH that could result in falls
PT in employed in PHC of PLWH/-	1	Health system deficiency	No physiotherapists employed in primary care of PLWH/ Human resources deficiency
Hospital initiatives for risk of falls/+	2	PT equipped for fall Px	Hospitals have falls prevention strategies in place
Inadequate assistive devices	2	Health system deficiencies	Assistive devices e.g. crutches, walking frames or wheelchairs are inaccessible to PLWH

CPD on falls in PLWH/-	1	PT not adequately equipped for falls Px	Physiotherapists have not had opportunities for CPD
HR/-	1	Health system deficiencies	Shortage of health care professionals to provide services to PLWH
UGT/-	11	PT not adequately equipped for falls Px	Physiotherapists did not have enough training on care of PLWH including falls prevention during prelicensure training
Inefficient data capturing systems	1	Health system deficiencies	Physiotherapists do not statistical evidence available to them due to inefficient data capturing
Facility to measures BMD/-	7	Health system deficiencies	Physiotherapists do not have access to facilities for measuring BMD in PLWH: expensive or unavailable
Social support for PLWH/-	1	Health system deficiencies	PLWH do not have social support from families or community
Recommendation/ MDT education	3	Recommendations	Physiotherapists recommended that members of MDT be educated about falls prevention in PLWH and role physiotherapists play
Negative side effects of ART	5	Unaware of BMD loss in PLWH	Physiotherapists cited other negative side effects of ART besides bone demineralisation
Fall Px strategies/-	3	PT not adequately equipped for falls Px	No fall prevention strategies in their current management of PLWH
Financial support for PLWH/-	1	Health system deficiencies	Lack of community-re-integration for PLWH regarding financial independence
Routine Ax of falls in PLWH/-	5	PT not adequately equipped for falls Px	Physiotherapists not routinely assessing for falls in PLWH
Screening tools/-	6	PT not adequately equipped for falls Px	Physiotherapists do not have screening tools available to them to assess falls in PLWH
Other health professionals Ax ROF	4	PT not adequately equipped for falls Px	The role of assessing falls carried out by other health professionals besides physiotherapists
Patient perception	1		PLWH's perception of their falls
PLWH discharged before able to walk	2	Health system deficiencies	Lack of community-re-integration for PLWH regarding functional independence
PLWH unaware of status	1	Unaware of risk of falls in PLWH	PLWH do not know that they have HIV infection
Poor referral system	2	Health system deficiencies	PLWH are not referred adequately to other health care professionals
Positive effects of ARVs	9	Unaware of BMD loss in PLWH	Physiotherapists cited positive side effects of ART rather than bone demineralisation
Possible reasons for risk of falls in PLWH	17	Aware of falls in PLWH	Clinical reasoning to explain why falls would likely occur in PLWH even though they were not aware of the risk
PT not encouraging ARV adherence	1	PT not adequately equipped for falls Px	Physiotherapists not assessing PLWH's adherence to ART

PT referral to MDT/-	3	PT not adequately equipped for falls Px	Physiotherapists not referring PLWH to other health care professionals for falls prevention
PT referral to MDT/+	16	PT equipped for fall Px	Physiotherapists referring PLWH to other health care professionals for falls prevention
PT unaware of BMD loss in PLWH	4	Unaware of BMD loss in PLWH	Physiotherapists are unaware of risk of accelerated bone loss in PLWH
PT unaware of effects of ART on bones	7	Unaware of BMD loss in PLWH	Physiotherapists are unaware of bone loss occurring as effect of ART
PT unaware of falls risk in PLWH	13	Unaware of risk of falls in PLWH	Physiotherapists indicate general unawareness of risk of falls in PLWH
PT unaware of PLWH's serostatus	1	Unaware of risk of falls in PLWH	Physiotherapists do not know serostatus of patients
Recommendation/ Community awareness	6	Recommendations	Physiotherapists recommend that community is made aware of possible risk of falls in PLWH
Recommendation/ Development of CPG	1	Recommendations	Physiotherapists recommend development of clinical practice guidelines on care of PLWH including falls prevention
Recommendation/ PT education	6	Recommendations	Physiotherapists recommend that qualified and student physiotherapists receive training on falls prevention in PLWH
Recommendation/ PT increased awareness	3	Recommendations	Physiotherapists realise they need to be on the lookout for PLWH at high risk of falls during their assessments
Screening tool/+	1	PT equipped for fall Px	Physiotherapists have screening tools for assessment of falls in PLWH
Undefined PT roles in care of PLWH	1	Health system deficiencies	Physiotherapists' role in care of PLWH is not well-defined
Unequal opportunities for PT's CPD	9	Health system deficiencies	Physiotherapists have unequal opportunities for CPD courses on falls prevention and/or care of PLWH.