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HIV among older adults in sub-Saharan Africa: a neglected epidemic

Joel Negin

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

Doctor of Philosophy

THE UNIVERSITY OF SYDNEY

Sydney School of Public Health
The University of Sydney
October 2012
Declaration

The work presented in this thesis is, to the best of my knowledge and belief, original except as acknowledged in the text. I hereby declare that I have not submitted this material, either in full or in part, for a degree at this or any other institution.

Signature:

Date: 18 October 2012
Acknowledgements

I would like to thank the many people who have supported me throughout the PhD journey. I have had the benefit of guidance and collegial collaboration from a number of people around the world that have made the process intellectually stimulating and enjoyable.

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Table of contents

Note on the Author’s Contribution ........................................... 1
Abbreviations ............................................................................. 2
Thesis overview .......................................................................... 4

Introduction .............................................................................. 7

  Supplementary Information ....................................................... 45


  Supplementary Information ....................................................... 63

  Supplementary Information ....................................................... 84


Appendix Two: Negin J, Rozea A, Martiniuk ALC. HIV behavioural interventions targeted to older adults: a systematic review. Submitted


Appendix Four: Negin J, Mills EJ, Albone R. Continued neglect of ageing of HIV epidemic at UN meeting. Lancet 2011; 378:768

Appendix Five: Signed co-author certification forms
Note on the author’s contribution

For all publications contained in this thesis, the candidate designed the specific research question, performed the vast majority of the data analysis, interpreted the data, prepared the first draft of each manuscript and facilitated the finalisation of the final manuscripts for submission. In addition, for Chapters One and Three, the candidate contributed to the development of the data collection instruments. For the other chapters, the candidate gained access to data that had been collected and was either publicly available or that was made available to the candidate by other researchers. For Chapter Three, Bennett Nemser provided statistical support with multilevel model analysis. The candidate is primary author on all publications. The candidate researched and wrote the introduction and conclusion sections including performing the literature review.

Signed authors contribution statements for each chapter can be found in the Appendix.
### Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>AIDS</td>
<td>Acquired Immunodeficiency Syndrome</td>
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<tr>
<td>ART</td>
<td>anti-retroviral treatment</td>
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<td>ARV</td>
<td>antiretroviral</td>
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<td>BMI</td>
<td>Body Mass Index</td>
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<td>CHW</td>
<td>community health worker</td>
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<td>CI</td>
<td>confidence interval</td>
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<td>DBP</td>
<td>diastolic blood pressure</td>
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<td>DHS</td>
<td>Demographic and Health Surveys</td>
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<td>HIV</td>
<td>Human Immunodeficiency Virus</td>
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<td>HIV+</td>
<td>HIV positive</td>
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<tr>
<td>HSRC</td>
<td>Human Sciences Research Council</td>
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<tr>
<td>IeDEA</td>
<td>International Epidemiologic Databases to Evaluate AIDS</td>
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<td>KAIS</td>
<td>Kenya AIDS Indicator Survey</td>
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<tr>
<td>LMIC</td>
<td>Low and Middle Income Countries</td>
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<td>MDG</td>
<td>Millennium Development Goals</td>
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<td>MOH</td>
<td>Ministry of Health</td>
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<td>MVP</td>
<td>Millennium Villages Project</td>
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<tr>
<td>NCD</td>
<td>non-communicable disease</td>
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<td>NDOH</td>
<td>National Department of Health, South Africa</td>
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<tr>
<td>PEPFAR</td>
<td>U.S. President's Emergency Plan for AIDS Relief</td>
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<td>PLWHA</td>
<td>people living with HIV and AIDS</td>
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<tr>
<td>PMTCT</td>
<td>prevention of mother to child transmission</td>
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<td>ROADMAP</td>
<td>Reeducating Older Adult in Maintaining AIDS Prevention</td>
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<td>SAGE</td>
<td>Study of global AGEing and adult health</td>
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<td>SBP</td>
<td>systolic blood pressure</td>
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<td>Abbreviation</td>
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<tr>
<td>SSA</td>
<td>sub-Saharan Africa</td>
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<tr>
<td>UHSS</td>
<td>Uganda HIV/AIDS Sero-behavioural Survey</td>
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<tr>
<td>UNAIDS</td>
<td>Joint United Nations Programme on HIV/AIDS</td>
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<tr>
<td>UNGASS</td>
<td>United Nations General Assembly Special Session</td>
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<tr>
<td>US</td>
<td>United States</td>
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<td>VA</td>
<td>verbal autopsy</td>
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<td>WHO</td>
<td>World Health Organization</td>
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<td>WHODAS</td>
<td>WHO Disability Assessment Schedule</td>
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<td>WHR</td>
<td>wait to hip ratio</td>
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Thesis Overview

As the HIV epidemic enters into its fourth decade, the epidemiology continues to change and the response continues to adapt. One of the most significant trends in HIV in developed countries has been the ageing of the cohort as HIV-positive individuals infected while young survive longer with anti-retroviral treatment and due to ongoing sexual transmission among those aged 50 years and older. In the United States for example, recent estimates have noted that around 50% of people living with HIV will be older than 50 by 2015.

Despite these clear trends and their significant implications for prevention, care and treatment – specifically with regard to co-morbidity with various chronic diseases – very little analysis has been conducted on the HIV and ageing phenomenon in developing countries.

This thesis aims to address the shortage of evidence in this emerging area by focusing on HIV infection among older adults in sub-Saharan Africa – the region where the HIV burden is greatest – from a number of different quantitative angles.

This thesis contains five published works. The University of Sydney’s Academic Board approved submission of published work as a thesis on 14 August 2002. The thesis adheres to the University of Sydney thesis by publication format.
Chapter One highlights the high rates of AIDS-related mortality among older adults in a rural community in high prevalence western Kenya. This mortality underscores the need to better understand the issue of HIV among older adults in Africa.

Chapter Two estimates the number of people aged 50 years and older living with HIV in sub-Saharan Africa using United Nations data. Chapter Three examines HIV-related awareness, knowledge and testing behaviour among those aged 50 years and older in nine rural sites in seven African countries.

Chapter Four examines HIV infection and treatment outcomes among older adults in Zomba District in Malawi. Chapter Five uses a large population-based survey among older adults in South Africa to develop a picture of HIV infection along with an examination of rates of diabetes, stroke, arthritis, depression and other conditions.

Together, these papers and chapters explore the multi-faceted aspects of HIV among older adults in Africa. Mortality, epidemiology, awareness, treatment outcomes and co-morbidities are all addressed to develop a fuller quantitatively-driven picture of the issues and challenges facing older adults and the responses needed for this important emerging trend.

**Ethical Clearance**

Malawi’s National Health Sciences Research Committee provided ethical approval for Chapter Four. The research conducted for Chapters One and Three was approved by the ethical review committee at Columbia University, New York, USA, and by all governments of host countries – in the case of Chapter One specifically, the Kenya...
Medical Research Institute ethics board. Ethical review and clearance for Chapter Five was obtained through the World Health Organization and South Africa’s Human Sciences Research Council Research Ethics Committee. Ethical approval was not required for Chapter Two. Prior to receipt and analysis for this thesis, all data sets were anonymised.
Introduction
The Human Immunodeficiency Virus (HIV) is one of the greatest public health challenges facing the global community. Since first being identified in 1981, HIV and the Acquired Immunodeficiency Syndrome (AIDS) that it causes have led to an estimated 30 million deaths worldwide [1]. As of 2008, AIDS caused 3.1% of total global mortality making it the sixth highest cause of death [2]. At the end of 2010, UNAIDS estimated that, worldwide, 34 million people [range of 31.6 million to 35.2 million] were living with HIV [3]. This led Kofi Annan, then Secretary-General of the United Nations, to declare in 2006 that HIV and AIDS “has inflicted the single greatest reversal in the history of human development… it has become the greatest challenge of our generation”[4].

More than 92% of people living with HIV and AIDS (PLWHA) live in low- and middle-income countries (LMIC) with about 68% of the total living in sub-Saharan Africa [3]. It is in Africa that the HIV epidemic has had and continues to have its greatest impact with 70% of new HIV infections in 2010. The countries with the highest prevalence of HIV among those aged 15-49 years are in the southern part of Africa. Sub-Saharan Africa is also a region of the world beset by high rates of poverty with 51% of the population living on less than the United Nations and World Bank defined poverty line of $1.25 a day as of 2005 [5].

Over the past decade and especially over the past five years, there has been a robust response to the epidemic in LMICs. While the total available funds for HIV-related activities in LMIC in 2001 was US$1.6 billion, according to UNAIDS, in 2009 US$15.9 billion was available for HIV-related activities in LMIC from all sources [1]. Of this, US$7.6 billion was from international donor funding disbursements [6].
The response – focusing on prevention, care and treatment – has predominantly focused on certain groups. Much of the early emphasis of the HIV response was on children partly due to the view that they were innocent (while their parents suffered from the high levels of early stigma) and partly due to the fact that single-dose nevirapine was the first preventative treatment seen to be appropriate for use in developing countries based on feasibility and costs. As a result, a great deal of attention went into prevention of mother-to-child transmission services and, in order to reach pregnant women, the delivery channel widely used was the pre-existing provision of ante-natal care services [7, 8].

Additionally, following on from patterns seen in developed countries such as the United States and Australia, the early response to the epidemic focused on those deemed to be at high-risk of HIV infection such as men who have sex with men, sex workers and injecting drug users.

One group that has not received much attention in the LMIC HIV response has been adults aged 50 years and older. Those aged 50 years and older are not even counted in the common HIV prevalence reports. Setel and colleagues assert the importance of “making everyone count by counting everyone,”[9] yet in the context of HIV, older adults are ignored. UNAIDS and the World Health Organization (WHO) annual HIV epidemic updates report on prevalence for those aged 15-49 and for children aged 0-14 and has done so for more than a decade [1]. The indicators used by the United Nations General Assembly Special Session on HIV/AIDS reporting cycle also focus on those aged 15-49 and those aged 15-24 for some indicators [10]. The Millennium
Development Goals HIV-related indicators require reporting on those aged 15-24 only [11]. Demographic and Health Surveys that serve as the basis for much health-related evidence in developing countries generally only interview women aged 15-49 and men up to ages 54 or 59 [12]. The lack of attention to those aged 50 years and older is not only in terms of statistics but also in terms of prevention messaging and targeted programming which predominantly targets youth, pregnant women and the aforementioned high risk groups.

In this thesis, the term “older adults” is used to describe those aged 50 years and older. It is acknowledged that in many developed countries, people in this age group would not be considered old or elderly. In Australia for example, most studies on the elderly focus on those aged 65 years and above or even 70 [13]. The reason the 50 years cut off point is used in this thesis is because of the use mentioned in the previous paragraph of the 15-49 bracket for the majority of HIV surveillance over the first two decades of the HIV response. Many individuals aged 50 and above are productive members of society and are community, business and political leaders. They do not necessarily exhibit characteristics that would generally be associated with the elderly. Therefore, the relative term “older adult” is used to differentiate from the commonly used 15-49 category. Where evidence relates to groups that are not aged 50 years and older, the specific age bracket is provided.

Some would assume that because HIV is a sexually-transmitted infection that older adults are not at risk or should not be considered in the HIV response. The need to pay more attention to older adults and HIV is driven by two realities: a) that people
aged 50 years and older remain sexually active; and b) that the roll-out of treatment has led to PLWHA surviving longer and ageing with HIV.

Despite ageist attitudes that older adults are not sexually active [14], there is substantial evidence that people remain sexually active past the age of 50 and well into their 70s. Data from the United States (US) [15, 16], Europe [17, 18] and Asia [19, 20] all highlight that a considerable proportion of the elderly are sexually active – especially men. In a Swiss study, the 46-65 age group showed the highest number of occasional sexual contacts per person compared to those aged 19-30 and 31-45 [17]. At the same time, actions to actively prevent the transmission of sexually transmitted infections are less common among older adults than among younger adults [21]. Rates of condom use in particular are less frequent among older adults in developed country settings [22].

The expansion of treatment has also had a considerable impact on the ageing of the HIV epidemic. In the face of the immense challenges posed by HIV and AIDS, the global community has, over the past eight years, made substantial progress in the provision of treatment. At the end of 2010, UNAIDS estimated that at least 6.6 million people in LMICs were receiving life-prolonging anti-retroviral treatment (ART) [3]. At the end of 2002, this figure was 300,000 demonstrating the considerable achievements made in a relatively short period of time in difficult circumstances. In 2010 alone, 1.35 million people were put on treatment. In total, as of the end of 2010, in low- and middle-income countries, 47% of the 14.2 million people eligible for treatment were on ART with some countries including Namibia, Rwanda and Zambia achieving coverage rates over 70% [3].
As expected, widespread provision of ART to those living with HIV in developed and developing countries has been proven to significantly reduce mortality from AIDS with strong evidence from South Africa [23] and Ethiopia [24] among other countries. The widespread provision of ART has therefore reduced mortality from AIDS-related causes down from a peak of 2.2 million per year in the mid-2000s to 1.8 million in 2010 [3].

One of the results of the roll-out of ART more widely in Africa and other parts of the world has been that PLWHA have been surviving longer. HIV and AIDS is no longer a death sentence but has been transformed to a large degree into a chronic disease that can be managed. With individuals now surviving for years on ART and with the upper limit of survival on ART unknown but certainly surpassing 15 years, those who were infected with HIV in their 30s and 40s are now surviving into their 50s and beyond. This is leading to an ageing of the HIV cohort in LMIC.

_HIV among older adults in developed countries_

Despite being largely ignored in LMIC, the ageing of the epidemic has been widely documented in developed countries. As far back as the early 1990s, clinicians in the US were commenting on HIV infection among older adults and lamenting the neglect by those providing medical services [25-27]. For example, el-Sadr and Gettler stated that healthcare providers were less likely to attribute HIV-related symptoms to the disease in older people [28] and another article outlined specific tips for how nurses could identify HIV among the aged [29]. At the same time, this led researchers to
examine HIV-related risk behaviour among older adults specifically with a view to better understanding possible preventative response models [30, 31].

Epidemiological data on the ageing of the HIV cohort in developed countries is abundant. In the US, in 2005, 25% of those infected with HIV were older than 50 years of age [32] and recent estimates have noted that around 50% of people living with HIV will be older than 50 by 2015 [33]. The number of adults aged 50 years and older living with HIV grew by 14% a year between 2004 and 2007 [34]. This is not only the results of longer survival due to treatment; older adults accounted for 15% of new cases of HIV in the US in 2005 [35]. Western European data reveals that 12.9% of newly reported cases of HIV infection in 2007 were among people aged 50 and older compared to 10.4% in 2003 [36]. The percentage of older adults among new infections in Eastern Europe has doubled over the same time frame [36]. In the Swiss HIV Cohort, 31% of individuals are aged 50 and older [37]. Articles have highlighted the HIV and ageing phenomenon in New York [38], London [39], Italy [40] and Australia [41].

The various developed country studies note that older people are less knowledgeable about HIV than younger people [42]. Older adults in the US have also been shown to perceive themselves to be at lower risk of HIV infection which has considerable implications on risk behaviour [42]. Evidence shows that older adults engage in risky sexual behaviour as much as younger adults [43]. One study revealed that among those who had more than one partner in the past five years, those aged over 50 were one-sixth as likely to use condoms as risk takers in their twenties [43]. Older women
in particular have difficulty negotiating safe sex [44]. This situation is driven by the lack of sexual health information specifically targeting older adults [45].

As in LMIC, in developed countries, the ageing of the epidemic has been driven by both individuals surviving longer on treatment and sexual transmission among over 50s. One UK study estimates that 48% of older adults diagnosed between 2000 and 2007 acquired their infection at age 50 and over [46].

Over the past few years, evidence on how older adults respond to infection and treatment has been emerging [47-50]. Age, independent of HIV infection, is linked to a decline in the production of naïve T cells and diminished T cell functionality; these are exacerbated by HIV infection [51]. As a result, older adults have been shown to have steeper declines in CD4 count [52] and slower immune system reconstitution than younger adults following treatment [53].

Hypotheses attribute some of the poorer outcomes to the low levels of knowledge of and services for older adults. The result of this was that those aged 50 and older are more often late presenters with a UK study finding that the proportion of older adults who were diagnosed with a CD4 cell count less than 200 was higher than among younger individuals [46]. Older adults have been found to progress to an AIDS diagnosis faster than younger adults in the absence of treatment and to have higher rates of morality [54]. Post-ART studies have mixed outcomes but generally show little difference in mortality between older and younger adults [55, 56].
Much of the recent evidence on HIV and ageing coming from developed country settings focuses on the issue of co-morbidities between HIV and various non-communicable diseases. Whereas the early emphasis was on AIDS-related conditions such as Kaposi’s sarcoma, pneumonia and tuberculosis, the majority of the clinical events occurring among those on ART in developed countries are classified as “non-AIDS” events including many chronic non-communicable diseases [57]. Amy Justice has called this “the inevitable price of success” as individuals on treatment survive longer into older age [34].

As far back as 1991, a US study found that HIV-infected individuals 55 years old have nearly four times more chronic co-morbid conditions than do those 45 years old [58]. Since then, the focus on co-morbidities with HIV among older adults has intensified identifying high rates of conditions such as hypertension, diabetes, arthritis and depression among older adults living with HIV [59]. Older people with HIV infection are at an increased risk of asymptomatic ischaemic heart disease [60] and evidence has linked both HIV infection [61] and ART [62] to diabetes. Studies have identified increased risk of certain cancers [63], intracranial hemorrhage [64] and osteoporosis [65].

A study in Italy confirmed higher rates of liver and renal toxicities in older adults with HIV compared to younger controls aged 25-35 [66]. Over the course of the study, new cardiovascular, endocrine and neuralgic disorders were diagnosed in older individuals (24.5 per 100 person-years) than in the younger controls (3.4 per 100 person-years). Hasse and colleagues used data from the Swiss HIV Cohort Study to highlight elevated rates of multimorbidity among older adults living with HIV and on
ART in Switzerland controlling for factors other than age [37]. An increasing number of patients on ART aged 50 and older were taking four or more other medications. Additional evidence suggests that older adults living with HIV might be at greater risk of cognitive impairment [67] - which may have important implications for medication adherence [68].

Some of the elevated rate of co-morbidities is not due to HIV infection but due to ART itself. One study noted a higher risk of hypertension after five or more years on treatment [69].

The full reasons for the elevated levels of chronic disease among PLWHA are not entirely clear. Some attribute it to residual inflammation and from persistent viral replication [34]. Treatment itself might be a cause [70]. The high and early rates of chronic diseases among HIV-positive older adults in developed countries – what some have characterised as “premature ageing” – might be driven by some nucleoside analog anti-retroviral drugs which affect mitochondrial DNA mutations in a way that mirrors that of normal ageing [71].

The emphasis on co-morbidities heralds an important shift in developed countries of how HIV care is viewed moving from opportunistic infections and AIDS-defining malignancies to chronic co-morbidities. The emerging evidence led one research team to state that:

“Physiological changes observed with ageing, including increased risk of infection, reduced immunocompetence, the appearance of several comorbid conditions which can affect the disease process and complicate its management,
and interactions among antiretrovirals and drugs used for the treatment of other diseases, underline the need for age-related evaluations of treatment and management strategies.” [66]

Beyond developed country studies, data from Brazil’s long-standing and well-resourced HIV epidemic and response reveals that ageing is occurring there as well. According to Pardi and colleagues, the percentage of patients aged 50 years and older diagnosed with AIDS increased from 7% in 1996 to 13% in 2003 [72]. Further Brazilian data from Lacerda and Kitner revealed that older adults aged 60 and older had more AIDS-defining diseases at diagnosis and had a mortality rate four times higher than younger adults [73]. Once on ART however, mortality rates among the two groups were similar.

This preponderance of evidence led Jules Levin, the founder and executive director of the New York–based National AIDS Treatment Advocacy Project, to state in 2009 that “aging is the No. 1 problem in HIV today”[74].

*Neglect of older adults by the international community*

Despite the clear trend evidence from developed countries, the main organisations involved in the global HIV response have made little or no mention of the ageing of the epidemic in their publications and proclamations. An encouraging start was seen in 2006 with the UNAIDS report on the global AIDS epidemic that year stating that their new estimates of the number of adults living with HIV would now include all adults aged 15 years and older as opposed to just those aged between 15 and 49 [75].
They made this change because “it is now evident that a substantial proportion of people living with HIV are 50 years and older” and they estimated that there were around 2.8 million adults aged 50 years and older living with HIV as of 2005 [75].

Since then however, reading the HIV reports of UNAIDS and the World Health Organization among others reveals almost no mention of HIV among those aged 50 years and older. Searching for terms such as “ageing,” “aging,” “mature,” “elderly,” “older adult,” and “demographic trends/changes,” comes up with very few matches.

In the 2011 UNAIDS World AIDS Day report [3], in the 364-page 2010 report on the global AIDS epidemic [76], and in the 2008 WHO towards universal coverage progress report [77], these terms do not appear once and there is no discussion of the future demographic trends that might impact the response.

Both the 2009 epidemic update and the 2011 “AIDS at 30” report by UNAIDS acknowledge that while “older adults in heterosexual relationships account for a large share of new infections,” there are few programmes that address their specific needs [1, 78]. Despite this statement, no further information or data was provided to support a change in policy.

Beyond the UN system documents, there have been other opportunities to highlight the emerging trend of the ageing of the HIV cohort and its potential impact on the HIV response. In June 2011, the UN held a High Level Meeting on AIDS in New York ten years after the historic 2001 United Nations Special Session on HIV/AIDS. The purpose of the meeting was to “take stock of the progress and challenges of the last 30 years and shape the future AIDS response”[79]. Despite the explicit forward
looking goal of the meeting and the presence of many prominent practitioners and heads of state, in the meeting resolution document, there is no acknowledgement of the ageing of the epidemic and its implications and only one mention of non-communicable diseases amidst a long list of conditions with programmatic overlaps with HIV [80].

Beyond the major institutions tasked with responding to the HIV epidemic, individual researchers and practitioners have also failed to directly address the ageing of the epidemic. In order to chart the long-term actions needed to address the trajectory of the HIV epidemic, UNAIDS established a group called “aids2031” with the mandate to do so. This group has emphasised the need for a shift in the response from “crisis management to sustained strategic response” [81]. Despite this, their recent publication makes no mention of ageing and no mention of the likely demographic trends [81].

These organisations and researchers that are meant to be charting the future course of the response to the epidemic have ignored one of the major trends – one that will have considerable impacts on prevention, care and treatment. This led some WHO staff to title an article “the unexplored story of HIV and ageing”[82].

The need for more evidence

It is clear that more evidence is needed regarding HIV among older adults outside of developed countries. This thesis focuses on HIV among older adults in sub-Saharan Africa particularly and does not examine the issue in other parts of the developing
world such as Asia and Latin America. I have chosen to focus on sub-Saharan Africa due to the high rates of HIV prevalence and number of people living with HIV and due to the neglect to date of older adults in Africa.

Furthermore, the prevalence, transmission, treatment and care of HIV among older adults in sub-Saharan Africa will be different from that of developed countries and likely from that of other developing regions – and therefore warrants particular study – for a number of reasons. Firstly, the continuing high rates of poverty among older adults, the higher likelihood of residence in rural areas, and higher rates of illiteracy make questions of access particularly important to older adults in Africa. Secondly, high rates of infectious diseases such as tuberculosis [83], malaria [84] and neglected tropical diseases [85] that are known to interact with HIV make the possible disease burden and co-morbidity issues in Africa distinct from those other settings. Thirdly, the health systems challenges that are pervasive across most African settings – including shortages of health workers, unsustainable health financing systems, poor health information systems and shortages of required medicines [86] – all limit the ability to develop an appropriate response to the challenge of HIV among older adults.

Additionally, a pertinent area of sexual activity that specifically focuses on older adults is intergenerational relationships, which is one of the causes of the prevalence disparity seen between young women and men of the same age. Most studies on intergenerational sex rightly emphasise the vulnerability of young women [87, 88], but fail to examine the age, characteristics, attitudes and behaviours of the older men – at least some of whom are likely to be older than 50 – who are exploiting the vulnerability. This represents another example of how older adults have been
neglected from the HIV response even in situations where they are directly implicated.

The larger contextual background to the lack of exploration of HIV among older adults in Africa is that the general situation of older people in Africa and their health has been neglected by the global policy and research community. This despite the fact that there is a rapidly increasing number of people aged 50 and older in Africa. The United Nations has estimated that the percentage rise of the elderly population in Africa will be the greatest of any region in the world with the proportion aged 65 or over in Africa projected to rise from 3 per cent in 2009 to 7 per cent in 2050 [89]. According to Smith and Mensah, in sub-Saharan Africa alone, the number of persons aged 65 years and older is expected to increase by 50% from 2000 to 2015, from 19.3 million to 28.9 million [90]. They estimate that in the 30-year period from 2000 to 2030, the population of elderly persons is projected to double in the Democratic Republic of Congo, Mozambique, Cameroon and Ghana.

Despite this increase in absolute numbers and as a percentage of the population, the health of people aged 50 and older in Africa has not been a source of much policy or research focus compared to that of women and children. The little work that has been done has highlighted the poor health of older adults. Two reviews of the nutrition and health status of the elderly in sub-Saharan Africa found high rates of poverty and undernutrition among older adults [91, 92]. A Ugandan study found 68% of older women to be undernourished, 81% of older adults to be illiterate, and noted that 76% did not visit health facilities when unwell due to lack of funds and weakness [93]. The reviews and other work have led the authors of one study to state that “very little
is known about the health and well-being of African elders”[94] and another to note that the “elderly are not a health policy priority for African countries”[92].

Most of the evidence on HIV and older adults in Africa to date focuses on caregiving by older adults through the lens of the orphanhood crisis. One estimate stated that up to 323,000 older individuals in Africa could be the sole caregivers of young children due to high rates of AIDS-related mortality [95]. Various studies have examined grandparents providing care for AIDS orphans through the lenses of coping [96], carers’ physical health [97] and emotional well-being [98].

With regard to HIV infection itself among older adults in sub-Saharan Africa, this is an emerging area on which little had been published prior to commencement of this PhD in early 2010. In 2004, a review paper called “aging and infectious diseases in the developing world” contained very little evidence on HIV in Africa [99]. A few older studies from African settings examined HIV among older adults specifically in medical wards [100, 101] or small communities [102] and other research extracted small amounts of data on older adults from amongst larger HIV cohorts [103]. For example, an African study using 1990s data examined death rates among those with HIV and noted that death rates, in the absence of treatment, are higher among older adults than younger counterparts [104]. Other work that emerged prior to commencement of the PhD included a South African HIV survey that found high rates of HIV infection among older people leading to the inclusion of males older than 50 in the national list of most-at-risk populations [105].
More recently, since the start of this PhD, the evidence regarding HIV among older adults has slowly started to build and the published chapters of this PhD have contributed to this momentum. Firstly, two short reports were published acknowledging the phenomenon of HIV and ageing in Africa, its importance and the need for more attention to it [106] - including one in the widely-read Lancet that refers directly to two of the chapters included in this thesis [107].

The wider range of research evidence on HIV and ageing in Africa published since 2010 is outlined in the conclusion but two specific papers that emphatically highlight the importance of the topic to the future of the epidemic’s response are noted here. Using Ugandan data, Mills and colleagues estimated the life expectancy of patients once they initiate ART and found that those who start ART at age 20 are likely to live an additional 26.7 years; at age 35, life expectancy was an additional 27.9 years and at age 50, an additional 24.0 years [108]. This makes clear that as ART coverage expands and as individuals are put on treatment at higher baseline CD4 counts and with better regimens, life expectancy among PLWHA in Africa is likely to extend well past the age of 50.

The evidence of the long-term success of ART has important implications for the demographics of those living with HIV well into the future. Hontelez and colleagues modelled the future trend of HIV over the 30 years from 2010 to 2040 in South Africa [109]. They estimate that HIV prevalence in people aged 50 years and older will nearly double in that time period from 9% to 17% with the fraction of all HIV infected people who are aged 50 and older going up from 1 in 12 now to 1 in 4. These
projections reinforce the importance of understanding HIV among older adults as it will be central to the response over the coming years.

Additionally, the importance of this area of research and policy will increase with the greater attention given to NCDs by the global community over the last few years and in Africa specifically [110-112]. In September 2011, a High Level Meeting on NCDs was held at the United Nations to put the challenge onto the global agenda. Though HIV barely warranted a mention at the NCD meetings, some commentators have drawn the obvious and explicit links noting that “the burden of chronic NCDs is also likely to increase as scaled-up programmes of antiretroviral treatment (ART) of HIV-infected people lead to reduced mortality from HIV/AIDS and possible metabolic side effects resulting from life-long ART medications”[113].

Outline of the thesis

This thesis aims to address the shortage of evidence in this emerging area by focusing on HIV infection among older adults in sub-Saharan Africa from a number of different angles. Each of the chapters presents an analytic perspective on the issue using a variety of quantitative sources. As per University of Sydney guidelines on theses by publication, each of the five main chapters – excluding the introduction and conclusion – are manuscripts that have been published in peer reviewed academic journals. The chapters have been published in high ranking HIV and global health journals including AIDS, the Bulletin of the World Health Organization, JAIDS and AIDS and Behavior.
The first paper included in the thesis as Chapter One highlights the high rates of AIDS-related mortality among older adults in a rural community in high prevalence western Kenya. By revealing that AIDS-related mortality persists at high levels among those aged 50 and older, it becomes clear that there are older adults who are infected with HIV. The facts of mortality underscore the need to better understand the issue of HIV among older adults in Africa.

The second paper and Chapter aims to fill the large epidemiologic evidence gap by estimating the number of people aged 50 years and older living with HIV in sub-Saharan Africa. Using UNAIDS data along with United Nations population data, the number of people living with HIV and the prevalence rates among those 50 and older are estimated. This provides a critical baseline for future analysis and advocacy in line with Setel and colleagues call to make “everyone count by counting everyone”[9].

A critical component of HIV among older adults concerns awareness, knowledge and testing behaviour fundamentally asking: what do older adults know of HIV? Most of the focus of the HIV response to date has been on younger adults and it was thus hypothesised that older adults would have lower rates of HIV-related knowledge than younger adults. This is critical not only for their own prevention and access to treatment but also with regard to providing care to the next generation. Using data from nine rural Millennium Village sites in seven African countries, this hypothesis is tested in the third paper (Chapter Three). Questions around HIV knowledge, awareness, testing and treatment availability were all included and analysed comparing those aged 25-49 with those aged 50 and older.
After developing a better understanding of knowledge and prevention, the fourth paper (Chapter Four) examines infection and treatment. Using ART data from Zomba District in Southern Malawi, the characteristics of older adults enrolled in treatment are analysed along with their treatment outcomes using survival analysis techniques. The central question of if older adults living with HIV are different from their younger counterparts and if they respond as well to treatment is critical to the development of age-appropriate responses to enrolment in treatment, prevention and care.

As highlighted above, the question of co-morbidities has been a focus of the response to HIV among older adults in developed country settings. But very little corresponding analysis has been conducted in Africa. Using a large population based survey among older adults in South Africa, the multi-morbidity question is explored in the fifth paper (Chapter Five). The data is nationally representative of South Africa so a clear picture of HIV infection among older adults in the country is available along with an examination of rates of diabetes, stroke, arthritis and depression among other conditions.

Together, these papers and chapters explore the multi-faceted aspects of HIV among older adults in Africa. Issues of mortality, epidemiology, awareness, treatment outcomes and co-morbidities are all addressed to develop a fuller quantitatively-driven picture of the issues and challenges facing older adults and the responses needed for this important emerging trend.
The research for this thesis was conducted using a variety of quantitative methods including primary data collection in collaboration with the Millennium Villages Project [114] – a multi-sectoral health and development initiative launched in 2004 that aims to demonstrate that achievement of Millennium Development Goals in rural Africa is possible through the coordinated delivery of science-based interventions at the community level [115]. Routinely collected programmatic data from Zomba District in Malawi was also used as well as analysis of available United Nations and World Health Organization datasets. The methods range from national surveys to community health worker administered surveys in a rural Kenyan village. The data presented here all have the advantage of including comparison groups of those younger than 50 years of age so that the older cohort data can be understood in relation to younger age brackets.

Four additional manuscripts that I have led are included as appendices as they relate directly to the topic of this thesis. The first uses data from three rural sites in sub-Saharan Africa and examines risk factors for NCDs among older adults [116]. This appendix provides some of the first data on risk factors among rural older adults and also contributes to the thesis theme of HIV among older adults by examining rates of alcohol use – a known risk factor for HIV transmission [117].

The second appendix is a systematic review of published evidence on HIV interventions specifically targeted to older adults. This review was conducted globally and not specifically for sub-Saharan Africa so is therefore not included as a core chapter. The findings from the review and their relevance to sub-Saharan Africa are, however, discussed in the thesis’s conclusion.
The third appendix is a Perspective piece published in the New England Journal of Medicine that I co-wrote and that provides an overview of the importance of the issue of HIV and ageing in developing countries [118]. The fourth is a letter published in the Lancet critiquing the continued neglect of HIV and ageing at the 2011 United Nations High Level Meeting on AIDS.
References


80. United Nations. Political Declaration on HIV/AIDS: Intensifying our Efforts to Eliminate HIV/AIDS. Draft resolution submitted by the President of the


Chapter One

High Rates of AIDS-Related Mortality Among Older Adults in Rural Kenya

Joel Negin, MIA,* † James Wariero, BPharm,‡ Robert G. Cumming, MBBS, MPH, PhD,* Patrick Mutuo, PhD, † and Paul M. Pronyk, PhD†

**Background:** Health challenges faced by older people in developing countries are often neglected amidst a wide range of competing priorities. This is evident in the HIV field where the upper age limit for reporting HIV prevalence remains 49 years. However, the long latency period for HIV infection, and the fact that older people continue to be sexually active, suggests that HIV and AIDS are likely to affect older people. To better understand this, we studied mortality due to AIDS in people aged 50 and older in an area of rural Kenya with high rates of HIV infection.

**Methods:** A community health worker–administered verbal autopsy system was introduced in Nyanza Province, encompassing 63,500 people. Algorithms were used to determine cause of death.

**Results:** A total of 1228 deaths were recorded during the study period; 368 deaths occurred in people aged 50 years and older. AIDS was the single most common cause of death, causing 27% of all deaths. AIDS continued to be the main cause of death up to age 70 years, causing 34% of deaths in people aged 50–59 years and 23% of deaths in people aged 60–69 years.

**Conclusions:** AIDS remains the principle cause of death among older people in Nyanza Province in western Kenya up until the age of 70 years. Greater efforts are needed to integrate older people into the HIV response and to better understand the specific vulnerabilities and challenges faced by this group.

**Key Words:** AIDS mortality, older adults, verbal autopsy

*(J Acquir Immune Defic Syndr 2010;55:239–244)*

**INTRODUCTION**

Beyond the immediate and acute impacts of HIV infection, it has been suggested that HIV represents a “long-wave event” whose full effects emerge gradually over a period of decades.1 As HIV survival in sub-Saharan Africa increases with the long-wave elements of the epidemic in Africa cannot be ignored. Despite this, the global HIV community has largely focused its attention on the 15–49 age bracket in surveillance and in prevention and treatment programming.

To date, very few studies on HIV have focused on people 50 and older, and these few studies have focused on developed countries.4–10 With Joint United Nations Programme on HIV/AIDS and other prominent HIV data focusing on prevalence of those aged 15–49, the burden of disease among those older than 50 is often ignored and represents a significant blind spot in the response to the epidemic.

One component of understanding disease impact is through examining the patterns and determinants of mortality. However, in many developing countries, where high numbers of deaths take place outside of health facilities, vital events often go unregistered and unreported,11 and the data that do exist are often of poor quality or derived from uncertain estimates.12 Monitoring adult deaths, particularly among those older than 50 years, has received little attention despite the fact that the proportion of older people in developing countries is expected to rise dramatically over the coming decades.13 A number of sources including Demographic and Health Surveys do not include mortality assessments among those aged 50 years or older and do not interview women older than 49 years of age.14–16 Several other adult mortality studies also stop recording at either 49 or 59 years old.17,18

To contribute to a better understanding of HIV among older adults in Africa, this article examines patterns of mortality among older adults in rural western Kenya. We employed data from a novel real-time vital events and verbal autopsy (VA) monitoring platform to track numbers of deaths and their causes, with an emphasis on HIV and AIDS, and note the implications for more effective prevention, care, and support services.

**SETTINGS AND METHODS**

The project was conducted in a cluster of villages in rural Nyanza Province, Kenya—the site of a multisectoral health and development initiative launched in 2004. The Millennium Villages Project (MVP) aims to accelerate progress toward the Millennium Development Goals in rural Africa through the coordinated delivery of science-based interventions at the village scale in agriculture, health, education, and infrastructure.19–22 The project operates in 14 sites in 10 sub-Saharan African countries with project sites drawn from a diversity of agro-ecological zones in “hunger hot-spots,” where rates of child undernutrition exceed 20%.
The villages in the Nyanza Province site encompass 63,500 people of whom 90% lived on less than $2 a day at project commencement in 2004. A baseline survey in 2004 revealed children younger than 5 mortality rate of 149 per 1000 live births and infant mortality rate of 95 per 1000 live births. The area is holoendemic for malaria, and 63% of children younger than 5 tested positive for malaria. The majority of residents are engaged in subsistence agriculture and animal husbandry. Ethical approval for the MVP was provided by both Columbia University and Kenya Medical Research Institute ethics boards.

As of 2008, 12.1% of the study population were aged 50 years or older and 6.6% were 60 years or older.

In the MVP project site, mortality information was routinely collected through a community health worker (CHW)–administered vital events and VA system. VAs have evolved over the past several decades as tools to supplement deficiencies in vital information. Operating at the juncture of demography and public health, VAs are structured interviews administered by non-health workers to the care givers of the deceased. They pose standardized questions about the main symptoms and signs experienced by the deceased in the time leading up to death and the circumstances preceding death. The information obtained from these field interviews are used to make a determination of the probable cause of death. Numerous studies have documented the reliability of the VA technique and its validity (when compared with medical records), with reasonable sensitivity and specificity for selected causes of death among adults and children in Africa and Asia.

The VA administered for this project included the following components:

1. CHW administration: CHWs have been introduced to maximize the delivery of health information and services to households in the project site. There are currently 83 CHWs in the project site—a ratio of 1 CHW to every 130–180 households, with household visits taking place every 1–2 months. Part of the portfolio of these CHWs is the tracking of vital events.

2. Verbal autopsy specialist: The VA specialist is a community health worker specially trained in the VA methodology.

When a death is recorded, a VA is triggered immediately. In practice, VAs are conducted within 2–4 weeks after a death has taken place.

3. VA tools: A standardized VA tool has been developed with separate forms for adult/maternal deaths and for children. The cause of death form has been derived from previously validated VA tools that are tailored to assess signs and symptoms experienced by the deceased in the time preceding death.

4. Algorithmic assessment of cause of death diagnosis: To facilitate a rapid turn-around time for generating critical information for targeting interventions, “expert algorithms” have been employed. These are established valid techniques for determining the probable cause of death, which have been expanded to facilitate an assessment of the social circumstances leading up to death. This innovation eliminates the need for standard dual physician-based assessments, which can be both expensive and create a long-time delay in generating “real-time” information for program managers that can contribute to operational adaptations to rapidly improve service delivery.

Mortality data were routinely collected as part of programmatic interventions for the period January 2008 through May 2009 and were anonymized before analysis. Analysis was conducted in SPSS (SPSS Inc, Chicago, IL) and Excel (Microsoft, Seattle, WA). The age and sex distribution of the population in the survey area was estimated from detailed population demographic information that was previously collected through a household survey of a subsample of the population. This methodology has been presented in detail elsewhere.

Deaths were categorized according to Global Burden of Disease designations with anemia and “old age” categories being added.

RESULTS

Information on a total of 1228 deaths from January 2008 to May 2009 was collected. The annualized mortality rate was 13.65 per 1000. Males accounted for 56.2% of all deaths, with mortality rates of 15.44 per 1000 per year for males and 11.87 per 1000 per year for females. Figure 1 shows number of deaths and mortality rates per year by 5-year age band.

![Figure 1. Number of deaths and mortality rate per 1000 per year by 5-year age groups.](image-url)
Overall, communicable, maternal, perinatal, and nutritional conditions plus anemia accounted for 71.9% of deaths, with noncommunicable diseases accounting for 16.4% and injuries 7.8%. The 5 leading causes of death—AIDS, malaria, respiratory infections, diarrheal diseases, and cardiovascular diseases—accounted for two-thirds of total deaths (Table 1).

For 1.7% of deaths, no specific cause of death could be attributed, and these cases were classified as “other.” The deaths attributed to old age were those for which no specific underlying cause of death could reliably be assigned based on the verbal autopsy tool. The average age of those whose death was characterized as old age was 85.7 years.

AIDS accounted for 39.2% of deaths among men aged 15–49 and 50.0% of deaths among women in the same age group. Together, intentional and unintentional injuries accounted for 15.8% of deaths among men aged 15–49.

Among people aged 50 and older, there were 368 deaths. AIDS was the most frequent cause of death, causing 18.3% of male deaths and 15.8% of female deaths (Table 2). Other communicable diseases such as respiratory infections and malaria were also common causes of death, whereas noncommunicable disease mortality rates were, as expected, higher than in those aged younger than 50. Analysis of mortality in 5-year age bands showed that AIDS remained the main cause of death among those aged in their 50s and 60s, with noncommunicable diseases such as cardiovascular disease and diabetes only overtaking AIDS as the major cause of death past the age of 70 years (Fig. 2).

**Table 1. Total Deaths and Percentage by Cause and by Sex**

<table>
<thead>
<tr>
<th>Cause of Death</th>
<th>Male Deaths</th>
<th>Female Deaths</th>
<th>Total Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIV/AIDS</td>
<td>179 (25.9%)</td>
<td>154 (28.6%)</td>
<td>333 (27.1%)</td>
</tr>
<tr>
<td>Malaria</td>
<td>110 (15.9%)</td>
<td>67 (12.5%)</td>
<td>177 (14.4%)</td>
</tr>
<tr>
<td>Respiratory infections</td>
<td>67 (9.7%)</td>
<td>54 (10.0%)</td>
<td>121 (9.9%)</td>
</tr>
<tr>
<td>Diarrheal diseases</td>
<td>49 (7.1%)</td>
<td>39 (7.2%)</td>
<td>88 (7.2%)</td>
</tr>
<tr>
<td>Cardiovascular diseases</td>
<td>28 (4.1%)</td>
<td>24 (4.5%)</td>
<td>52 (4.2%)</td>
</tr>
<tr>
<td>Intentional injuries</td>
<td>40 (5.8%)</td>
<td>11 (2.0%)</td>
<td>51 (4.2%)</td>
</tr>
<tr>
<td>Malignant neoplasms</td>
<td>19 (2.8%)</td>
<td>8 (1.5%)</td>
<td>27 (2.2%)</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>30 (4.3%)</td>
<td>17 (3.2%)</td>
<td>47 (3.8%)</td>
</tr>
<tr>
<td>Unintentional injuries</td>
<td>28 (4.1%)</td>
<td>17 (3.2%)</td>
<td>45 (3.7%)</td>
</tr>
<tr>
<td>Perinatal conditions</td>
<td>14 (2.0%)</td>
<td>14 (2.6%)</td>
<td>28 (2.3%)</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>18 (2.6%)</td>
<td>9 (1.7%)</td>
<td>27 (2.2%)</td>
</tr>
<tr>
<td>Digestive diseases</td>
<td>17 (2.5%)</td>
<td>10 (1.9%)</td>
<td>27 (2.2%)</td>
</tr>
<tr>
<td>Old age</td>
<td>9 (1.3%)</td>
<td>13 (2.4%)</td>
<td>26 (2.1%)</td>
</tr>
<tr>
<td>Respiratory diseases</td>
<td>11 (1.6%)</td>
<td>13 (2.4%)</td>
<td>24 (2.0%)</td>
</tr>
<tr>
<td>Meningitis</td>
<td>15 (2.2%)</td>
<td>6 (1.1%)</td>
<td>21 (1.7%)</td>
</tr>
<tr>
<td>Other</td>
<td>10 (1.4%)</td>
<td>11 (2.0%)</td>
<td>21 (1.7%)</td>
</tr>
<tr>
<td>Infectious diseases other</td>
<td>8 (1.2%)</td>
<td>12 (2.2%)</td>
<td>20 (1.6%)</td>
</tr>
<tr>
<td>Anemia</td>
<td>10 (1.4%)</td>
<td>9 (1.7%)</td>
<td>19 (1.5%)</td>
</tr>
<tr>
<td>Genitourinary diseases</td>
<td>14 (2.0%)</td>
<td>3 (0.6%)</td>
<td>17 (1.4%)</td>
</tr>
<tr>
<td>Nutritional deficiencies</td>
<td>6 (0.9%)</td>
<td>7 (1.3%)</td>
<td>13 (1.1%)</td>
</tr>
<tr>
<td>Maternal conditions</td>
<td>0 (0.0%)</td>
<td>10 (1.9%)</td>
<td>10 (0.8%)</td>
</tr>
<tr>
<td>Childhood cluster diseases</td>
<td>2 (0.3%)</td>
<td>4 (0.7%)</td>
<td>6 (0.5%)</td>
</tr>
<tr>
<td>Neuropsychiatric conditions</td>
<td>5 (0.7%)</td>
<td>0 (0.0%)</td>
<td>5 (0.4%)</td>
</tr>
<tr>
<td>Congenital anomalies</td>
<td>1 (0.1%)</td>
<td>1 (0.2%)</td>
<td>2 (0.2%)</td>
</tr>
<tr>
<td>Endocrine disorders</td>
<td>0 (0.0%)</td>
<td>1 (0.2%)</td>
<td>1 (0.1%)</td>
</tr>
<tr>
<td>Total</td>
<td>690</td>
<td>538</td>
<td>1228</td>
</tr>
</tbody>
</table>

**Table 2. Total Deaths and Percentage by Cause and by Sex Among Those 50 and Older**

<table>
<thead>
<tr>
<th>Cause of Death</th>
<th>Male Deaths</th>
<th>Female Deaths</th>
<th>Total Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIV/AIDS</td>
<td>36 (18.3%)</td>
<td>27 (15.8%)</td>
<td>63 (17.1%)</td>
</tr>
<tr>
<td>Respiratory infections</td>
<td>27 (13.7%)</td>
<td>17 (9.9%)</td>
<td>44 (12.0%)</td>
</tr>
<tr>
<td>Cardiovascular diseases</td>
<td>23 (11.7%)</td>
<td>20 (11.7%)</td>
<td>43 (11.7%)</td>
</tr>
<tr>
<td>Malignant neoplasms</td>
<td>12 (6.1%)</td>
<td>22 (12.9%)</td>
<td>34 (9.2%)</td>
</tr>
<tr>
<td>Malaria</td>
<td>19 (9.6%)</td>
<td>10 (5.8%)</td>
<td>29 (7.9%)</td>
</tr>
<tr>
<td>Old age</td>
<td>9 (4.6%)</td>
<td>17 (9.9%)</td>
<td>26 (7.1%)</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>16 (8.1%)</td>
<td>6 (3.5%)</td>
<td>22 (6.0%)</td>
</tr>
<tr>
<td>Diarrheal diseases</td>
<td>7 (3.6%)</td>
<td>14 (8.2%)</td>
<td>21 (5.7%)</td>
</tr>
<tr>
<td>Digestive diseases</td>
<td>5 (2.5%)</td>
<td>7 (4.1%)</td>
<td>12 (3.3%)</td>
</tr>
<tr>
<td>Genitourinary diseases</td>
<td>9 (4.6%)</td>
<td>2 (1.2%)</td>
<td>11 (3.0%)</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>7 (3.6%)</td>
<td>4 (2.3%)</td>
<td>11 (3.0%)</td>
</tr>
<tr>
<td>Unintentional injuries</td>
<td>6 (3.0%)</td>
<td>5 (2.9%)</td>
<td>11 (3.0%)</td>
</tr>
<tr>
<td>Infectious diseases other</td>
<td>6 (3.0%)</td>
<td>4 (2.3%)</td>
<td>10 (2.7%)</td>
</tr>
<tr>
<td>Intentional injuries</td>
<td>4 (2.0%)</td>
<td>4 (2.3%)</td>
<td>8 (2.2%)</td>
</tr>
<tr>
<td>Respiratory diseases</td>
<td>3 (1.5%)</td>
<td>5 (2.9%)</td>
<td>8 (2.2%)</td>
</tr>
<tr>
<td>Other</td>
<td>8 (4.1%)</td>
<td>7 (4.1%)</td>
<td>15 (4.1%)</td>
</tr>
<tr>
<td>Total</td>
<td>197</td>
<td>171</td>
<td>368</td>
</tr>
</tbody>
</table>

**DISCUSSION**

This study employed a vital events and verbal autopsy system to examine patterns of mortality in rural western Kenya, with a particular focus on older adults. Communicable diseases were the most frequent cause of death with AIDS, malaria, respiratory infections, and diarrheal diseases causing the largest number of deaths. Among those aged 50 and older, AIDS remained the most significant cause of death up to the age of 70. It was only among those aged older than 70 that noncommunicable diseases surpassed AIDS as the most common cause of death.

Total annual mortality rates in this study were slightly lower than those seen across demographic surveillance systems sites in Tanzania, Ethiopia, Ghana, Burkina Faso, and Mozambique. In a study conducted in another area in Western Kenya in 2003, rates of cardiovascular disease, diarrheal disease, and respiratory infections rates were relatively similar to the rates found in our study, but rates of AIDS and tuberculosis mortality were higher and number of deaths through injuries was lower. Other studies have confirmed high rates of malaria mortality among older adults even in highly endemic areas where acquired immunity has been assumed.

The high level of mortality found in this study suggests that AIDS is a very important cause of death among people older than 50 in rural Kenya. The HIV epidemic in Kenya is generalized and mature. Women are generally infected younger than men, perhaps contributing to the higher rates of AIDS-related mortality among males older than 50 given the median 10-year period between infection and death. Recent studies in Kenya have estimated that, nationally, 5% of those infected with HIV are aged 50 years and older and that HIV prevalence is 7.8% among 50-year to 54-year olds, 3.6% among 55–59, and 2.7% among 60-year to 64-year olds. A home-based voluntary counseling and testing program in the project site revealed HIV prevalence of 6.8% among those aged 50 and older.
Prevalence among 50-year to 59-year olds was 10.0% (11.1% in males, 9.5% in females) and for those 60 and older, it was 4.8% (7.2% in males, 3.1% in females).

In one of the few sub-Saharan African studies to look carefully at causes of death in people 50 years and older, Adjuik et al.38 found that, in Southern Africa, the AIDS mortality rate was higher in 45-year to 59-year olds than among 15-year to 44-year olds. Zaba et al.45 using cohort study data from 6 African sites, also show that mortality of HIV-infected persons increases steadily with age though their data stops at age 55 for some sites and 65 for others. This suggests that the results of this study are generalizable to locations beyond rural Kenya that share similar HIV prevalence rates.

Most studies on HIV and older adults in developing countries focus on the impact of HIV on economic and social roles—and in particular on the role of grandparents in caring for HIV orphans—with little regard to the prevalence of HIV in older people or the direct impact of HIV infection on their health.9,46,47 Misconceptions remain common regarding older people and HIV. The authors of a study in Nigeria assert that “older people are no longer sexually active, and it is believed that HIV/AIDS is not a major problem in that segment of the population.”48 This low sense of risk can potentially lead to older people not being tested as part of routine testing and low uptake of HIV counseling, testing, and other services. Kyobutungi et al.10 lament the lack of HIV programs targeting older people in sub-Saharan Africa.

Reasons have been posited for the high rates of AIDS mortality among older people. The Collaborative Group on AIDS Incubation and HIV Survival has noted that the older the individual, the faster the progression from HIV infection to AIDS with life expectancy of only 4 years for those infected at age 65 or older.49 The high levels of HIV prevalence among older people might be related to remarriage after widowhood or divorce and the risk of forming HIV discordant partnerships.50 In general, however, the sexual activity of older individuals in the developing world is barely researched.9

Older populations also experience high rates of mortality due to noncommunicable diseases such as cardiovascular disease and diabetes. As has been reported elsewhere, such diseases are common even in rural areas of developing countries.51,52 However, the mortality rates from cardiovascular disease and diabetes in rural Kenya appear to be much lower than in rural India.53

CHW-administered VAs could potentially overlook a proportion of deaths, thus underrepresenting mortality. To assess this systematically, a 3-month retrospective review of all households was conducted. It revealed only one missing death during the assessment period suggesting information on the vast majority of deaths in the cluster are routinely captured using the CHW-based approach.

Over the past several decades, VAs have been increasingly accepted as a tool to assess mortality, and have undergone substantial methodological refinement. Although VAs have been validated in numerous studies,25-31 limitations include recall bias, alongside errors in classification, and verification.54,55 Additionally, many deaths are multifactorial with significant overlap between causes of death such as AIDS and tuberculosis. Multiple studies have, however, demonstrated a high correlation between VA cause of death and HIV status56,57 though the validity of VA in identifying child HIV deaths58 and older adult HIV death59 has been questioned. Another potential limitation is that, in rural populations in resource-poor countries, age reporting may be inaccurate especially among older age groups.18

**IMPLICATIONS**

With HIV and noncommunicable diseases together contributing to more than half of the deaths among older people in western Kenya, greater efforts are needed to address premature deaths arising from these conditions. Although responses have traditionally been implemented separately, there is increasing realization that there are significant synergies available. In particular, the shared “chronicity” of therapies for HIV, diabetes, and cardiovascular disease suggest that a unified response might be appropriate.60 HIV, cardiovascular disease, and diabetes are largely asymptomatic and require long-term treatments to prolong life, and therefore require similar systems of protocol-based decentralized delivery, with well-coordinated care and support to optimize adherence. Furthermore, the
diseases themselves are biologically linked, as antiretroviral therapy has been associated with increased risk of diabetes and heart disease.\textsuperscript{61,62}

The HIV treatment systems that have been developed in many African countries—adherence support, ongoing treatment delivery mechanisms, drug procurement procedures—could be leveraged to deliver noncommunicable disease programs. Already systems that had been developed for other diseases are shifting to respond to noncommunicable diseases; in Cambodia, for example, those trained to provide leprosy care are being retrained to support diabetes patients with foot care (Sally Duke, MBBS, MIPH, personal communication, August 2009).

The high rate of AIDS mortality among older adults highlights the need for targeted prevention and treatment efforts and research to develop a better understanding of the specific vulnerabilities facing this age group. As more individuals with HIV survive and as population aging continues, the challenge of HIV and older adults will only become more pressing.

REFERENCES


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Chapter One
Supplementary Information

The community health worker administered verbal autopsy form used in Sauri, Kenya is provided as supplementary information. The layout of the actual form used by the community health workers differs from the one presented here.
Ministry of Health/ Sauri Millennium Villages Project
Record of Death
- to be filled by trained community health worker at the earliest appropriate opportunity after a report of death, for persons resident within the cluster area for a period of at least 4 months before the death

1. Identity of Deceased Person

<table>
<thead>
<tr>
<th>Name of Deceased Person</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Village, Sub-village</td>
<td></td>
</tr>
<tr>
<td>Homestead Number</td>
<td></td>
</tr>
<tr>
<td>Household Number</td>
<td></td>
</tr>
<tr>
<td>Personal Identification Number</td>
<td></td>
</tr>
</tbody>
</table>

2. Identity of Respondent
- should be a close relative of the deceased e.g. parent, grown up child, spouse, etc.

<table>
<thead>
<tr>
<th>Name of Respondent</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Village, Sub-village</td>
<td></td>
</tr>
<tr>
<td>Homestead Number</td>
<td></td>
</tr>
<tr>
<td>Household Number</td>
<td></td>
</tr>
<tr>
<td>Personal Identification Number</td>
<td></td>
</tr>
</tbody>
</table>

3. Date of death: …….(dd)/……….(mm)/………….(yyyy)
Date of birth: …….(dd)/……….(mm)/………….(yyyy)
Age of Deceased: ………….(yy)……………..(mm)
Gender: o Male           o Female

4. Place of Death: (where did the deceased die?)
o At home            o At Health Facility (Name…………………………………………..)
o At traditional healer’s
do Outside home ……………………………………………………………………………

5. Cause of death: (what caused the death of the deceased?)
o Illness            o Road accident    o Assault/murder       o Suicide   o Other accident/injury
do Childbirth

6. Details of Illness:
(i) If the deceased died of illness in a hospital, what was the respondent told is the cause of death?
o Malaria            o HIV related complication (ayaki)    o Tuberculosis
(TB/kahera)          o Other chest infection (Tuo kor)    o Asthma (athma, tuo mar thung’)
o Diabetes (tuo mar sukari)    o Epilepsy (hunwa/ndulume)    o High blood pressure (remo maringo matek)    o Other Heart disease (tuo adundo)
o Cancer             o Diarrhoeal infection (tuo diep)  o Other-specify-……………………………………..
(ii) If the patient died of illness at home, what does the respondent think was the cause of death?
- Malaria
- HIV related complication (ayaki)
- Tuberculosis (TB/kahera)
- Other chest infection (Tuo kor)
- Asthma (athma, tuo mar thung')
- Diabetes (tuo mar sukari)
- Epilepsy (hunwa/ndulume)
- High blood pressure (remo maringo matek)
- Other Heart disease (tuo adundo)
- Cancer
- Diarrhoeal infection (tuo diep)
- Other-specify

(iii) If the respondent does not know what the deceased died from but knows it was illness, ask about the symptoms the deceased had (Use this verbal autopsy format specifying symptom and duration):

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fever</td>
<td>o Diarrhea</td>
</tr>
<tr>
<td>Rash</td>
<td>o Vomiting</td>
</tr>
<tr>
<td>Bleeding</td>
<td>o Headache</td>
</tr>
<tr>
<td>Weight loss</td>
<td>o Fits/Convulsions</td>
</tr>
<tr>
<td>Jaundice</td>
<td>o Paralysis</td>
</tr>
<tr>
<td>Swelling</td>
<td>o Urine Output</td>
</tr>
<tr>
<td>Ulcers</td>
<td>o Recent Surgery</td>
</tr>
<tr>
<td>Cough</td>
<td>o Pregnancy</td>
</tr>
<tr>
<td>Chest pain</td>
<td>o Alcohol Use</td>
</tr>
<tr>
<td>Other pain</td>
<td>o Other (specify)</td>
</tr>
</tbody>
</table>

Table 1: Algorithm used for the detections of cause of death, in Heskan and Mareko districts, Ethiopia, 2000.

<table>
<thead>
<tr>
<th>Algorithm</th>
<th>Diagnosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration of illness &lt; 30 days + Accidents (intentional or unintentional)</td>
<td>Injuries</td>
</tr>
<tr>
<td>Female sex + (Pregnant or in labor or in the puerperal period)</td>
<td>Maternal causes</td>
</tr>
<tr>
<td>Duration of illness &gt; 30 days + Cough + Weight loss + (Bloody sputum or Fever or Ascites) + no diarrhea</td>
<td>Tuberculosis</td>
</tr>
<tr>
<td>Duration of illness &gt; 30 days + Cough + Diarrhea + Fever + Weight loss</td>
<td>AIDS</td>
</tr>
<tr>
<td>Duration of illness &gt; 15 days + (Edema of legs or Ascites) + Jaundice</td>
<td>Liver diseases</td>
</tr>
<tr>
<td>Duration of illness &lt; 15 days + Abdominal swelling + Repetitive vomiting + No diarrhea</td>
<td>Acute abdomen</td>
</tr>
<tr>
<td>Duration of illness &gt; 30 days + Cough + Dyspnea + Wheezing + No bloody sputum</td>
<td>Chronic obstructive lung diseases</td>
</tr>
<tr>
<td>Duration of illness &lt; 30 days + Diarrhea + No cough</td>
<td>Diarrhoeal diseases</td>
</tr>
<tr>
<td>Duration of illness &lt; 15 days + Fever + Headache</td>
<td>Acute febrile illness</td>
</tr>
<tr>
<td>Duration of illness &lt; 15 days + Fever + Headache + Numb stiffness</td>
<td>Meningitis</td>
</tr>
<tr>
<td>Duration of illness &lt; 30 days + Cough + Fever + (Dyspnea or Chest pain)</td>
<td>Pneumonia</td>
</tr>
<tr>
<td>Duration of illness &lt; 30 days + Dyspnea + Palpitation + (Edema of legs or Ascites)</td>
<td>Cardio Vascular diseases</td>
</tr>
</tbody>
</table>

Health Facilitator’s Final Conclusion on Most Probable Cause of Death:

SUMMARY OF FINDINGS

<table>
<thead>
<tr>
<th>Age</th>
<th>Gender</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Date of Death | Place of Death | Probable Cause of Death |
Chapter Two

**HIV infection in older adults in sub-Saharan Africa: extrapolating prevalence from existing data**

Joel Negin & Robert G Cumming

**Objective** To quantify the number of cases and prevalence of human immunodeficiency virus (HIV) infection among older adults in sub-Saharan Africa.

**Methods** We reviewed data from Demographic and Health Surveys (DHS). Although in these surveys all female respondents are < 50 years of age, 18 of the surveys contained data on HIV infection among men aged ≥ 50 years. To estimate the percentage of older adults (i.e. people ≥ 50 years of age) who were positive for HIV (HIV+), we extrapolated from data from the Joint United Nations Programme on HIV/AIDS on the estimated number of people living with HIV and on HIV infection prevalence among adults aged 15–49 years.

**Findings** In 2007, approximately 3 million people aged ≥ 50 years were living with HIV in sub-Saharan Africa. The prevalence of HIV infection in this group was 4.0%, compared with 5.0% among those aged 15–49 years. Of the approximately 21 million people in sub-Saharan Africa aged ≥ 15 years that were HIV+, 14.3% were ≥ 50 years old.

**Conclusion** To better reflect the longer survival of people living with HIV and the ageing of the HIV+ population, indicators of the prevalence of HIV infection should be expanded to include people > 49 years of age. Little is known about comorbidity and sexual behaviour among HIV+ older adults or about the biological and cultural factors that increase the risk of transmission. HIV services need to be better targeted to respond to the growing needs of older adults living with HIV.

As more people in sub-Saharan Africa have begun taking antiretroviral treatment, mortality rates have dropped and HIV+ individuals are surviving longer. At the same time, older people remain at risk for infection. In the light of the ageing of the general population, there is a need to better understand the prevalence and characteristics of HIV infection among older adults in sub-Saharan Africa. To begin to address this information gap, we have used existing data and information to estimate the prevalence of HIV infection among people > 49 years of age in sub-Saharan Africa.

**Methods**

The data in this analysis came from a variety of sources. The main source was data on the prevalence of HIV infection released by UNAIDS in conjunction with its 2008 report on the global AIDS epidemic. The UNAIDS web site provides data, by country and by year, on the estimated number of people living with HIV as well as on the prevalence of HIV infection among adults aged 15–49 years. It does not, however, provide the number of HIV+ people aged ≥ 50 years or the prevalence of HIV infection in this age group. To derive those data, we needed to know the total population of each country in sub-Saharan Africa and its age distribution. We obtained the total population of each country from the 2007 world population data sheet and extracted the percentage of the total population aged 15–49 years and ≥ 50 years, by country, from World population prospects: the 2008 revision, using data from 2005, the most recent year for which data were available. Using population data from 2007 and the percentage of the total population aged 15–49 years and ≥ 50 years, we calculated the number of people aged 15–49 years in each country. The use of UNAIDS data on the prevalence of HIV infection in this age group allowed us to calculate the
number of people that had HIV infection. By subtracting this number from the total number of HIV+ people who were aged ≥ 50 years, as calculated by UNAIDS, we estimated the number of HIV+ people aged ≥ 50 years. We then divided this number by the total number of people aged ≥ 50 in a country (as derived from World population prospects: the 2008 revision) to estimate the prevalence of HIV infection among people aged ≥ 50 years.

For this analysis we used sub-Saharan African countries as classified by UNAIDS. Data were not available for Cape Verde, Comoros or Sao Tome and Principe. For the Democratic Republic of the Congo UNAIDS only provides high and low estimates of the number of people living with HIV. We used the midpoint between the two. UNAIDS data for Kenya for 2007 were awaiting finalization of the Kenya AIDS Indicator Survey, so we used those results, released in 2009, for analysis.17 Population-based surveys, predominantly the Demographic and Health Surveys (DHS) web site,18 were a second source of data for this study. We accessed the DHS reports and AIDS Indicator Survey reports on the site. To focus on the most recent data, we reviewed all surveys conducted after 2000 that contained information on HIV testing in countries in sub-Saharan Africa, and we extracted relevant data. Of the 43 DHS reports conducted after 2000 in countries in sub-Saharan Africa, 39 (91%) included interviewees aged ≥ 50, but only if they were men, and the upper age limit for these interviewees ranged from 54 to 64 years. Because the surveys are designed primarily to collect data on maternal and child health, the age ceiling for women interviewees is 49 years.

Of the 39 reports that included interviewees aged ≥ 50, 18 provided data on the prevalence of HIV infection based on population-based HIV testing of interviewees in this age group. The others contained information only on HIV-related awareness and behaviour. Of the four AIDS Indicator Surveys for which data were available, only the Ugandan survey included interviewees aged > 49 years: in that country, both men and women aged < 60 years were interviewed.

In addition, we searched the Internet and the grey literature to identify other sources of data on population-based HIV testing in sub-Saharan Africa. South African data sources and the Kenyan AIDS Indicator Survey were identified through this process.

Results
Based on the analysis of data obtained from UNAIDS and World population prospects: the 2008 revision, we estimated that in 2007 approximately 3 million people aged ≥ 50 years were living with HIV in sub-Saharan Africa. This represents 14.3% of the approximately 21 million people aged ≥ 15 years who are infected with HIV (Table 1). The five countries with the highest number of older adults living with HIV in sub-Saharan Africa were Mozambique, Nigeria, South Africa, Zambia and Zimbabwe; together these countries accounted for 54% of the total number of older adults living with HIV. The estimated prevalence of HIV infection among the 74 million people aged ≥ 50 years in sub-Saharan Africa is 4.0% compared with 5.0% among those aged 15–49 years.

Table 2 presents information on the prevalence of HIV infection among those aged ≥ 50 years in several countries in sub-Saharan Africa from DHS, AIDS Indicator Surveys and other population-based surveys. The highest prevalence of HIV infection among those aged ≥ 50 years was found in Zimbabwe during 2005–2006: 20% of all men aged 50–54 years were living with HIV.21 The 39 DHS reports that include male interviewees aged ≥ 50 also contain data on HIV-related awareness, behaviour and attitudes. The questions asked during the course of the decade included in our study differ and this makes direct comparisons difficult, but for each country the responses of those aged ≥ 50 years can be compared with those of people < 50. In general, older men are less aware of and knowledgeable about HIV-prevention measures than men aged 15–49. Interviewees in eight countries (Benin, Cape Verde, Ghana, Lesotho, Mali, Nigeria, Uganda and Zambia) were asked the same question about whether using a condom and having only one sexual partner are effective prevention measures, and in seven of the countries (all but Ghana) men aged ≥ 50 years knew less than men < 50. For example, in Nigeria 68.6% (2612/3808) of men aged 15–49 knew that using condoms and having only one partner are effective prevention measures, as opposed to only 58.3% (978/1678) of men aged 50–59.23

In four of the seven countries where interviewees were asked about the number of sexual partners they had during the past 12 months, namely Benin, the Democratic Republic of the Congo, Ghana and Nigeria, men aged ≥ 50 years were more likely to have had two or more sexual partners than those aged 15–49. In each of these four countries, the percentage of men aged ≥ 50 years who had had two or more sexual partners during the previous 12 months and who had used condoms the last time they had engaged in sexual intercourse was much lower than among men aged 15–49. For example, in Ghana only 7.9% (5/64) of the men aged 50–59 years who had engaged in sex with at least two partners over the previous 12 months had used a condom during their last sexual intercourse, compared with 26.2% (120/459) of men aged 15–49.

Discussion
An analysis of UNAIDS and World population prospects data suggests that approximately 3 million adults aged ≥ 50 years are living with HIV in sub-Saharan Africa. People in this age group account for 14.3% of all HIV+ people ≥ 15 years of age. This study confirms that HIV infection does not affect younger people exclusively.

Comparisons between the two types of data sources used in this study reveal an occasional match between the prevalence of HIV infection estimated from UNAIDS data and the prevalence obtained from population-based HIV testing. For example, in Benin calculations made from UNAIDS data suggest that in 2007 the prevalence of HIV infection among those aged ≥ 50 years was 1.0%; similarly, DHS data for 2006 suggest a prevalence of 1.0% among men aged 50–64.21 However, in other countries there are significant discrepancies. For Lesotho, data derived from UNAIDS statistics suggest a prevalence of 27.8% in 2007 among those aged ≥ 50 years, whereas according to data from the 2004 DHS, prevalence among men aged 50–59 is around 16%.21 These surveys do not measure the same indicator: most DHS data cover men in a limited age range, as previously indicated, while UNAIDS data are for all adults aged ≥ 50 years.

The main results presented in this paper depend on the quality of the data obtained from UNAIDS. These data are derived from mathematical and demographic projection models based primarily on prevalence data from population-based surveys, time–trend prevalence data from antenatal clinics, estimates of the need for antiretroviral treatment and its coverage, mortality rates and total population;17 18 they are not designed specifically to quantify the prevalence.
Consequently, prevalence and case-load calculations from UNAIDS reports represent the best available, but they do not allow derivation of exact population numbers. Population-based surveys of HIV infection among older adults would provide more reliable and robust data.

<table>
<thead>
<tr>
<th>Country</th>
<th>Older adults who are HIV+</th>
<th>People aged 15–49 who are HIV+</th>
<th>People aged ≥ 15 who are HIV+</th>
<th>HIV+ older adults as a percentage of all HIV+ people aged ≥ 15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angola</td>
<td>24 600</td>
<td>155 400</td>
<td>180 000</td>
<td>13.7</td>
</tr>
<tr>
<td>Benin</td>
<td>8 900</td>
<td>50 100</td>
<td>59 000</td>
<td>15.1</td>
</tr>
<tr>
<td>Botswana</td>
<td>49 700</td>
<td>230 300</td>
<td>280 000</td>
<td>17.8</td>
</tr>
<tr>
<td>Burkina Faso</td>
<td>9 400</td>
<td>110 600</td>
<td>120 000</td>
<td>7.8</td>
</tr>
<tr>
<td>Burundi</td>
<td>6 500</td>
<td>83 500</td>
<td>90 000</td>
<td>7.2</td>
</tr>
<tr>
<td>Cameroon</td>
<td>59 900</td>
<td>440 100</td>
<td>500 000</td>
<td>12.0</td>
</tr>
<tr>
<td>Central African Republic</td>
<td>12 200</td>
<td>127 800</td>
<td>140 000</td>
<td>8.7</td>
</tr>
<tr>
<td>Chad</td>
<td>11 700</td>
<td>168 300</td>
<td>180 000</td>
<td>6.5</td>
</tr>
<tr>
<td>Congo</td>
<td>9 200</td>
<td>63 800</td>
<td>73 000</td>
<td>12.6</td>
</tr>
<tr>
<td>Côte d’Ivoire</td>
<td>48 500</td>
<td>371 500</td>
<td>420 000</td>
<td>11.6</td>
</tr>
<tr>
<td>Democratic Republic of the Congo</td>
<td>81 600</td>
<td>368 400</td>
<td>450 000</td>
<td>18.1</td>
</tr>
<tr>
<td>Djbouti</td>
<td>2 400</td>
<td>12 600</td>
<td>15 000</td>
<td>15.9</td>
</tr>
<tr>
<td>Equatorial Guinea</td>
<td>1 600</td>
<td>8 200</td>
<td>9 800</td>
<td>16.4</td>
</tr>
<tr>
<td>Eritrea</td>
<td>3 400</td>
<td>31 600</td>
<td>35 000</td>
<td>9.9</td>
</tr>
<tr>
<td>Ethiopia</td>
<td>157 700</td>
<td>732 300</td>
<td>890 000</td>
<td>17.7</td>
</tr>
<tr>
<td>Gabon</td>
<td>8 200</td>
<td>37 800</td>
<td>46 000</td>
<td>17.9</td>
</tr>
<tr>
<td>Gambia</td>
<td>1 200</td>
<td>6 300</td>
<td>7 500</td>
<td>16.2</td>
</tr>
<tr>
<td>Ghana</td>
<td>33 900</td>
<td>216 100</td>
<td>250 000</td>
<td>13.6</td>
</tr>
<tr>
<td>Guinea</td>
<td>6 300</td>
<td>74 700</td>
<td>81 000</td>
<td>7.8</td>
</tr>
<tr>
<td>Guinea-Bissau</td>
<td>1 100</td>
<td>13 900</td>
<td>15 000</td>
<td>7.1</td>
</tr>
<tr>
<td>Kenya</td>
<td>169 100</td>
<td>1 430 900</td>
<td>1 600 000</td>
<td>10.6</td>
</tr>
<tr>
<td>Lesotho</td>
<td>61 900</td>
<td>198 100</td>
<td>260 000</td>
<td>23.8</td>
</tr>
<tr>
<td>Liberia</td>
<td>1 700</td>
<td>30 300</td>
<td>32 000</td>
<td>18.6</td>
</tr>
<tr>
<td>Madagascar</td>
<td>4 400</td>
<td>8 500</td>
<td>13 000</td>
<td>34.9</td>
</tr>
<tr>
<td>Malawi</td>
<td>156 200</td>
<td>683 800</td>
<td>840 000</td>
<td>18.6</td>
</tr>
<tr>
<td>Mali</td>
<td>6 200</td>
<td>86 800</td>
<td>93 000</td>
<td>6.7</td>
</tr>
<tr>
<td>Mauritania</td>
<td>1 600</td>
<td>12 400</td>
<td>14 000</td>
<td>11.4</td>
</tr>
<tr>
<td>Mauritius</td>
<td>800</td>
<td>12 200</td>
<td>13 000</td>
<td>5.9</td>
</tr>
<tr>
<td>Mozambique</td>
<td>228 500</td>
<td>1 171 500</td>
<td>1 400 000</td>
<td>16.3</td>
</tr>
<tr>
<td>Namibia</td>
<td>18 100</td>
<td>161 900</td>
<td>180 000</td>
<td>10.0</td>
</tr>
<tr>
<td>Niger</td>
<td>7 200</td>
<td>48 800</td>
<td>56 000</td>
<td>12.9</td>
</tr>
<tr>
<td>Nigeria</td>
<td>300 300</td>
<td>2 099 700</td>
<td>2 400 000</td>
<td>12.5</td>
</tr>
<tr>
<td>Rwanda</td>
<td>1 500</td>
<td>128 500</td>
<td>130 000</td>
<td>1.2</td>
</tr>
<tr>
<td>Senegal</td>
<td>5 600</td>
<td>58 400</td>
<td>64 000</td>
<td>8.7</td>
</tr>
<tr>
<td>Sierra Leone</td>
<td>7 400</td>
<td>43 600</td>
<td>51 000</td>
<td>14.5</td>
</tr>
<tr>
<td>Somalia</td>
<td>3 100</td>
<td>20 900</td>
<td>24 000</td>
<td>12.8</td>
</tr>
<tr>
<td>South Africa</td>
<td>679 700</td>
<td>4 720 300</td>
<td>5 400 000</td>
<td>12.6</td>
</tr>
<tr>
<td>Swaziland</td>
<td>31 400</td>
<td>138 600</td>
<td>170 000</td>
<td>18.5</td>
</tr>
<tr>
<td>Togo</td>
<td>14 800</td>
<td>105 200</td>
<td>120 000</td>
<td>18.5</td>
</tr>
<tr>
<td>Uganda</td>
<td>150 100</td>
<td>659 900</td>
<td>810 000</td>
<td>18.5</td>
</tr>
<tr>
<td>United Republic of Tanzania</td>
<td>199 200</td>
<td>110 080</td>
<td>1 300 000</td>
<td>15.3</td>
</tr>
<tr>
<td>Zambia</td>
<td>200 000</td>
<td>780 000</td>
<td>980 000</td>
<td>20.4</td>
</tr>
<tr>
<td>Zimbabwe</td>
<td>206 600</td>
<td>993 400</td>
<td>1 200 000</td>
<td>17.2</td>
</tr>
<tr>
<td>Sub-Saharan Africa</td>
<td>2 993 500</td>
<td>17 997 800</td>
<td>20 991 300</td>
<td>14.3</td>
</tr>
</tbody>
</table>

HIV+, HIV-positive.

This table reflects sub-Saharan African countries as classified by the Joint United Nations Programme on HIV/AIDS; the data do not include Cape Verde, Comoros and Sao Tome and Principe.

Numbers have been rounded to the nearest hundred.

Sources: data derived from references 15 and 16.
### Table 2. Prevalence of infection with the human immunodeficiency virus (HIV) among older adults (i.e. people aged ≥ 50 years) in sub-Saharan Africa, by country, from population-based surveys conducted after 2000

<table>
<thead>
<tr>
<th>Country</th>
<th>Year(s)</th>
<th>Sex of respondents</th>
<th>Age range (years)</th>
<th>Prevalence of HIV infection (%)</th>
<th>Source</th>
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</table>

A few studies have documented HIV infection among older adults: a study in rural Cameroon showed a prevalence of 2.6% among men and women aged 55–70 years, and a study among people admitted to hospital in Dar es Salaam, United Republic of Tanzania, reported a prevalence of 15% among those aged ≥ 55. A study in the Congo described 175 cases of HIV infection among people aged ≥ 55 years from 1990 to 1996. An 81-year-old male who was HIV+ was identified in an Ethiopian study. In general, however, data on HIV infection in older adults in Africa are limited.

Two facets to the issue of HIV positivity among older adults generate particular challenges. One is the occurrence of new cases of HIV infection among older adults and the other is the ageing of the population infected with HIV.

Previous studies have shown that those who became infected with HIV later in life progress more rapidly towards AIDS and death than those who are infected at a younger age. Justice and Weissman have noted evidence that being older at the time of seroconversion is strongly associated with faster disease progression and shorter survival. A study in the United Kingdom of Great Britain and Northern Ireland revealed that those who became infected between the ages of 15 and 34 years had a 10-year survival rate of 72%, compared with 12% of those who seroconverted after the age of 55. In 2001, the Collaborative Group on AIDS Incubation and HIV Survival predicted a life expectancy of only four years for people who become infected at age ≥ 65 years. A 2001 study in the United States demonstrated that reconstitution of the immune system after initiating antiretroviral treatment was slower in older patients.

As more people survive longer with HIV, the overall case-load will age and new challenges will arise in sub-Saharan Africa. Older adults have greater comorbidity, experience more side-effects from antiretroviral treatment and hence may be less likely to adhere to treatment. The toxicity of antiretroviral therapy, combined with decreased kidney and liver function in older individuals, may lead to treatment difficulties such as drug interactions. Studies are needed to better understand the pharmacokinetics of antiretroviral agents in elderly people.

Common misconceptions about sexual activity among older people remain. A study in Nigeria dismissed older people as no longer being sexually active, confirming what Ory et al. called “ageist assumptions about sexual behaviour”. These attitudes limit the development of appropriate responses tailored specifically to older adults.

Several factors put older people at a higher risk of becoming infected with HIV. The thinning of the vaginal wall after menopause increases the risk of HIV transmission during sex. Practices such as wife inheritance and ritual cleansing, in which a widow is expected to either marry or have sex with relatives of the deceased husband, can increase older women’s exposure to the virus. Additionally, many older people are poor and may not be able to afford health services.

Older adults’ access to HIV-related services and information is limited: the UNAIDS update for 2009 stated that “even though the largest share of new infections in many African countries occurs among older heterosexual couples, relatively few prevention programmes have specifically focused on older adults”. DHS data suggest that levels of condom use and knowledge about condoms are low among older adults. In the United States, Ory and Mack noted that people aged ≥ 50 years who had known risk factors for HIV infection were one-sixth as likely to report using condoms as people in their twenties with comparable risk factors. The lack of targeted prevention services becomes even more important considering that many older people care for younger ones, since a lack of knowledge may prevent older people from effectively teaching the next generation about HIV.

The delivery of services to older adults with HIV infection needs to be improved. In the United States, el-Sadr and Getler have indicated that health-care providers are less likely to attribute signs and symptoms of disease in older people to HIV infection. Data from Brazil suggest that older people are diagnosed later in the course of HIV infection, with more AIDS-defining diseases present at diagnosis. This may be true for Africa as well.

South Africa has added men aged ≥ 50 years to its list of populations considered to be at greatest risk for HIV infection, according to a 2008 survey. The 6.0% prevalence among these men, together with the limited reach of national communication programmes, low levels of knowledge and poor adoption of preventive behaviours, has highlighted the need to focus prevention on this group.

The need to better understand the various HIV-related challenges faced by older adults will increase as the HIV+ population ages. Research should be aimed at understanding the specific vulnerabilities and challenges faced by this group. It should focus on understanding the impact of highly active antiretroviral therapy on older people in Africa and on understanding the sexual behaviour and practices of older people.

Barnett views HIV infection and AIDS as posing a new type of challenge for the global community: a “long-wave event” whose “troubling and large-scale effects emerge gradually over decades”. For the past few decades, the global HIV community has focused on people aged 15–49 years, often ignoring the long-wave elements of the epidemic. A significant percentage of the population – those aged ≥ 50 years – has been largely excluded from HIV prevention and testing services. The high prevalence of HIV infection and the high rates of death from AIDS-related causes among older people in developing countries call for greater efforts to integrate the needs of older people into responses to the HIV epidemic and to strengthen targeted prevention, care and support programmes.

Competing interests: None declared.
The study found that among adults aged 50 years or older in sub-Saharan Africa, approximately 14.3% had HIV, compared to 5.0% among those aged 15-49 years. This indicates a significant increase in HIV prevalence among older adults in the region, despite a 4% reduction in HIV prevalence in the general population aged 15-49 years. The study also highlights the need for targeted interventions to address the specific needs of older adults living with HIV.

Research
HIV infection among older adults in sub-Saharan Africa
Joel Negin & Robert G Cumming

References

Resumen
Infección por el VIH entre los adultos de mayor edad en el África subsahariana: extrapolación de la prevalencia a partir de datos existentes
Objetivo: Quantifier le nombre de cas et la prévalence de l’infection par le virus de l’immunodéficience humaine (VIH) chez les adultes âgés en Afrique subsaharienne.
Méthodes: Nous avons étudié les données des enquêtes démographiques et sanitaires. Même si, dans ces enquêtes, toutes les femmes interrogées sont âgées de moins de 50 ans, 18 des enquêtes contenait des données sur l’infection à VIH chez les hommes âgés de 50 ans et plus. Pour évaluer le pourcentage d’adultes âgés (c.-à-d. de personnes âgées de 50 ans et plus) qui étaient séropositifs (VIH+), nous avons extrapolé à partir des données du Programme commun des Nations Unies sur le VIH et le Sida (ONUSIDA) sur le nombre estimé de personnes vivant avec le VIH et sur la prévalence de l’infection à VIH chez les adultes âgés de 15 à 49 ans.
Résultats: En 2007, approximativement 3 millions de personnes âgées de 50 ans et plus vivaient avec le VIH en Afrique subsaharienne. La prévalence de l’infection par le VIH dans ce groupe était de 4%. Elle était en comparaison de 5% chez les 15–49 ans. Sur quelques 21 millions d’habitants de l’Afrique subsaharienne âgés de 15 ans et plus qui étaient porteurs du virus VIH, 14,3% d’entre eux étaient âgés de 50 ans et plus.
Conclusion: Pour mieux refléter la survie plus longue des personnes vivant avec le VIH et le vieillissement de la population séropositive, les indicateurs de prévalence de l’infection à VIH doivent être étendus afin d’inclure les personnes âgées de plus de 49 ans. On sait peu de choses sur la comorbidité et le comportement sexuel des adultes âgés séropositifs ou sur les facteurs biologiques et culturels qui augmentent le risque de transmission. Les services relatifs au VIH doivent être mieux ciblés pour répondre aux besoins croissants des adultes âgés qui vivent avec le virus.

Resumé
Infection à VIH chez les adultes âgés en Afrique subsaharienne: extrapolation de la prévalence à partir de données existantes
Objectif: Quantifier le nombre de cas et la prévalence de l’infection par le virus de l’immunodéficience humaine (VIH) chez les adultes âgés en Afrique subsaharienne.
Méthodes: Nous avons étudié les données des enquêtes démographiques et sanitaires. Même si, dans ces enquêtes, toutes les femmes interrogées sont âgées de moins de 50 ans, 18 des enquêtes contenait des données sur l’infection à VIH chez les hommes âgés de 50 ans et plus. Pour évaluer le pourcentage d’adultes âgés (c.-à-d. de personnes âgées de 50 ans et plus) qui étaient séropositifs (VIH+), nous avons extrapolé à partir des données du Programme commun des Nations Unies sur le VIH et le Sida (ONUSIDA) sur le nombre estimé de personnes vivant avec le VIH et sur la prévalence de l’infection à VIH chez les adultes âgés de 15 à 49 ans.
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References
HIV infection among older adults in sub-Saharan Africa

Joel Negin & Robert G Cumming


Chapter Three

HIV Attitudes, Awareness and Testing Among Older Adults in Africa

Joel Negin · Bennett Nemser · Robert Cumming · Eliud Lelerai · Yanis Ben Amor · Paul Pronyk

Abstract In Africa, older adults aged 50 and older are still sexually active and play a critical role as caregivers, yet little is known about their attitudes towards HIV and awareness of services. In this study, surveys were conducted in nine African sites. A multilevel model was fitted to evaluate the relationship between age and outcome variables. The study reveals that people aged 50 years and older have lower levels of HIV-related knowledge and awareness than those aged 25–49. Older adults were less likely to have been tested for HIV and women aged 50 and older showed particularly low levels of awareness.

Keywords HIV testing · HIV awareness · Older adults · Africa

Introduction

In sub-Saharan Africa (SSA), HIV among older adults has largely been ignored, though there has been some emerging interest in this topic [1]. A recent study estimated that there are three million HIV positive people in SSA aged 50 and older representing more than 14% of those over the age of 15 infected [2]—suggesting that increased attention is warranted for older age groups.

Despite this, most HIV prevention efforts largely target younger people and little is known about the attitudes towards HIV and awareness of prevention, testing and treatment among older adults. Examining HIV-related knowledge and attitudes among people over 50 in SSA is important for a number of reasons. Older adults remain sexually active and therefore remain at risk of HIV infection. As anti-retroviral therapy (ART) is rolled out, more HIV positive individuals are living longer thus furthering the ageing of the epidemic. Older adults in SSA also play a critical role as educators and caregivers and older people remain influential community members and leaders. Many older people are involved in taking care of young adults and children and act as gatekeepers of information, playing a major role in reinforcing attitudes and normative behaviour. Recent work has noted that caregivers perceive a lack of skills to provide information to and care for dependents [3].

Very little research has been done on HIV-related knowledge and attitudes among older adults in SSA. A recent study on ART knowledge in Africa found only one relevant study on this topic [4]. Some research has been conducted in other parts of the world—particularly in developed countries. A review of HIV attitudes among older adults in the US showed that inadequate HIV transmission education and poor awareness contributed to increased HIV risk [5]. A study from Thailand directly compared HIV knowledge and attitudinal data for Thais 50 years of age and older against that of young adults (20–39) revealed lower levels of correct knowledge among those aged 50 and older as well as lower levels of HIV testing and less awareness of treatment availability [6].

In Africa, most work on HIV attitudes and stigma has ignored older adults and has also provided less focus on rural areas specifically. Demographic and Health Surveys (DHS) include questions on HIV awareness and attitudes but question female interviewees only up to the age of 49.
and only up to 54 or 59 for men [7]. In order to address these gaps, we examined HIV awareness, attitudes, behaviour and testing among older adults across a number of rural sites in Africa.

### Setting and Methods

The study was conducted in nine clusters of villages across eight countries in sub-Saharan Africa as part of the Millennium Villages Project (MVP). The MVP is a multisectoral health and development initiative launched in 2004 that aims to demonstrate that achievement of Millennium Development Goals in rural Africa is possible through the coordinated delivery of science-based interventions at the community level in agriculture, health, education and infrastructure [8]. The project sites are all rural and are drawn from a diversity of agro-ecological zones in ‘hunger hot-spots,’ where rates of child under-nutrition exceeded 20% at baseline and where the majority of residents were engaged in subsistence agriculture and animal husbandry.

The sites extend across a broad geographic range including West Africa, East Africa and Southern Africa locations that had different levels of HIV prevalence at the time of the study surveys from 2005 to 2007. District-level prevalence among those aged 15–49 varied from 0.5% in Louga district in Senegal to 17.8% in Zomba district in Malawi. Prevalence data for those aged 50 and older is not available as older adults are not included in UNAIDS data and most DHS studies [2].

Before project commencement, baseline surveys were conducted. Within each MVP community, a detailed household mapping was conducted including a population census and a household wealth score. Proportional sampling was carried out to randomly select 300 households stratified by geographic area, gender of household head, and wealth. Consenting households were then included in baseline data collection. Within each participating household, individuals were recruited for study inclusion based on eligible age range.

The information in this paper comes from the HIV and sexually transmitted infection baseline survey which was developed based on validated DHS tools [7]. Questions focus on HIV-related knowledge, attitudes, and behaviour; however, seroprevalence was not determined during baseline survey activities. The same questionnaire was utilised across all sites. Sites were excluded from analysis if the sample size of the 50 years and older age group was below 30.

Respondents who had not heard of HIV or AIDS were not asked subsequent questions but have been included in the denominator for relevant questions based on the assumption that they would not have correct knowledge or have awareness of other elements of HIV and AIDS. This adheres to DHS guidelines [9].

A multilevel model was fitted to evaluate the relationship between age group (25–49 years versus 50 + years) and the respective outcome variables. The research evaluated multiple outcome variables related to HIV knowledge, stigma, and behaviour. Six knowledge questions [continuous variable, range 0–6] and two stigma-related questions [binary variable: 1 = at least one stigmatic response] were used (Table 2). Multilevel models were fitted considering the hierarchical structure of data where MVP site locations is the Level 2 (higher level) classification unit. This was done to account for sources of variation between sites. Independent covariates, such as gender, that were statistically significantly associated with HIV-related outcomes in unadjusted models (using $P < 0.1$ as the cut-off) were included in further multivariable modelling. Additionally, multiplicative interaction terms were tested between age group and gender.

To examine the scope for multilevel modeling, the magnitude of between site variation in HIV related outcomes was examined in a two level random intercepts model. The variance partitioning coefficient (VPC) was computed, which is the ratio of the random site variance to the total variance. For binary variables, residuals were assumed to have a standard logistic variance structure at the Level 1 and normally distributed variance structure at Level 2.

Statistical modelling was conducted using Stata Software (Stata Corp, 4905 Lakeway Drive, College Station, TX 77845 USA).

Additionally, a secondary analysis was conducted to evaluate site-specific variation by age group for each respective question. Chi square test of independence was used to assess this site-specific variation. These site-specific analyses were conducted in Microsoft Excel (Microsoft Corporation, One Microsoft Way, Redmond, WA 98052).

### Results

Across the nine sites, there were a total of 1,534 respondents aged 25–49 and 722 aged 50 and older. Of those aged 50 and older, 45.2% ($n = 326$) were aged 50–59, 32.1% ($n = 232$) aged 60–69 and 22.7% ($n = 164$) aged 70 and older. The male/female ratio among those aged 25–49 was 0.90 and among those aged 50 and older 1.19.

Multilevel models for all four outcomes variables were evaluated using three explanatory variables: age group, gender, and interaction between age group and gender. In the unadjusted model, knowledge score was significantly lower for adults older than 50 years as compared to adults aged 25–49.
aged 25–49 years (Table 1). The average male participant correctly answered 3.47 questions, while females correctly answered 0.63 fewer questions. In the final model, controlling for other covariates, knowledge score was significantly lower for adults older than 50 years and for females. Older adults had correct knowledge of 0.50 fewer questions and females answered 0.35 fewer questions correctly than the average male respondent aged 25–49. Moreover, there was a significant multiplicative effect for older females, who had significantly lower knowledge scores (0.35 fewer correctly answered questions) after controlling for the overarching age and gender effects. As for the variance partition coefficient in the final model, 26.8% of the total variance in knowledge score was due to between-site differences.

For the two questions comprising the stigma score, stigma was not significantly different by age group. In the final model, stigma was significantly lower among females as compared to males and the difference between those older than 50 and those 25–49 was not significant.

For the final model of HIV testing, age group and gender were statistically significant. The odds of ever having an HIV test were 0.56 smaller for older adults (50+) and 0.32 smaller for females compared to males aged 25–49. However, the interaction between age group and gender was not significant. HIV testing had the highest between-site VPC of the four final models.

After controlling for other covariates, the odds of talking to a partner about HIV was significantly lower for older adults (50+) and for females. The interaction term between age group and gender was significant (P value <0.1) while controlling for the overall affects of age group and gender.

For the secondary analysis of site-specific variation, Table 2 presents selected data from five sites on knowledge, stigma, testing and whether or not respondents had talked to their partner about HIV. In eight of the nine sites, older adults were significantly (P < 0.05) less likely to have heard of voluntary counselling and testing than those aged 25–49. Levels of awareness of prevention of mother-to-child transmission (PMTCT) and anti-retroviral treatment (ART) were also lower among older adults. In all of the West African sites, more than 84% of older women had not heard of ART. In eight of the nine sites (six significantly), older adults were less likely to know that one could reduce their chances of getting HIV by using a condom every time they had sex when compared to respondents aged 25–49.

HIV testing levels among older adults were significantly lower than among those aged 25–49 in three of four West Africa sites, but in only one East African site. Levels of ever tested among older men ranged from 23% in Rwanda to 0% in Senegal and among older women from 17% in Rwanda to 0% in Senegal. Across all sites, a minimum of 50% of respondents aged 50 and older expressed a willingness to be tested for HIV.

Discussion

Information on HIV awareness and knowledge among younger adults is widely available. Our study is one of the first among older people and it reveals that people aged 50 years and older in rural Africa have lower levels of HIV-related knowledge and awareness than those aged 25–49. Older adults are also less likely to have been tested for HIV and are less likely to have spoken to their partners about HIV. Women aged 50 and older show particularly low levels of awareness and knowledge compared to both younger women and to men aged 50 and older. Despite this, older adults demonstrated a high level of willingness to care for family members who are HIV-positive.

The few DHS studies that included men aged 50 and older reveal similar findings to our study. In the 2008 Nigerian DHS, men aged 50–59 were less likely than men aged 15–49 to know that condoms were an effective prevention measure when used during every sexual encounter and had less knowledge of PMTCT [10]. Confirming our results, DHS reports conducted since 2005, which do not include data on older women, reveal that testing rates among men aged 50 and older (with the upper age range varying from 54–64 depending on site) are lower than among men aged 15–49 in Nigeria, Benin, Democratic Republic of Congo, Lesotho, Uganda and Cape Verde [7]. The Kenya AIDS Indicator Survey also revealed lower testing rates among older adults and among older women in particular [11]. While 18.9% of men aged 60–64 had been tested for HIV, only 6.0% of women of the same age had. Additionally, the highest syphilis prevalence rates in Kenya were among those aged 60–64. A study in Uganda revealed that participants over 50 years of age were less ART knowledgeable than younger interviewees [4].

The findings of this study have important implications for HIV services in Africa. Low levels of knowledge among sexually active older adults will impact HIV transmission. Higher general knowledge of HIV and treatment knowledge are associated with better adherence to ARVs [12] suggesting that, without information, treatment outcomes among older adults might be compromised.

The persistence of high levels of stigma among older adults and among older women in particular can reduce the possible uptake of HIV testing programs and can lead to reduced care seeking behaviour. Stigma is particularly important among older adults who are often expected to take on caregiving roles for their children or grandchildren affected by HIV. A South African study showed that providing HIV education workshops to older people led to a
<table>
<thead>
<tr>
<th>Outcome variable</th>
<th>Unadjusted - age group only</th>
<th>Full adjusted - all variables</th>
<th>Final</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Score</td>
<td>95% CI</td>
<td>P value</td>
</tr>
<tr>
<td>Knowledge score</td>
<td>3.47 (2.8, 4.14)</td>
<td>0.328</td>
<td>0.268</td>
</tr>
<tr>
<td>Intercept</td>
<td>4.00 (3.29, 4.71)</td>
<td>0.00***</td>
<td>0.50 (-0.68, -0.32)</td>
</tr>
<tr>
<td>Age group</td>
<td>-0.63 (-0.76, -0.49)</td>
<td>0.00***</td>
<td>0.50 (-0.68, -0.32)</td>
</tr>
<tr>
<td>Gender</td>
<td>-0.35 (-0.5, -0.2)</td>
<td>0.00***</td>
<td>-0.35 (-0.5, -0.2)</td>
</tr>
<tr>
<td>Interaction: age group by gender</td>
<td>-0.35 (-0.61, -0.09)</td>
<td>0.01***</td>
<td>-0.35 (-0.61, -0.09)</td>
</tr>
<tr>
<td>Stigma</td>
<td>0.99 (0.81, 1.21)</td>
<td>0.92</td>
<td>0.94 (0.71, 1.24)</td>
</tr>
<tr>
<td>Age group</td>
<td>1.15 (0.93, 1.44)</td>
<td>0.00***</td>
<td>0.94 (0.71, 1.24)</td>
</tr>
<tr>
<td>Gender</td>
<td>1.17 (0.78, 1.75)</td>
<td>0.45</td>
<td>0.94 (0.71, 1.24)</td>
</tr>
<tr>
<td>Interaction: age group by gender</td>
<td>1.17 (0.78, 1.75)</td>
<td>0.45</td>
<td>0.94 (0.71, 1.24)</td>
</tr>
<tr>
<td>Ever tested for HIV</td>
<td>0.303</td>
<td>0.00***</td>
<td>0.303</td>
</tr>
<tr>
<td>Age group</td>
<td>0.43 (0.31, 0.59)</td>
<td>0.00***</td>
<td>0.51 (0.34, 0.77)</td>
</tr>
<tr>
<td>Gender</td>
<td>0.74 (0.55, 1.01)</td>
<td>0.06*</td>
<td>0.68 (0.52, 0.89)</td>
</tr>
<tr>
<td>Interaction: age group by gender</td>
<td>0.74 (0.55, 1.01)</td>
<td>0.06*</td>
<td>0.68 (0.52, 0.89)</td>
</tr>
<tr>
<td>Talked to partner about HIV</td>
<td>0.157</td>
<td>0.00***</td>
<td>0.157</td>
</tr>
<tr>
<td>Age group</td>
<td>0.58 (0.47, 0.7)</td>
<td>0.00***</td>
<td>0.62 (0.47, 0.82)</td>
</tr>
<tr>
<td>Gender</td>
<td>0.60 (0.48, 0.75)</td>
<td>0.00***</td>
<td>0.60 (0.48, 0.75)</td>
</tr>
<tr>
<td>Interaction: age group by gender</td>
<td>0.68 (0.45, 1.02)</td>
<td>0.06*</td>
<td>0.68 (0.45, 1.02)</td>
</tr>
</tbody>
</table>

VPC variance partitioning coefficient

Binary variables: age group: 1 = 50+ years; Gender: 1 = Female; Age and Gender Interaction: 1 = Female 50+ years

Significance testing: *** P value < 0.01, ** P value < 0.05; * P value < 0.1
| Table 2 | Responses to knowledge, stigma, testing and talking to partner questions by age for selected sites |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
|                | Mwandama, Malawi | Ikaram, Nigeria | Potou, Senegal   | Mayange, Rwanda  | Mbola, Tanzania  |
|                | 25–49 years | 50+ years | 25–49 years | 50+ years | 25–49 years | 50+ years | 25–49 years | 50+ years | 25–49 years | 50+ years | 25–49 years | 50+ years | 25–49 years | 50+ years | 25–49 years | 50+ years | 25–49 years | 50+ years | 25–49 years | 50+ years |
| Overall Sample Size | 150 | 75 | 150 | 152 | 161 | 48 | 182 | 75 | 158 | 85 |
| Knowledge | | | | | | | | | | | | | | | | | | | | |
| Is there anything a person can do to avoid getting HIV/AIDS, or the virus that causes AIDS? | 98% | 97% | 0.755 | 72% | 54% | 0.002*** | 86% | 60% | 0.000*** | 100% | 97% | 0.026** | 89% | 76% | 0.009*** |
| Can a person get the AIDS virus from mosquito or other insect bites? | 53% | 51% | 0.777 | 30% | 20% | 0.054* | 32% | 21% | 0.147 | 66% | 53% | 0.044** | 61% | 49% | 0.089* |
| Can people reduce their chances of getting the AIDS virus by using a condom every time they have sex? | 60% | 56% | 0.593 | 5% | 37% | 0.005*** | 54% | 25% | 0.000*** | 82% | 63% | 0.002*** | 66% | 52% | 0.025** |
| Can a mother who is infected with the AIDS virus reduce the risk of giving the virus to the baby by taking certain drugs during pregnancy? | 55% | 40% | 0.036** | 23% | 17% | 0.141 | 28% | 6% | 0.002*** | 87% | 68% | 0.000*** | 47% | 34% | 0.045** |
| Is there any medicine that a person with AIDS can take to stay alive? | 91% | 72% | 0.000*** | 19% | 14% | 0.197 | 33% | 8% | 0.002*** | 81% | 65% | 0.006*** | 61% | 44% | 0.008*** |
| Have you ever heard of VCT, Voluntary Counseling and Testing for the virus that causes HIV/AIDS? | 97% | 84% | 0.001*** | 40% | 28% | 0.032** | 55% | 17% | 0.000*** | 77% | 65% | 0.049** | 82% | 65% | 0.003*** |
| Stigma | | | | | | | | | | | | | | | | | | | | |
| If a member of your family got infected with the virus that causes AIDS, would you want it to remain a secret or not? | 62% | 56% | 0.379 | 28% | 25% | 0.692 | 40% | 42% | 0.844 | 28% | 33% | 0.442 | 31% | 32% | 0.927 |
| If a relative of yours became sick with the virus that causes AIDS, would you be willing to care for her or him in your own household? | 94% | 96% | 0.646 | 84% | 78% | 0.283 | 91% | 78% | 0.051* | 96% | 97% | 0.548 | 95% | 96% | 0.599 |
| Testing | | | | | | | | | | | | | | | | | | | | |
| Have you ever been tested to see if you have the AIDS virus? | 31% | 9% | 0.000*** | 5% | 5% | 0.822 | 7% | 0% | 0.063* | 44% | 19% | 0.000*** | 24% | 9% | 0.005*** |
| Talking to partner | | | | | | | | | | | | | | | | | | | | |
| Have you ever talked with (your husband/wife/partner you are living with) about ways to prevent getting the virus that causes AIDS? | 68% | 52% | 0.025** | 41% | 26% | 0.009*** | 30% | 8% | 0.003*** | 80% | 55% | 0.000*** | 64% | 66% | 0.761 |

Statistical testing: *P < 0.1, **P < 0.05, ***P < 0.01
more positive attitude towards people living with HIV and led them to perceive themselves as more able to provide care to HIV-positive family members [3].

The role of grandparents and the older generation on the attitudes and health-seeking behaviour of the wider population is important. Bezner Kerr and colleagues note that health education efforts rarely involve grandmothers and that hospital personnel often have disparaging attitudes towards the role that grandmothers can and do play in the community and that few health education programs have addressed the role that grandmothers play in decision-making [13]. The older generation’s attitudes and knowledge has resonance and impact beyond their own behaviour and therefore cannot be ignored. The low levels of awareness of service availability suggest that there needs to be done to increase the responsiveness of the health system to older individuals’ needs.

The development of a better understanding of the sexual behaviour and attitudes of older adults will not only have impact on their own risk profile but also possibly on that of the younger generations. Intergenerational relationships—sexual relationships predominantly between younger women and older men—are one of the drivers of the epidemic in sub-Saharan Africa.

The strength of this study is the cross-country comparability using the same survey tool as well as attention to factors on rural populations. Limitations include the small sample size in some sites which precluded analysis of narrower age groupings as well as the fact that some of the data is now a few years old. Given the amount of activity and funding for HIV activities in many of these countries over the past few years (albeit starting in urban areas and not focused on older populations), attitudes and awareness might have improved slightly. The HIV status of the respondents was not available and could not be associated with knowledge responses. Lastly, the data is not nationally representative and provides a snapshot of a number of specific rural areas.

There is a need for targeted prevention messaging and the building of treatment awareness among older adults in SSA. Healthcare organisations, governments, and local communities should view older adults as sexually active, as caretakers and educators. Recognising this, South Africa has added males older than 50 to their list of most-at-risk populations [14]. Workshops have been conducted among older adults, such as caregiver workshops in South Africa, which have led to more positive attitudes and improved knowledge [3]. Such initiatives are needed so older Africans can more effectively provide leadership towards an AIDS-free generation.

Acknowledgments The authors would like to thank Alex Radunsky, Maria Muniz and Cheryl Palm of the Earth Institute for their assistance with data preparation and support. Funding for the Millennium Villages was provided by the Lenfest, Blaustein, Sara McCune, Stephen Lewis/MAC/aid, and Yara Foundations and the Government of Japan through the United Nations Development Programme’s Human Security Trust Fund.

References:

Chapter Three
Supplementary Information

Additional tables with supplementary information are provided here that were not included in the final published version of the manuscript.
Supplementary Table 1. Survey Sites and Adult HIV Prevalence by Site during Survey Year

<table>
<thead>
<tr>
<th>Country – Village</th>
<th>Year of Survey</th>
<th>National HIV Prevalence (15-49) in that Year (26)</th>
<th>District/Province/State/Region HIV Prevalence in Nearest Year for Which Data is Available</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malawi – Mwandama</td>
<td>2006</td>
<td>12.1</td>
<td>17.8% in Zomba district (2004) (29)</td>
</tr>
<tr>
<td>Mali – Tiby</td>
<td>2007</td>
<td>1.5</td>
<td>1.3% in Segou region (2006) (30)</td>
</tr>
<tr>
<td>Rwanda – Mayange</td>
<td>2006</td>
<td>2.9</td>
<td>2.5% in East province (2005) (33)</td>
</tr>
<tr>
<td>Senegal – Potou</td>
<td>2007</td>
<td>1.0</td>
<td>0.5% in Louga district (2005) (34)</td>
</tr>
</tbody>
</table>
## Supplementary Table 2. Outcome and exposure variables

| Knowledge Score: number of correct responses to six (6) HIV knowledge questions [continuous variable, range 0-6] [“don’t know” responses were regarded as lack of knowledge] | a. Is there anything a person can do to avoid getting HIV/AIDS, or the virus that causes AIDS?  
b. Can a person get the AIDS virus from mosquito or other insect bites?  
c. Can people reduce their chances of getting the AIDS virus by using a condom every time they have sex?; and  
d. Can a mother who is infected with the AIDS virus reduce the risk of giving the virus to the baby by taking certain drugs during pregnancy?; and  
e. Have you ever heard of VCT, Voluntary Counseling and Testing for the virus that causes HIV/AIDS?  
f. Is there any medicine that a person with AIDS can take to stay alive? |
| --- | --- |
| Stigma: stigmatic response to at least one of two stigma questions [binary variable: 1 = at least 1 stigmatic response] [“don’t know” responses were excluded from analysis] | a. If a member of your family got infected with the virus that causes AIDS, would you want it to remain a secret or not?; or  
b. If a relative of yours became sick with the virus that causes AIDS, would you be willing to care for her or him in your own household? |
| Behaviour – Ever Tested for HIV [binary variable: 1 = ever tested for HIV] | a. Have you ever been tested to see if you have the AIDS virus? |
| Behaviour – Ever Talked to Partner about HIV [binary variable: 1 = talked to partner] | a. Have you ever talked with your husband/wife/partner about ways to prevent getting the virus that causes AIDS? |
| Exposure Variables | Age Group: binary variable (1=50+ years)  
Sex: binary variable (1=Female)  
Age and Sex Interaction: binary variable (1=Female 50+ years) |
### Supplementary Table 3. Characteristics of Study Participants

<table>
<thead>
<tr>
<th>Location</th>
<th>N (Male/Female Ratio)</th>
<th>25-49 Years</th>
<th>50+ Years</th>
<th>Total: 25+ Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ghana - Bonsaaso</td>
<td>214 (0.86)</td>
<td>44 (1.20)</td>
<td></td>
<td>258 (0.91)</td>
</tr>
<tr>
<td>Kenya – Sauri</td>
<td>131 (1.02)</td>
<td>94 (0.96)</td>
<td></td>
<td>225 (0.99)</td>
</tr>
<tr>
<td>Malawi - Mwandama</td>
<td>150 (0.92)</td>
<td>75 (0.67)</td>
<td></td>
<td>225 (0.83)</td>
</tr>
<tr>
<td>Mali – Tiby</td>
<td>164 (0.94)</td>
<td>87 (1.69)</td>
<td></td>
<td>251 (1.15)</td>
</tr>
<tr>
<td>Nigeria - Ikaram</td>
<td>150 (0.74)</td>
<td>152 (0.99)</td>
<td></td>
<td>302 (0.86)</td>
</tr>
<tr>
<td>Nigeria - Pampaida</td>
<td>224 (0.99)</td>
<td>62 (3.36)</td>
<td></td>
<td>286 (1.25)</td>
</tr>
<tr>
<td>Rwanda - Mayange</td>
<td>182 (0.81)</td>
<td>75 (0.91)</td>
<td></td>
<td>257 (0.84)</td>
</tr>
<tr>
<td>Senegal - Potou</td>
<td>161 (0.81)</td>
<td>48 (0.66)</td>
<td></td>
<td>209 (0.77)</td>
</tr>
<tr>
<td>Tanzania - Mbola</td>
<td>158 (1.03)</td>
<td>85 (2.23)</td>
<td></td>
<td>243 (1.33)</td>
</tr>
<tr>
<td>Total</td>
<td>1534 (0.90)</td>
<td>722 (1.19)</td>
<td></td>
<td>2256 (0.98)</td>
</tr>
</tbody>
</table>
Supplementary Table 4.
Responses to knowledge, stigma, testing and talking to partner questions by age by West African site

<table>
<thead>
<tr>
<th>Bonsaaso, Ghana</th>
<th>Tiby, Mali</th>
<th>Ikaram, Nigeria</th>
<th>Pampaida, Nigeria</th>
<th>Potou, Senegal</th>
</tr>
</thead>
<tbody>
<tr>
<td>25-49 yrs</td>
<td>50+ yrs</td>
<td>p-value</td>
<td>25-49 yrs</td>
<td>50+ yrs</td>
</tr>
<tr>
<td>Overall Sample Size</td>
<td>214</td>
<td>44</td>
<td>164</td>
<td>87</td>
</tr>
</tbody>
</table>

**KNOWLEDGE**

<table>
<thead>
<tr>
<th>Question</th>
<th>25-49 yrs</th>
<th>50+ yrs</th>
<th>p-value</th>
<th>25-49 yrs</th>
<th>50+ yrs</th>
<th>p-value</th>
<th>25-49 yrs</th>
<th>50+ yrs</th>
<th>p-value</th>
<th>25-49 yrs</th>
<th>50+ yrs</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is there anything a person can do to avoid getting HIV/AIDS, or the virus that causes AIDS?</td>
<td>93%</td>
<td>84%</td>
<td>0.074   *</td>
<td>81%</td>
<td>80%</td>
<td>0.887</td>
<td>72%</td>
<td>54%</td>
<td>0.002 ***</td>
<td>71%</td>
<td>63%</td>
<td>0.231</td>
</tr>
<tr>
<td>Can a person get the AIDS virus from mosquito or other insect bites?</td>
<td>36%</td>
<td>32%</td>
<td>0.639</td>
<td>16%</td>
<td>22%</td>
<td>0.239</td>
<td>30%</td>
<td>20%</td>
<td>0.054 *</td>
<td>37%</td>
<td>34%</td>
<td>0.645</td>
</tr>
<tr>
<td>Can people reduce their chances of getting the AIDS virus by using a condom every time they have sex?</td>
<td>58%</td>
<td>48%</td>
<td>0.193</td>
<td>66%</td>
<td>53%</td>
<td>0.044 **</td>
<td>53%</td>
<td>37%</td>
<td>0.005 ***</td>
<td>44%</td>
<td>51%</td>
<td>0.322</td>
</tr>
<tr>
<td>Can a mother who is infected with the AIDS virus reduce the risk of giving the virus to the baby by taking certain drugs during pregnancy?</td>
<td>17%</td>
<td>9%</td>
<td>0.197</td>
<td>25%</td>
<td>30%</td>
<td>0.405</td>
<td>23%</td>
<td>17%</td>
<td>0.141</td>
<td>25%</td>
<td>31%</td>
<td>0.412</td>
</tr>
<tr>
<td>Is there any medicine that a person with AIDS can take to stay alive?</td>
<td>24%</td>
<td>9%</td>
<td>0.030 **</td>
<td>37%</td>
<td>25%</td>
<td>0.069 *</td>
<td>19%</td>
<td>14%</td>
<td>0.197</td>
<td>17%</td>
<td>23%</td>
<td>0.354</td>
</tr>
<tr>
<td>Have you ever heard of VCT, Voluntary Counseling and Testing for the virus that causes HIV/AIDS?</td>
<td>55%</td>
<td>80%</td>
<td>0.003 ***</td>
<td>65%</td>
<td>51%</td>
<td>0.031 **</td>
<td>40%</td>
<td>28%</td>
<td>0.032 **</td>
<td>3%</td>
<td>2%</td>
<td>0.631</td>
</tr>
</tbody>
</table>

**STIGMA**

<table>
<thead>
<tr>
<th>Question</th>
<th>25-49 yrs</th>
<th>50+ yrs</th>
<th>p-value</th>
<th>25-49 yrs</th>
<th>50+ yrs</th>
<th>p-value</th>
<th>25-49 yrs</th>
<th>50+ yrs</th>
<th>p-value</th>
<th>25-49 yrs</th>
<th>50+ yrs</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>If a member of your family got infected with the virus that causes AIDS, would you want it to remain a secret or not?</td>
<td>41%</td>
<td>33%</td>
<td>0.375</td>
<td>53%</td>
<td>44%</td>
<td>0.189</td>
<td>28%</td>
<td>25%</td>
<td>0.692</td>
<td>42%</td>
<td>47%</td>
<td>0.584</td>
</tr>
<tr>
<td>If a relative of yours became sick with the virus that causes AIDS, would you be willing to care for her or him in your own household?</td>
<td>79%</td>
<td>90%</td>
<td>0.092 *</td>
<td>88%</td>
<td>89%</td>
<td>0.846</td>
<td>84%</td>
<td>78%</td>
<td>0.283</td>
<td>70%</td>
<td>68%</td>
<td>0.758</td>
</tr>
</tbody>
</table>

**TESTING**

<table>
<thead>
<tr>
<th>Question</th>
<th>25-49 yrs</th>
<th>50+ yrs</th>
<th>p-value</th>
<th>25-49 yrs</th>
<th>50+ yrs</th>
<th>p-value</th>
<th>25-49 yrs</th>
<th>50+ yrs</th>
<th>p-value</th>
<th>25-49 yrs</th>
<th>50+ yrs</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Have you ever been tested to see if you have the AIDS virus?</td>
<td>5%</td>
<td>7%</td>
<td>0.554</td>
<td>10%</td>
<td>6%</td>
<td>0.275</td>
<td>5%</td>
<td>5%</td>
<td>0.822</td>
<td>0%</td>
<td>2%</td>
<td>0.329</td>
</tr>
</tbody>
</table>

**TALKING TO PARTNER**

<table>
<thead>
<tr>
<th>Question</th>
<th>25-49 yrs</th>
<th>50+ yrs</th>
<th>p-value</th>
<th>25-49 yrs</th>
<th>50+ yrs</th>
<th>p-value</th>
<th>25-49 yrs</th>
<th>50+ yrs</th>
<th>p-value</th>
<th>25-49 yrs</th>
<th>50+ yrs</th>
<th>p-value</th>
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</thead>
<tbody>
<tr>
<td>Have you ever talked with (your husband/ wife/partner you are living with) about ways to</td>
<td>63%</td>
<td>50%</td>
<td>0.105</td>
<td>33%</td>
<td>26%</td>
<td>0.305</td>
<td>41%</td>
<td>26%</td>
<td>0.009 ***</td>
<td>26%</td>
<td>26%</td>
<td>0.969</td>
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</tbody>
</table>

67
<table>
<thead>
<tr>
<th>prevent getting the virus that causes AIDS?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Statistical Testing: * for ( p&lt;0.1 ); ** ( p&lt;0.05 ); *** ( p&lt;0.01 )</td>
</tr>
</tbody>
</table>
### Supplementary Table 5.
Responses to knowledge, stigma, testing and talking to partner questions by age by East and Southern African site

<table>
<thead>
<tr>
<th></th>
<th>Sauri, Kenya</th>
<th>Mwandama, Malawi</th>
<th>Mayange, Rwanda</th>
<th>Mbola, Tanzania</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>25-49 yrs</td>
<td>50+ yrs</td>
<td>25-49 yrs</td>
<td>50+ yrs</td>
</tr>
<tr>
<td><strong>Overall Sample Size:</strong></td>
<td>131 94</td>
<td>150 75</td>
<td>182 75</td>
<td>158 85</td>
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<tr>
<td><strong>KNOWLEDGE</strong></td>
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<tr>
<td>Is there anything a person can do to avoid getting HIV/AIDS, or the virus that causes AIDS?</td>
<td>94% 79% 0.001 ***</td>
<td>98% 97% 0.755</td>
<td>100% 97% 0.026 **</td>
<td>89% 76% 0.009 ***</td>
</tr>
<tr>
<td>Can a person get the AIDS virus from mosquito or other insect bites?</td>
<td>55% 45% 0.128</td>
<td>53% 51% 0.777</td>
<td>66% 53% 0.044 **</td>
<td>61% 49% 0.089 *</td>
</tr>
<tr>
<td>Can people reduce their chances of getting the AIDS virus by using a condom every time they have sex?</td>
<td>84% 66% 0.002 ***</td>
<td>60% 56% 0.593</td>
<td>82% 63% 0.002 ***</td>
<td>66% 52% 0.025 **</td>
</tr>
<tr>
<td>Can a mother who is infected with the AIDS virus reduce the risk of giving the virus to the baby by taking certain drugs during pregnancy?</td>
<td>68% 66% 0.713</td>
<td>55% 40% 0.036 **</td>
<td>87% 68% 0.000 ***</td>
<td>47% 34% 0.045 **</td>
</tr>
<tr>
<td>Is there any medicine that a person with AIDS can take to stay alive?</td>
<td>86% 77% 0.086 *</td>
<td>91% 72% 0.000 ***</td>
<td>81% 65% 0.006 ***</td>
<td>61% 44% 0.008 ***</td>
</tr>
<tr>
<td>Have you ever heard of VCT, Voluntary Counseling and Testing for the virus that causes HIV/AIDS?</td>
<td>97% 81% 0.000 ***</td>
<td>97% 84% 0.001 ***</td>
<td>77% 65% 0.049 **</td>
<td>82% 65% 0.003 ***</td>
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<tr>
<td><strong>STIGMA</strong></td>
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<tr>
<td>If a member of your family got infected with the virus that causes AIDS, would you want it to remain a secret or not?</td>
<td>43% 36% 0.330</td>
<td>62% 56% 0.379</td>
<td>28% 33% 0.442</td>
<td>31% 32% 0.927</td>
</tr>
<tr>
<td>If a relative of yours became sick with the virus that causes AIDS, would you be willing to care for her or him in your own household?</td>
<td>92% 87% 0.201</td>
<td>94% 96% 0.646</td>
<td>96% 97% 0.548</td>
<td>95% 96% 0.599</td>
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<tr>
<td><strong>TESTING</strong></td>
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<tr>
<td>Have you ever been tested to see if you have the AIDS virus?</td>
<td>22% 16% 0.249</td>
<td>31% 9% 0.000 ***</td>
<td>44% 19% 0.000 ***</td>
<td>24% 9% 0.005 ***</td>
</tr>
<tr>
<td><strong>TALKING TO PARTNER</strong></td>
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<tr>
<td>Have you ever talked with (your husband/ wife/partner you are living with) about ways to prevent getting the virus that causes AIDS?</td>
<td>69% 52% 0.017 **</td>
<td>68% 52% 0.025 **</td>
<td>80% 55% 0.000 ***</td>
<td>64% 66% 0.761</td>
</tr>
</tbody>
</table>

Statistical Testing: * for p<0.1; ** p<0.05; *** p<0.01
Chapter Three

Supplementary Information

The Millennium Village Project *AIDS and other Sexually Transmitted Diseases Module* Survey used in this study is provided as supplementary information. Surveys were adapted slightly for use in each site based on local context and therefore surveys for each site have slight differences. The survey provided here is the one that was used in the Ruhiira, Uganda site.
The following questions are designed to collect information on sexually transmitted infections (STI) and HIV AIDS in men and women within a household. The information is needed to estimate the scope and scale of these infections and the effectiveness of mitigating interventions promoted under the Millennium Development Village Project. Your co-operation and patience in answering these questions ACCURATELY will be highly appreciated. These questions should be answered by both the Household head and/or their spouse(s) as well as any adult males and females aged 13 years and above.

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<thead>
<tr>
<th>Question</th>
<th>Option 1</th>
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<th>Option 4</th>
<th>Option 5</th>
<th>Option 6</th>
<th>Option 7</th>
<th>Option 8</th>
<th>Option 9</th>
<th>Option 10</th>
<th>Option 11</th>
<th>Option 12</th>
<th>Other 1</th>
<th>Other 2</th>
<th>Don't Know</th>
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<td>4  Can a person get the AIDS virus from mosquito or other insect bites?</td>
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<tr>
<td>5  Can people reduce their chances of getting the AIDS virus by using a condom every time they have sex?</td>
<td>YES</td>
<td>NO</td>
<td>DON'T KNOW</td>
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<tr>
<td>6  Do you know someone personally who has the virus that causes AIDS or someone who died of AIDS?</td>
<td>YES</td>
<td>NO</td>
<td>DON'T KNOW</td>
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<tr>
<td>7  Can the virus that causes AIDS be transmitted from a mother to a child?</td>
<td>During pregnancy: YES</td>
<td>NO</td>
<td>DON'T KNOW</td>
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<tr>
<td>8  Can a mother who is infected with the AIDS virus reduce the risk of giving the virus to the baby by taking certain drugs during pregnancy?</td>
<td>YES</td>
<td>NO</td>
<td>DON'T KNOW</td>
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<tr>
<td>9  Have you ever talked with (your husband/ wife/partner you are living with) about ways to prevent getting the virus that causes AIDS? IF MORE THAN ONE WIFE/PARTNER, ASK ABOUT ALL.</td>
<td>YES</td>
<td>NO</td>
<td>DON'T KNOW</td>
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<tr>
<td>10 If a member of your family got infected with the virus that causes AIDS, would you want it to remain a secret or not?</td>
<td>YES, KEEP IT SECRET</td>
<td>NO</td>
<td>DON'T KNOW</td>
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<tr>
<td>11 If a relative of yours became sick with the virus that causes AIDS, would you be willing to care for her or him in your own household?</td>
<td>YES</td>
<td>NO</td>
<td>DON'T KNOW</td>
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<tr>
<td>12 If a female teacher has the AIDS virus, should she be allowed to continue teaching in school?</td>
<td>CAN CONTINUE</td>
<td>SHOULD NOT CONTINUE</td>
<td>DON'T KNOW</td>
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<tr>
<td>13 Do you think your chances of getting AIDS are small, moderate, great, or no risk at all?</td>
<td>NO RISK AT ALL</td>
<td>SMALL</td>
<td>MODERATE</td>
<td>GREAT</td>
<td>HAS AIDS</td>
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<tr>
<td>14 Why do you think that you have (no risk/a small chance) of getting AIDS? Any other reason?</td>
<td>IS NOT HAVING SEX</td>
<td>USES CONDOMS</td>
<td>HAS ONLY ONE PARTNER</td>
<td>LIMITS THE NUMBER OF PARTNERS</td>
<td>PARTNERS TESTED NEGATIVE</td>
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<tr>
<td>15 Why do you think that you have a (moderate, great) chance of getting AIDS? Any other reason?</td>
<td>DOES NOT USE CONDOM</td>
<td>HAS MORE THAN 1 SEX PARTNER</td>
<td>PARTNER HAS OTHER PARTNERS</td>
<td>HOMOSEXUAL CONTACTS</td>
<td>HAD BLOOD TRANSFUSION/INJECTION</td>
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<tr>
<td>16 Is there any medicine that a person with AIDS can take to stay alive?</td>
<td>YES</td>
<td>NO</td>
<td>DON'T KNOW</td>
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<td>17 Should children aged 12-14 be taught about using condom to avoid AIDS?</td>
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<td>NO</td>
<td>DON'T KNOW</td>
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<td>Question</td>
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<tr>
<td>18 Have you ever heard of VCT, Voluntary Counseling and Testing for the virus that causes HIV/AIDS?</td>
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<td>19 I do not want to know the results, but have you ever been tested to see if you have the AIDS virus?</td>
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<td>20 I don't want to know the results of the test, but did you ever get the results of the test?</td>
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<td>21 When was the last time you were tested?</td>
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<td>22 The last time you were tested, did you ask for the test, was it offered to you and you accepted, or was it required?</td>
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<td>23 Where did you go for the test?</td>
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<td>24 Would you want to be tested for the AIDS virus?</td>
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<td>25 Do you know a place where you could go to get an AIDS test?</td>
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<td>26 Where can you go for the AIDS test?</td>
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<td>27 (Apart from AIDS), have you heard about (other) infections that can be transmitted through sexual contact?</td>
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<tr>
<td>If a man has a sexually transmitted disease, what symptoms might he have?</td>
<td>Abdominal pain, genital discharge/dripping, foul smelling discharge, burning pain on urination, redness/inflammation in genital area, swelling in genital area, genital sores/ulcers, genital warts, genital itching, blood in urine, loss of weight, impotence/no erection, other (specify)</td>
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<tr>
<td>If a woman has a sexually transmitted disease, what symptoms might she have?</td>
<td>Abdominal pain, genital discharge/dripping, foul smelling discharge, burning pain on urination, redness/inflammation in genital area, swelling in genital area, genital sores/ulcers, genital warts, genital itching, blood in urine, loss of weight, hard to get pregnant/have a child, other (specify)</td>
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<tr>
<td>Now I would like to ask you some questions about your health in the last 12 months. During the last 12 months, have you had a sexually-transmitted disease?</td>
<td>Yes, no, don't know</td>
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<td>Is respondent a man?</td>
<td>If a woman</td>
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<td>Sometimes, men experience an abnormal discharge from their penis. During the last 12 months, have you had an abnormal discharge from your penis?</td>
<td>Yes, no, don't know</td>
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<tr>
<td>Sometimes men have a sore or ulcer on or near their penis. During the last 12 months, have you had a sore or ulcer on or near your penis?</td>
<td>Yes, no, don't know</td>
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<tr>
<td>Sometimes, women experience an abnormal vaginal discharge. During the last 12 months, have you had a bad-smelling unusual discharge from your vagina?</td>
<td>Yes, no, don't know</td>
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<tr>
<td>Sometimes women have a genital sore or ulcer. During the last 12 months, have you had a genital sore or ulcer?</td>
<td>Yes, no, don't know</td>
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<tr>
<td>The last time you had (problem(s) from Q30, Q32/33, Q34/35), did you seek any kind of advice or treatment?</td>
<td>Yes, no, don't know</td>
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</table>
38 The last time you had (PROBLEM(S) did you do any of the following?

A. Did you go to a clinic, hospital or private doctor?
   YES ........................................ 1
   NO ......................................... 2

B. Did you consult a traditional healer?
   YES ........................................ 1
   NO ......................................... 2

C. Did you seek advice or buy medicines in a shop or pharmacy?
   YES ........................................ 1
   NO ......................................... 2

D. Did you ask for advice from friends or relatives?
   YES ........................................ 1
   NO ......................................... 2

39 When you had (PROBLEM(S) FROM Q30, Q32/33, Q34/35), did you tell the person(s) with whom you were having sex?
   YES ........................................ 1
   NO ......................................... 2
   SOME/NOT AT ALL ..................... 3
   DID NOT HAVE A PARTNER .......... 4

40 When you had (PROBLEM(S) FROM Q30, Q32/33, Q34/35), did you do anything to avoid infecting your sexual partner(s)?
   YES ........................................ 1
   NO ......................................... 2
   PARTNER(S) ALREADY INFECTED ... 3

41 What did you do to avoid infecting your partner(s)?

A. Did you use medicine?
   YES ........................................ 1
   NO ......................................... 2

B. Did you stop having sex?
   YES ........................................ 1
   NO ......................................... 2

C. Did you use a condom when having sex?
   YES ........................................ 1
   NO ......................................... 2

42 How old were you when you first started being sexually active?
   NOT YET SEXUAL ACTIVE .......... UR1
   SEXUALY ACTIVE .................. UR2 YRS

43 How many sexual partners have you ever had in your lifetime?
   0 PARTNER ............................. 1
   1 PARTNER ............................. 2
   2-5 PARTNERS ......................... 3
   6-10 PARTNERS ....................... 4
   11-20 PARTNERS ..................... 5
   21-50 PARTNERS .................... 6
   MORE THAN 50 PARTNERS ....... 7

44 In the past 12 months, have you had sex with anyone else, other than the one who is your main partner?
   YES ........................................ 1
   NO ......................................... 2
   REFUSED TO ANSWER ............. 7

45 The last time you had sexual intercourse with someone who is not your main partner, did you use a condom?
   YES ........................................ 1
   NO ......................................... 2
   REFUSED TO ANSWER ............. 7

Thank you very much for sparing time to answer these questions. Your services are highly appreciated.
Chapter Four

Anti-Retroviral Treatment Outcomes among Older Adults in Zomba District, Malawi

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1 School of Public Health, University of Sydney, Sydney, Australia, 2 Dignitas International, Zomba, Malawi, 3 Dalla Lana School of Public Health, University of Toronto, Toronto, Canada, 4 Ministry of Health, Zomba, Malawi, 5 George Institute for Global Health, Sydney, Australia, 6 Sunnybrook Health Sciences Research Institute, University of Toronto, Toronto, Canada, 7 Department of Medicine, University of Toronto, St. Michael’s Hospital, Toronto, Canada

Abstract

Background: There are approximately 3 million people aged 50 and older in sub-Saharan Africa who are HIV-positive. Despite this, little is known about the characteristics of older adults who are on treatment and their treatment outcomes.

Methods: A retrospective cohort analysis was performed using routinely collected data with Malawi Ministry of Health monitoring tools from facilities providing antiretroviral therapy services in Zomba district. Patients aged 25 years and older initiated on treatment from July 2005 to June 2010 were included. Differences in survival, by age group, were determined using Kaplan–Meier survival plots and Cox proportional hazards regression models.

Results: There were 10,888 patients aged 25 and older. Patients aged 50 and older (N = 1419) were more likely to be male (P < 0.0001) and located in rural areas (P = 0.003) than those aged 25–49. Crude survival estimates among those aged 50–59 were not statistically different from those aged 25–49 (P = 0.925). However, survival among those aged 60 and older (N = 345) was worse (P = 0.019) than among those 25–59. In the proportional hazards model, after controlling for sex and stage at initiation, survival in those aged 50–59 did not differ significantly from those aged 25–49 (hazard ratio 1.00 (95% CI: 0.79 to 1.27; P = 0.998) but the hazard ratio was 1.46 (95% CI: 1.03 to 2.06; P = 0.032) for those aged 60 and older compared to those aged 25–49.

Conclusions: Treatment outcomes of those aged 50–59 are similar to those aged 25–49. A better understanding of how older adults present for and respond to treatment is critical to improving HIV services.

Introduction

There are approximately 3 million people aged 50 and older in sub-Saharan Africa who are HIV-positive, representing more than 13% of all HIV cases in the region [1]. These figures are likely to increase as the number of people on life-prolonging anti-retroviral treatment (ART) grows. Despite this, older people have been neglected in the global and regional HIV response. UNAIDS and other prominent data sources report prevalence rates of those aged 50–59, with this, for older adults in sub-Saharan Africa, issues of stigma, lack of access to health services, poor overall health [19] and ageist views on sexual behavior might negatively impact on the effectiveness of ART scale-up efforts.

In Malawi, a country with a 2009 HIV prevalence of 11% among those aged 15–49, analysis of 2007 UNAIDS data suggested that there are approximately 156,000 people over 50 who are living with HIV in Malawi or 16.8% of the total [1]. Furthermore, people over 50 make up 9.3% of Malawi’s population [20]. ART coverage has expanded dramatically over the past few years and, as of 2009, 72% of those who needed treatment were receiving it based on 2006 World Health Organization ART...
guidelines [2] suggesting that the numbers ageing with HIV will increase. Despite this, no published work exists for Malawi specifically examining HIV among older adults.

Using data from Zomba District in Malawi, this study examines the characteristics of older adults on ART, their condition at initiation and their treatment outcomes compared against younger adults.

**Methods**

Subjects were adults aged 25 and older at time of ART initiation residing in Zomba District in southern Malawi who accessed ART services in the district’s 23 health facilities between 1 July 2005 and 30 June 2010.

The methods used in this study have been described in detail elsewhere (Chan et al 2010) [21]. In brief, a retrospective cohort analysis was performed using data collected with standard Malawi Ministry of Health (MOH) ART monitoring tools. ART provision was implemented as per MOH guidelines based on WHO clinical staging or CD4 count <250 cells/mm3 where measurement of CD4 is available. The first line ART regimen in Malawi is stavudine, lamivudine and nevirapine in fixed-dosed combination. After initiation, follow-up was monthly and then, after approximately 6 months, patients were followed less often depending on assessment of adherence. In the project district, mortality was documented by trained health workers in health facilities and by reports from trained patient guardians where deaths occurred at home. Default tracing was also conducted which revealed additional deaths.

Analyses in this paper only included those aged 25 and older to exclude those regarded by MDG [22] and UNGASS [23] indicators as adolescents. Age was defined as age at treatment initiation. The 23 health facilities where MOH ART provision is supported by Dignitas International were classified as urban, semi-urban or rural based on location and catchment area of facility. Analysis of conditions at initiation was based on examination at baseline of 52 HIV-related conditions detailed in WHO clinical staging including: acute ulcerative mouth infections, Kaposi’s sarcoma, various types of pneumonia and weight loss to name a few. As per Malawi MOH guidelines, individuals were initiated based on characterization as being in WHO clinical stage 3 or 4 or, if characterized as Stage 1 or 2, based on low CD4 count if baseline of 52 HIV-related conditions was implemented as per MOH guidelines based on WHO clinical staging or CD4 count <250 cells/mm3 where measurement of CD4 is available. The first line ART regimen in Malawi is stavudine, lamivudine and nevirapine in fixed-dosed combination.

After initiation, follow-up was monthly and then, after approximately 6 months, patients were followed less often depending on assessment of adherence. In the project district, mortality was documented by trained health workers in health facilities and by reports from trained patient guardians where deaths occurred at home. Default tracing was also conducted which revealed additional deaths.

Interactions between age and location and between age and sex were tested and were not significant.

Analyses included Chi-square tests for categorical variables and t-tests for continuous variables to compare differences between groups. Logistic regression analyses were used for categorical outcomes including WHO clinical stage and number of conditions at initiation. Interactions between age and sex and between age and location of initiation were tested in the logistic regression analyses. Cox proportional hazard regression models were used to evaluate relationships between age, sex and status at initiation and treatment outcomes (death). CD4 count was not used for these analyses due to high number of missing values. Differences in survival time between groups of subjects by age categories and by sex were investigated using Kaplan-Meier survival plots. Data analysis was performed using SAS v9.2.

For the Cox proportional hazards model and Kaplan-Meier survival curves, analyses excluded those whose follow-up status was characterized in the dataset as “missing” or suspected of having “defaulted.” This represented 22.7% (N = 2475) of all those aged 25 and older who had initiated in the five year period from 1 July 2005 to 30 June 2010. Based on a systematic review [24] and data from two studies in Malawi, [25,26] we estimate that approximately 41–50% of those lost to follow-up would have died within approximately two years. Analyses were run to identify differences in characteristics between those in the analyzed cohort versus those excluded.

**Ethics Statement**

The study analysis received approval from the National Health Sciences Research Committee of Malawi in April 2011.

**Results**

There were 10888 patients aged 25 and older who had initiated ART between 1 July 2005 and 30 June 2010 in the database. Of those, 6789 (62.4%) were female; 9469 (87.0%) were aged 25–49, 1074 (9.9%) were 50–59 and 345 (3.2%) were aged 60 and older. The older age groups had significantly higher percentages of male patients than the younger age groups: 44.9% of those 50 years and older were male compared to 36.6% of those aged under 50 years (table 1). Older adults were also more likely to be living in a rural location compared to younger adults (P = 0.003). There were no significant differences between age groups for year of initiation or TB status at baseline.

After adjusting for location and sex, age group was not associated with WHO clinical stage at initiation of ART or with the number of HIV-related conditions at initiation. Females were slightly more likely than males to have two or more HIV-related conditions at initiation (odds ratio (OR): 1.17 (95% confidence interval (CI): 1.05 to 1.32)). Those who initiated in semi-urban and rural areas were less likely (OR: 0.61 (95% CI: 0.53 to 0.69)) to have two or more conditions compared to urban patients. Interactions between age and location and between age and sex were tested and were not significant.

Data were available for 8412 individuals for the analysis of treatment outcomes. Of these, 765 (9.1%) died within 5 years of initiation of treatment. Survival rates among those aged 50–59 were not statistically different from those aged 25–49 (P = 0.92) (figure 1). Survival among those aged 60 and older was significantly worse (P = 0.02) than among those 25–59. Those aged 60 and older also had significantly worse survival (P = 0.04) than those aged 50–59. Further analysis revealed that sex was a significant predictor of survival (P<0.0001), with males having worse survival than females (figure 2).

After controlling for sex and WHO clinical stage at initiation, the hazard ratio (HR) for those aged 50–59 compared to those aged 25–49 was 1.00 (95% CI: 0.79 to 1.27; P = 0.99) (table 2). Compared to those aged 25–49 years, those aged 60 and older were at significant increased risk of dying (HR = 1.46 (95% CI: 1.03 to 1.96; P = 0.03)). Controlling for stage and age group, being female reduced the risk of death with a hazard ratio of 0.58 (95% CI: 0.50 to 0.67; P<0.0001). As expected, WHO clinical stage was strongly associated with mortality. After controlling for sex and age group, compared to Stage 1, the hazard ratio for Stage 3 was 5.4 (95% CI: 1.74 to 16.94) and the hazard ratio for Stage 4 was 12.3 (95% CI: 3.93 to 38.32).

Of the 763 who died, 629 (82.2%) died within the first year of ART initiation. The pattern of mortality between the age groups was unchanged with those 50–59 have similar mortality to those aged 25–49 with those 60 and older having higher mortality.

Due to missing outcome data, 2475 (22.7%) of subjects were excluded from survival analyses. The mean age and baseline CD4 of those included in analysis were not meaningfully different from the mean age of those excluded but those excluded were more...
likely to be male and were more likely to have been characterized as WHO Stage 4 on initiation of treatment (table 3). Importantly, the relative differences in sex and WHO Stage between those included and those excluded from survival analyses were largely consistent among those over 50 and among those under 50. If the excluded patients are included in the survival analysis up to the point when they were classified as missing, the results and significance noted above remained in the same direction and changed only slightly in magnitude. The hazard ratio for those aged 60 and older became 1.52 (95% CI: 1.08 to 2.15; P = 0.0168) while the hazard ratio for those aged 50–59 remained 1.00 compared to those aged 25–49. Using the Kaplan-Meier survival curves, when including those with incomplete outcome data, those 60 and older had significantly worse survival than those 50–59 (P = 0.03).

Discussion

Adults aged 50 and older in Zomba District, Malawi, who initiated ART were more likely than younger adults to be male and be receiving treatment at a rural health facility. However, based on WHO clinical stage and number of HIV-related conditions at ART initiation, older adults in this population were no sicker at presentation than younger adults.

We found no difference in mortality on treatment among those aged 50 to 59 years compared to those aged 25 to 49, indicating that people in their fifties respond just as well to treatment as younger people. Survival among those aged 60 and older was reduced; however, this is to be expected due to higher rates of all-cause mortality among older adults. In this study, sex was a much better predictor of survival than age in the Zomba District ART cohort. This study suggests that females are more likely to survive than men.

In our study, 9% of those initiated on treatment died over the course of the five years. This level of mortality was higher than was found in Uganda [16] but comparable to data seen in South Africa, Cote d’Ivoire and elsewhere in Malawi [15].

The lack of significant differences in the clinical condition of older adults at initiation of ART is contrary to what has been hypothesized. In Brazil, those aged 60 and older had more AIDS-
Figure 1. Survival estimates by age. Kaplan-Meier survival estimates by age group for those aged 25 and older who initiated treatment in Zomba District between 1 July 2005 and 30 June 2010. Blue is 25–49 (N = 7297); Red is 50–59 (N = 839); Green is 60+ (N = 276).

doi:10.1371/journal.pone.0026546.g001

Figure 2. Survival estimates by sex. Kaplan-Meier survival estimates by sex for those aged 25 and older who initiated treatment in Zomba District between 1 July 2005 and 30 June 2010. Blue is Male (N = 3057); Red is Female (N = 5355).

doi:10.1371/journal.pone.0026546.g002
defining diseases at diagnosis than those aged 20–39 [8] and a review of developed country studies found that older adults presented later and sicker [6]. However, the recent South African ART among older adults study found that they did not present with more advanced disease than younger individuals [17]. Similar to our findings, the Ugandan study by Bakanda and colleagues also found that older adults were more likely to be male and did not differ in WHO clinical stage at treatment initiation [16].

With regard to treatment outcomes, the Ugandan study found that being aged 50 and older was associated with mortality compared to those 18 to 49 after controlling for other variables [16]. The South African study found that older adults had 32% excess mortality compared to those 25 to 49 [17]. A four site cross-Africa study found that treatment outcomes for over 50s were worse than for younger age groups [15]. Ours is the first study that breaks down the over 50 group into additional age categories for analysis. Especially for the 50–59 age group, our data confirms what has been seen in non-African studies where older HIV-infected patients responded as well to ART as younger age groups [27–30]. A Brazilian study that compared those aged 20–39 against those aged 60 and older found that, once on ART, mortality between the two groups was similar [8]. A recent case-control study, in which the outcome in patients aged 55 years or older was compared with patients aged 35 years or younger, all treated with ART, concluded that the virological outcome did not differ between groups [31]. The picture is complex however as a number of other studies have found that there is slower recovery of CD4 levels among older adults [12,32]. The eventual higher mortality among older adults in the study was expected and has been seen in other studies [33,34].

Our finding that women on ART are more likely to survive than men has been observed in other studies in Malawi [35] and across Africa [36]. Potential reasons for this sex difference could be that men seek care at a more advanced stage of illness and have poorer levels of adherence.

The strength of the study is its inclusion of program data from an entire district’s ART population including urban and rural sites. However, study limitations include concerns regarding accuracy and consistency that are associated with use of operational data. Because data were extracted from routine monitoring and evaluation indicators, information that might be included in a prospective study is not available, as it is not a part of routine clinical care for ART provision under the Malawi MOH

<table>
<thead>
<tr>
<th>Variable</th>
<th>Model with age, sex and WHO Stage at initiation (N=8390)</th>
<th>Model with Age and Sex (N=8412)</th>
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<tr>
<td></td>
<td>Hazard ratio</td>
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<tr>
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<td>60+</td>
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<td>Stage 4</td>
<td>12.27</td>
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</table>

Table 3. Comparison of those included in survival analysis and those excluded.

<table>
<thead>
<tr>
<th>Total population</th>
<th>Included in Analysis (N)</th>
<th>Excluded from Analysis (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (mean)</td>
<td>38.3 (8412)</td>
<td>38.0 (2475)</td>
</tr>
<tr>
<td>Sex (% male)</td>
<td>36.3% (3057)</td>
<td>42.1% (1042)</td>
</tr>
<tr>
<td>WHO Stage 3 and 4 (%)</td>
<td>61.1% (5122)</td>
<td>63.8% (1578)</td>
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<tr>
<td>Baseline CD4 (mean)</td>
<td>162.6 (4055)</td>
<td>154.6 (1070)</td>
</tr>
<tr>
<td>25 to 49</td>
<td>Age (mean)</td>
<td>35.5 (7297)</td>
</tr>
<tr>
<td>Sex (% male)</td>
<td>35.2% (2569)</td>
<td>41.1% (893)</td>
</tr>
<tr>
<td>WHO Stage 3 and 4 (%)</td>
<td>60.8% (4425)</td>
<td>63.9% (1386)</td>
</tr>
<tr>
<td>50 and older</td>
<td>Age (mean)</td>
<td>56.1 (1115)</td>
</tr>
<tr>
<td>Sex (% male)</td>
<td>43.8% (488)</td>
<td>49.0% (149)</td>
</tr>
<tr>
<td>WHO Stage 3 and 4 (%)</td>
<td>62.9% (697)</td>
<td>63.2% (192)</td>
</tr>
</tbody>
</table>
public health model and is reflective of resource limitations in that setting. Specifically, high levels of missing baseline CD4 data made usage of that variable difficult.

A further limitation was the approximately 20% loss to follow up in the dataset. However, the levels of loss to follow-up in this study are comparable to those seen in a review of loss to follow-up across Africa [24]. The exclusion of those lost to follow-up from analysis is likely to have led to underestimation of the absolute number of deaths and mortality rates. However, because the magnitude of differences in characteristics of those included and excluded was similar in the different age groups, the relative risk of death (or hazard ratio) comparing those aged 50 years and over with those aged under 50 was unlikely to be biased.

While some studies have also excluded those lost to follow-up, [15] other studies have used randomization techniques to impute outcome status [16,37]. These imputation techniques make assumptions about which variables are correlated with mortality. For example, Bakanda and colleagues [16] assumed that those with lower CD4 count and those who were older were more likely to die. We did not conduct outcome imputation for those lost to follow-up. Given that age and its relation to mortality was the primary outcome of this study, it was felt that including age in the imputation method would be inappropriate as the method of imputation would be directly related to the primary outcome of interest. Baseline CD4 was also not ideal for use as an imputation variable due to the large number of non-random missing values in our dataset. In the future, greater efforts will be needed to trace those lost to follow-up and examine specific characteristics and determinants of mortality [38,39].

That older adults respond well to ART despite a lack of specifically targeted services is an encouraging sign for ART scale-up. This evidence can be used to combat ageist stigma [40] and to specifically targeted services is an encouraging sign for ART scale-up. The ageing of the epidemic has implications on service delivery with a growing need for integrated diagnostic and treatment services for HIV and non-communicable diseases.

References


Chapter Four
Supplementary Information

The Zomba District anti-retroviral treatment initiation patient card is provided as supplementary information. This card is filled out for each new patient commencing treatment.
## Patient Details

**Patient Name**

**Sex, Birth date** M F DOB

**Phys. Address**

**Guardian Name**

**Agrees to FUP** N Y

**Patient Phone**

**DOB**

**Relation**

**Guardian Phone**

---

## Status at ART initiation

**WHO Stage**

1 2 3 4

**TB status** None Past Curr

**CD4 count** % KS

**CD4 Date**

**Pregnant** N Y

**Height, Wt.**

**Age at init.**

---

## First positive HIV test

**Date, Place**

**Rapid**

**ART Regimens**

1st Line

**Start date**

2nd Line

---

## Patient Master Card – ART Initiation

### Drug Administration Schedule

<table>
<thead>
<tr>
<th>Date</th>
<th>Hgt cm</th>
<th>Wt kg</th>
<th>Outcome</th>
<th>Outc Date</th>
<th>1st L</th>
<th>1st Line Alt</th>
<th>2nd L</th>
<th>Non Rx</th>
<th>ART Regimen</th>
<th>Pill count</th>
<th>Doses missed</th>
<th>ARVs given</th>
<th>Comments / Lab</th>
<th>Next appointment</th>
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<tbody>
<tr>
<td>Jan</td>
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</tbody>
</table>
### WHO Clinical Staging

#### Adults and Children

**Circle all conditions found in the patient**

<table>
<thead>
<tr>
<th>Adults only (15 years or older)</th>
<th>Children only (14 years or younger)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Asymptomatic</td>
<td>1. Asymptomatic</td>
</tr>
<tr>
<td>• Persistent generalized lymphadenopathy</td>
<td>• Hepatosplenomegaly, persistent unexplained</td>
</tr>
<tr>
<td>2. Respiratory tract infections, recurrent (sinusitis, tonsillitis, otitis media, pharyngitis)</td>
<td>• Lineal gingival erythema</td>
</tr>
<tr>
<td>• Herpes zoster</td>
<td>• Wart virus infection, extensive</td>
</tr>
<tr>
<td>• Angular cheilitis</td>
<td>• molluscum contagiosum, extensive</td>
</tr>
<tr>
<td>• Oral ulcerations, recurrent</td>
<td>• Parotid enlargement, persistent unexplained</td>
</tr>
<tr>
<td>• Papular pruritic eruptions / Fungal nail infections</td>
<td></td>
</tr>
<tr>
<td>3. Fever, persistent unexplained (intermittent or constant, &gt;1 month)</td>
<td>• Severe unexplained wasting / malnutrition not responding to treatment (weight-for-height 70-79% or MUAC 11-12cm)</td>
</tr>
<tr>
<td>• Oral hairy leukoplakia</td>
<td>• Diarrhoea, persistent unexplained (14 days or more)</td>
</tr>
<tr>
<td>• Pulmonary tuberculosis (current)</td>
<td>• Oral candidiasis</td>
</tr>
<tr>
<td>• Pulmonary tuberculosis within the last 2 years</td>
<td></td>
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<tr>
<td>• Anaemia, unexplained &lt; 8 g/dl</td>
<td>• Severe bacterial infections (pneumonia, empyema, pyomyositis, bone/joint, meningitis, bacteremia)</td>
</tr>
<tr>
<td>• Neutropenia, unexplained &lt; 50 /mm$^3$</td>
<td>• Acute necrotizing ulcerative stomatitis, gingivitis or periodontitis</td>
</tr>
<tr>
<td>• Thrombocytopenia, chronic &lt; 50,000/mm$^3$</td>
<td>• Lymph node tuberculosis</td>
</tr>
<tr>
<td>4. Pneumocystis pneumonia</td>
<td>• Severe unexplained wasting / malnutrition not responding to treatment (weight-for-height &lt;70% or MUAC &lt;11cm or oedema)</td>
</tr>
<tr>
<td>• Candidiasis of oesophagus, trachea, bronchi or lungs</td>
<td>• Bacterial infections, severe recurrent (empyema, pyomyositis, bone/joint, meningitis, but excluding pneumonia)</td>
</tr>
<tr>
<td>• Extrapulmonary tuberculosis</td>
<td>• Chronic herpes simplex infection (cervical or cutaneous &gt;1 month or visceral at any site)</td>
</tr>
<tr>
<td>• Kaposi’s sarcoma</td>
<td>• Cytomegalovirus infection: retinitis or cytomegalovirus infection affecting another organ (from age 1 month)</td>
</tr>
<tr>
<td>• HIV encephalopathy</td>
<td>• Toxoplasmosis of the brain (from age 1 month)</td>
</tr>
<tr>
<td>• Cryptococcal meningitis or other Extrapulmonary cryptococcosis</td>
<td>• Cerebral or B-cell non-Hodgkin lymphoma</td>
</tr>
<tr>
<td>• Disseminated non-tuberculous mycobacterial infection</td>
<td>• Progressive multifocal leukoencephalopathy</td>
</tr>
<tr>
<td>• Cryptosporidiosis, chronic with diarrhoea</td>
<td></td>
</tr>
<tr>
<td>• Isosporiasis &gt;1 month</td>
<td>• Toxoplasmosis of the brain</td>
</tr>
</tbody>
</table>
Chapter Five

Title: Prevalence of HIV and chronic comorbidities among older adults

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Abstract

Objectives: Limited evidence is available on HIV, aging and comorbidities in sub-Saharan Africa. This article describes the prevalence of HIV and chronic comorbidities among those aged 50 years and older in South Africa using nationally representative data.

Design: The WHO’s Study of global AGEing and adult health (SAGE) was conducted in South Africa in 2007–2008. SAGE includes nationally representative cohorts of persons aged 50 years and older, with comparison samples of those aged 18–49 years, which aims to study health and its determinants.

Methods: Logistic and linear regression models were applied to data from respondents aged 50 years and older to determine associations between age, sex and HIV status and various outcome variables including prevalence of seven chronic conditions.

Results: HIV prevalence among adults aged 50 and older in South Africa was 6.4% and was particularly elevated among Africans, women aged 50–59 and those living in rural areas. Rates of chronic disease were higher among all older adults compared with those aged 18–49. Of those aged 50 years and older, 29.6% had two or more of the seven chronic conditions compared with 8.8% of those aged 18–49 years ($P < 0.0001$). When controlling for age and sex among those aged 50 and older, BMI was lower among HIV-positive older adults aged 50 and older (27.5) than in HIV-negative individuals of the
same age (30.6) ($P<0.0001$). Grip strength among HIV-positive older adults was significantly ($P=0.004$) weaker than among similarly-aged HIV-negative individuals.

**Conclusion:** HIV-positive older adults in South Africa have high rates of chronic disease and weakness. Studies are required to examine HIV diagnostics and treatment instigation rates among older adults to ensure equity of access to quality care, as the number and percentage of older adults living with HIV is likely to increase.

**Keywords:** aging; chronic disease; comorbidity; HIV; older adults; South Africa
Introduction

As of 2007, almost one in eight people living with HIV in sub-Saharan Africa was aged 50 years and older [1]. With life expectancy increasing for individuals on antiretroviral (ARV) treatment (ART) [2], the number of older people with HIV will continue to increase and will have considerable impacts on the future course of the epidemic. Overall, South Africa is aging despite the impacts of HIV mortality on the total population, with the highest percentage (15.9%) of persons aged 50 years and above in sub-Saharan Africa in 2012 [3].

The aging of the HIV epidemic in South Africa has received more attention than other parts of Africa over the past few years [4–6]. Recent estimates for South Africa predict that HIV prevalence in patients aged 50 and older will nearly double in the next 30 years from 9% in 2010 to 17% in 2040, whereas the fraction of HIV-infected patients aged 50 and over will triple in the same period. The increase will be particularly pronounced among men: less than one in 12 HIV-infected people is aged over 50 in 2010 but in 2040 this will be one in four [7].

Despite this emerging evidence, there are still substantial knowledge gaps about HIV-positive individuals aged 50 and older in South Africa. Previous studies on older adults in South Africa have been conducted with subpopulations in which HIV is highly prevalent [4]. One of the key issues that has not yet received much attention in sub-Saharan Africa is noncommunicable diseases (NCDs) and comorbidities among people living with HIV.
Traditionally, HIV and AIDS-associated conditions have focused on opportunistic, primarily infectious diseases such as tuberculosis, pneumonia and Kaposi’s sarcoma. However, newer evidence from developed countries demonstrates that there is also an additional burden of HIV-related and ART-related chronic comorbidities, especially among those aged 50 and older [8]. Patients aging with HIV are more likely to develop NCDs and at an earlier age than those who are HIV-negative, threatening the long-term survival of people living with HIV. These conditions include coronary artery disease, dyslipidemia, some cancers, metabolic syndrome, diabetes, osteoporosis and dementia [9–11]. This has led to calls for greater attention to multimorbidity in the care of people living with HIV [12,13].

However, not much evidence on comorbidities occurring in HIV-infected individuals is available from African settings. Although chronic comorbidities in the context of HIV have been acknowledged as likely [14,15], the situation has not been well quantified. A small number of African studies have measured prevalence of specific conditions among HIV-positive individuals. For instance, one study reports that cardiac abnormalities are more common in people with HIV compared with controls [16].

The topic of HIV, aging and comorbidities remains neglected by the international community [17]. Examining the realities and complexities of HIV and aging in South Africa is critical to improving quality of care and treatment options. The co-existence of communicable and NCD burdens pose complex challenges for an already taxed
healthcare system: evidence is needed to better inform the South African health system and build its capacity to respond to multiple comorbidities [18–20]. In order to start to address the knowledge gaps, this article aims to describe HIV prevalence and associations between HIV and chronic comorbidities – among those aged 50 years and older in South Africa using nationally representative data.

**Methods**

The WHO implemented Wave 1 of the Study of global AGEing and adult health (SAGE) in six low-income and middle-income countries, including South Africa, in 2007–2008. Cross-sectional data was used from SAGE: a study with nationally representative cohorts of persons aged 50 years and older, with comparison samples of younger adults aged 18–49 years in each country, which aims to study health, health-related outcomes and their determinants. The survey instrument included multiple modules devised to measure health status, risk factors and chronic diseases, health systems coverage and responsiveness and healthcare expenditures. Biomarkers, including a blood sample, were collected. More information on SAGE survey methods and materials is available elsewhere [21–23].

Data for the South African SAGE survey were collected from March 2007 to September 2008. A population-based representative sample of the population aged 50 years or older was interviewed, with a smaller cohort of adults aged 18–49 years included for comparison purposes. The survey includes information on respondents’ health, physical
functioning, risk factors and perceptions of well being. Anthropometric measures were collected, including BMI and waist and hip circumferences. Dried blood spot samples were collected through finger prick and used to determine HIV status through laboratory testing. Grip strength was measured as a proxy for mobility and functioning. Interviewers were retired or unemployed nurses. Respondent consent was obtained for the interview and the blood sample. In South Africa, SAGE was carried out in partnership with the WHO, the Human Sciences Research Council (HSRC) and the National Department of Health (NDOH). Blood samples were stored and analyzed at Global Clinical and Viral Laboratories, Durban, South Africa. Ethical review and clearance was obtained through WHO and the HSRC Research Ethics Committee. Financial support was provided by the NDOH, the United States National Institute on Aging's Division of Behavioral and Social Research, HSRC and WHO.

Respondents were asked whether they had been diagnosed with a number of NCDs, using the following question format: ‘have you ever been told by a health professional that you have…?’ or ‘have you ever been diagnosed with…?’, for each health condition. Given the limitations of self-reported chronic conditions [24], a validated set of symptom questions and a related diagnostic algorithm were used to ascertain prevalence of angina, arthritis, asthma and depression [25]. The set of symptoms for each condition was derived from standard instruments, such as the World Mental Health Survey version of the Composite International Diagnostic Interview for the diagnosis of depression [26] or the Rose questionnaire for angina [27]. A validated set of symptom questions is not available for diabetes or stroke prevalence, which was, therefore, based on a self-report of the condition. Hypertension prevalence was based on mean blood pressure readings of equal to or greater than 140 mmHg for SBP and 90 mmHg for DBP.
The validated WHO Disability Assessment Schedule (WHODAS) 12-item instrument was used to assess functioning and disability [28]. The total score was transformed to an index between 0 and 100, with 0 representing extreme problems or complete disability and 100 representing a total absence of disability. Grip strength was calculated as mean maximum hand grip strength of both hands in kilograms.

Data was weighted using poststratified individual probability weights based on the selection probability at each stage of selection. Individual weights were poststratified by province, sex and age groups according to the 2009 medium mid-year population estimates from Statistics South Africa [29]. Weights were not normalized. Weights sum to the total population aged 18 years and older.

Regression models were applied to data from respondents aged 50 years and older to determine associations between explanatory variables age, sex and HIV status and various outcome variables. Logistic regression was applied with prevalence of various chronic conditions and linear regression analysis was conducted for continuous variables including WHODAS, BMI, grip strength and waist-to-hip ratio. Models were weighted using the aforementioned population weights. All analyses were conducted using SAS statistical software version 9.2 (SAS Institute Inc., Cary, North Carolina, USA).
Results

In total, 4227 individuals responded to the questionnaire of whom 385 (9.1%) were aged 18–49, 1695 (40.1%) were aged 50–59, 1232 (29.1%) were aged 60–69 and 912 (21.6%) were 70 years and older. The overall response rate for those aged 50 and older was 76%. Of the total respondents, HIV status results were available for 3161 (74.8%) individuals due to some respondents not consenting as well as a small number of inconclusive results. Response rates for HIV testing ranged from 72.2% among those aged 50–59 to 76.9% for those aged 70 years and older.

Focusing on those aged 50 years and older and using sample weights so that the data is nationally representative, 6.4% of older adults in South Africa were HIV-positive at the time of the survey. This ranges from 8.6% among those aged 50–59 to 3.3% among those aged 70 and older (Table 1). The HIV prevalence estimate for those aged 18–49 years in South Africa in 2008 was 16.9% [6]. HIV prevalence was higher among women, those living in rural areas, Africans and those with less education. Prevalence was highest in the Free State (12.2%) and lowest in the Western Cape (2.1%). HIV prevalence among women aged 50–59 years was considerably higher than among men of the same age (Figure 1).

Table 2a provides data on the prevalence of chronic comorbidities by HIV status across three age groups (18–49, 50–59, >60 years). First analysis compares prevalence of
comorbidities between HIV-positive older adults and HIV-negative older adults. Rates of arthritis were significantly ($P<0.0001$) lower among HIV-positive individuals over the age of 50 (6.5%) as compared with HIV-negative people of the same ages (18.8%).

Whereas 53.4% of all (both HIV-positive and negative) those aged 18–49 did not have any chronic condition, only 22.0% of those aged 50 and older did not. Only 8.8% of those aged 18–49 years had two or more conditions compared with 29.6% of those aged 50 and older ($P<0.0001$).

BMI was lower among HIV-positive older adults aged 50 and older (27.5 kg/m$^2$) than HIV-negative individuals of the same age (30.6 kg/m$^2$) ($P<0.0001$) (Table 2b). Grip strength among HIV-positive older adults (33.5 kg) was significantly ($P=0.004$) weaker than among similarly-aged HIV-negative individuals (38.3 kg).

Second analysis compares comorbidities among HIV-positive individuals aged 50 and older against HIV-positive individuals aged 18–49. Rates of hypertension among HIV-positive individuals were significantly higher ($P=0.0003$) among those above the age of 50. WHODAS was higher among HIV-positive older adults (23.0) than among those HIV-positive individuals aged 18–49 (6.2) ($P\leq0.0001$).

After adjusting for age and sex using logistic regression, arthritis was the only chronic condition that was statistically significantly associated with HIV status among people
aged 50 years and over (Table 3). Among individuals aged 50 years and older, living with HIV was associated with a lower prevalence of arthritis [odds ratio 0.30 (95% confidence intervals 0.14–0.65); \( P=0.002 \)]. Among those aged 50 and older, age and sex were not associated with the presence of chronic conditions. When including those aged 18–49 as well as older individuals, as expected, there was a significant positive association between older age and presence chronic conditions.

In linear regression models in those 50 years and older (Table 4), when controlling for age and sex, HIV status was statistically significantly associated with BMI and grip strength. The grip strength of those living with HIV was on average 4.73 kg weaker than among those who were HIV-negative (95% confidence intervals 0.77–8.70; \( P=0.019 \)). Those living with HIV also had on average a BMI 3.86 points lower (95% confidence intervals 2.17–5.55; \( P<0.0001 \)). Age and sex also had significant associations with WHODAS, BMI and grip strength.

Among those 50 years of age and older, levels of happiness and life satisfaction were lower among those who were HIV-positive. When asked how satisfied they were with life as a whole, 51.8% of HIV-positive individuals responding `satisfied' or `very satisfied' compared with 60.6% of those HIV-negative (\( P=0.039 \)). When ask about their level of happiness, 34.6% of the HIV-positive respondents replied `happy' or `very happy' compared with 55.5% of those HIV-negative (\( P<0.0001 \)).
Discussion

HIV prevalence among adults aged 50 and older in South Africa remains high and is particularly elevated among Africans, women aged 50–59 years, those living in rural areas and in some provinces such as Free State and KwaZulu-Natal. Rates of chronic disease were higher among all older adults compared with those aged 18–49 years. HIV status, however, was only statistically significantly associated with arthritis and not with any of the other conditions that we studied. When controlling for age and sex among those aged 50 and older, HIV status was significantly associated with lower BMI and weaker grip strength.

Our finding of 6.4% prevalence among all individuals aged 50 years and older is similar to that found by Peltzer et al. [5] in the 2005 South African HIV prevalence and behavioral survey (5.8%) and in the 2008 South African national HIV prevalence, incidence, behavior and communication survey (6.0%) [6]. The higher rate of HIV prevalence among women aged 50–59 relative to men of the same age found in this study was not seen in those two studies. The 3.3% HIV prevalence rate among those aged 70 and older could cautiously be taken as evidence of old age incidence.

A Ugandan study using the same survey methodology also found significantly lower BMI among HIV-infected older people compared with HIV-negative counterparts as well as lower rates of hypertension [30]. Overall, the Ugandan study found that older adults living with HIV had a similar health and functional status as other older people.
Despite significant evidence from developed country settings of associations between HIV and various chronic conditions, these were generally not found in this study among those aged 50 and older. Evidence of links between HIV and diabetes [31], cardiovascular disease [32], cerebrovascular and ischemic heart diseases [11], hypertension [33] and stroke [34] have been found in various studies in developed countries. HIV-associated arthritis has been observed in high-income countries linked to both HIV infection [35] and some ARV medications [36] and emerging evidence from Uganda shows high rates of rheumatic manifestations among HIV-positive individuals [37], although the Ugandan study did not have a HIV-negative comparison group. Despite this, our findings reveal lower rates of arthritis among those living with HIV aged 50 and older. There are many types of arthritis with differing causes and there is evidence that some types of ART might reduce the frequency of some types of arthritis [38,39]. Further research is needed on the interaction between HIV, ARVs and immune function in the occurrence and severity of various forms of arthritis.

The study is enhanced by the oversampling of older adults in SAGE providing a nationally representative perspective on the health of older adults. The approximately 25% missing HIV status values, however, may introduce bias, which could be leading to the lack of relationships observed between HIV status and various comorbidities in this study. Those with missing data were more likely to be female, African and slightly younger than those who responded. This might explain the high prevalence of HIV found in women aged 50–59 years in this study.
For a number of chronic conditions, prevalence was determined based on responses to a set of self-reported symptom questions rather than clinical diagnosis. This can lead to imprecision based on each individual’s interpretation of the question – especially in cases of neurological or cognitive deficit. For measures such as hypertension based on blood pressure, the reporting of prevalence based on established cut-off points ignores the continuous association between blood pressure and hypertension [40].

A further limitation of this study is the lack of data on ART. Valcour et al. [31] noted that it was ART especially that was associated with increased metabolic risk factors. Given that a number of comorbidities discussed in this article are more prevalent among those on certain ART regimens, the lack of such information limits the conclusions that can be drawn. As of December 2009, 971,556 South Africans were on ART, representing 56% of those who need treatment based on WHO 2006 guidelines and 37% of those who need it based on WHO 2010 guidelines [41]. According to 2008 data, ART coverage varied between provinces, from 25.8% in the Free State to 71.7% in the Western Cape [42]. In these 2008 data, there are no figures on ART by age group or among those over 50 years of age specifically. Whether or not people aged 50 and older are over-represented or under-represented in ART programs is unknown and this would have an impact on associations with some chronic comorbidities.

The question of multimorbidity is critical to the future care and treatment models of HIV. There is a shift in care from a focus on opportunistic infections and AIDS-defining malignancies to a new set of chronic comorbidities, which may be due to chronic inflammation from long-term HIV infection as well as ART toxicities exacerbated by
Evidence from developed countries shows high levels of multimorbidity among older adults [45,46]. A multimorbidity perspective has been recommended when considering optimal healthcare for older people, as it is more patient-centered and captures potentially interacting conditions [47].

This has important implications for integration of chronic care models in already strained developing country health systems. There is an opportunity to leverage the investment in HIV systems to develop an integrated response to a range of chronic diseases [48]. Chronic disease clinics that provide continuity of care, long-term adherence support and can prevent and monitor drug interactions and reactions is needed to ensure a high level of care [49].

In addition to the chronic conditions, the weaker grip strength, lower BMI and higher disability score highlights poorer overall health among older adults living with HIV compared with older adults who do not have HIV. More attention is needed to poverty, nutrition and access to disability and health services among older adults with HIV.

South Africa has added men over 50 to its list of most at-risk populations, meriting extra attention in the national HIV response [6]. Despite misperceptions to the contrary, older adults aged 50 and older in South Africa remain sexually active with 63% of men and 30% of women having had sex in the past month [5]. The most recent sexual partner of more than 11% of men aged 50–59 was aged 31–40 years, suggesting that intergenerational relationships remain of concern to HIV transmission [5]. National
communication programs have failed to sufficiently target older adults leading to lower rates of HIV knowledge among those aged 50 and older [6,50].

Future research among older adults living with HIV in sub-Saharan Africa, including upcoming SAGE surveys, will need to take into account access to ART, time on ART and the amount of time that an individual has been HIV-positive in order to better assess prevalence and incidence of comorbidities. Further diagnostic tests for chronic conditions – in addition to self-reported symptomatic algorithms – would enhance precision. Cancer and dementia are additional important health challenges among older adults and among people living with HIV that should be included in future studies. Furthermore, efforts to integrate care should be evaluated for their impact on quality of care, outcomes and avoidance of adverse drug reactions. As the HIV epidemic in Africa ages, more evidence will be needed to end the neglect of older adults and develop models of care that meet the needs of this vulnerable group.
Acknowledgements and Conflicts of Interest

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There are no conflicts of interest.
References


Figure 1. HIV prevalence among people aged 50 years and older by age and sex, 2007–08.

Weighted to be representative of South Africa. Note: weights were poststratified by province, sex and age groups according to 2009 data from Statistics South Africa.
### Table 1. HIV prevalence among people aged 50 years and older by group, 2007–08.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group</th>
<th>Unweighted N with HIV/total N</th>
<th>Weighted HIV prevalence</th>
<th>Weighted 95% confidence limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>50+</td>
<td>147/2869</td>
<td>6.4%</td>
<td>4.9–7.9%</td>
</tr>
<tr>
<td></td>
<td>50-59</td>
<td>96/1224</td>
<td>8.6%</td>
<td>6.2–11.0%</td>
</tr>
<tr>
<td></td>
<td>60-69</td>
<td>35/944</td>
<td>5.0%</td>
<td>2.4–7.6%</td>
</tr>
<tr>
<td></td>
<td>70+</td>
<td>16/701</td>
<td>3.3%</td>
<td>1.4–5.1%</td>
</tr>
<tr>
<td>Sex</td>
<td>Male</td>
<td>56/1188</td>
<td>4.9%</td>
<td>3.0–6.8%</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>91/1681</td>
<td>7.5%</td>
<td>5.4–9.7%</td>
</tr>
<tr>
<td>Ethnicity</td>
<td>African/black</td>
<td>113/1540</td>
<td>8.2%</td>
<td>6.2–10.2%</td>
</tr>
<tr>
<td></td>
<td>White</td>
<td>0/188</td>
<td>0.0%</td>
<td>0.0–0.0%</td>
</tr>
<tr>
<td></td>
<td>Colored</td>
<td>19/593</td>
<td>2.1%</td>
<td>0.8–3.5%</td>
</tr>
<tr>
<td></td>
<td>Indian/Asian</td>
<td>2/229</td>
<td>0.7%</td>
<td>0.0–2.0%</td>
</tr>
<tr>
<td>Education</td>
<td>Less than primary</td>
<td>78/1354</td>
<td>7.7%</td>
<td>5.3–10.0%</td>
</tr>
<tr>
<td></td>
<td>Primary completed</td>
<td>30/571</td>
<td>6.1%</td>
<td>3.3–8.8%</td>
</tr>
<tr>
<td></td>
<td>Secondary completed</td>
<td>22/465</td>
<td>4.2%</td>
<td>1.4–7.0%</td>
</tr>
<tr>
<td></td>
<td>Postgraduate completed</td>
<td>2/104</td>
<td>1.4%</td>
<td>0.0–4.0%</td>
</tr>
<tr>
<td>Province (selected)</td>
<td>Free State</td>
<td>11/176</td>
<td>12.2%</td>
<td>2.7–21.8%</td>
</tr>
<tr>
<td></td>
<td>Gauteng</td>
<td>14/242</td>
<td>6.1%</td>
<td>1.9–10.3%</td>
</tr>
<tr>
<td></td>
<td>KwaZulu-Natal</td>
<td>29/399</td>
<td>8.8%</td>
<td>4.3–13.6%</td>
</tr>
<tr>
<td></td>
<td>Western Cape</td>
<td>4/199</td>
<td>2.1%</td>
<td>0.0–4.8%</td>
</tr>
<tr>
<td>Urban/rural</td>
<td>Urban</td>
<td>85/1816</td>
<td>5.5%</td>
<td>3.8–7.2%</td>
</tr>
<tr>
<td></td>
<td>Rural</td>
<td>62/1052</td>
<td>7.9%</td>
<td>5.2–10.6%</td>
</tr>
<tr>
<td>Marital status</td>
<td>Currently married/cohabitating</td>
<td>61/1469</td>
<td>4.6%</td>
<td>3.0–6.2%</td>
</tr>
<tr>
<td></td>
<td>Never</td>
<td>82/1356</td>
<td>8.4%</td>
<td>5.8–11.1%</td>
</tr>
</tbody>
</table>

Weighted to be representative of South Africa. Note: weights were poststratified by province, sex and age groups according to 2009 data from Statistics South Africa.
### Table 2. Measurement of conditions by HIV status and by age group

(a) Prevalence of conditions by HIV status by age group, 2007–08 (weighted to be representative of South Africa)

<table>
<thead>
<tr>
<th>Condition</th>
<th>Unweighted N with condition</th>
<th>HIV status</th>
<th>Ages 18–49 years</th>
<th>Unweighted N</th>
<th>Ages 50–59 years</th>
<th>Unweighted N</th>
<th>Ages &gt;60 years</th>
<th>Unweighted N</th>
<th>P value (HIV comparison)</th>
<th>P value (age comparison)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertension</td>
<td>2148</td>
<td>Positive</td>
<td>33.3%</td>
<td>25/53</td>
<td>76.0%</td>
<td>65/96</td>
<td>69.3%</td>
<td>36/51</td>
<td>0.167</td>
<td>0.0003</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Negative</td>
<td>53.0%</td>
<td>125/238</td>
<td>67.2%</td>
<td>754/1128</td>
<td>70.3%</td>
<td>1144/1595</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depression</td>
<td>141</td>
<td>Positive</td>
<td>5.9%</td>
<td>3/49</td>
<td>9.3%</td>
<td>9/93</td>
<td>2.6%</td>
<td>2/49</td>
<td>0.194</td>
<td>0.849</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Negative</td>
<td>6.7%</td>
<td>11/233</td>
<td>5.1%</td>
<td>66/1089</td>
<td>4.5%</td>
<td>50/1535</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arthritis</td>
<td>509</td>
<td>Positive</td>
<td>6.5%</td>
<td>2/49</td>
<td>5.1%</td>
<td>9/89</td>
<td>9.5%</td>
<td>5/44</td>
<td>&lt;0.0001</td>
<td>0.999</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Negative</td>
<td>3.2%</td>
<td>15/221</td>
<td>17.4%</td>
<td>175/1042</td>
<td>20.1%</td>
<td>303/1457</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Angina</td>
<td>188</td>
<td>Positive</td>
<td>5.0%</td>
<td>3/51</td>
<td>7.2%</td>
<td>7/92</td>
<td>13.7%</td>
<td>6/45</td>
<td>0.147</td>
<td>0.425</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Negative</td>
<td>2.2%</td>
<td>8/229</td>
<td>7.4%</td>
<td>71/1048</td>
<td>5.8%</td>
<td>93/1428</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asthma</td>
<td>171</td>
<td>Positive</td>
<td>2.0%</td>
<td>2/51</td>
<td>4.9%</td>
<td>7/93</td>
<td>5.5%</td>
<td>2/49</td>
<td>0.401</td>
<td>0.383</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Negative</td>
<td>2.8%</td>
<td>10/232</td>
<td>6.6%</td>
<td>62/1092</td>
<td>6.8%</td>
<td>88/1532</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stroke</td>
<td>119</td>
<td>Positive</td>
<td>0.0%</td>
<td>0/51</td>
<td>3.6%</td>
<td>3/94</td>
<td>3.6%</td>
<td>2/49</td>
<td>0.476</td>
<td>0.012</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Negative</td>
<td>1.2%</td>
<td>4/233</td>
<td>3.8%</td>
<td>41/1092</td>
<td>5.6%</td>
<td>69/1536</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diabetes</td>
<td>288</td>
<td>Positive</td>
<td>3.1%</td>
<td>1/51</td>
<td>10.1%</td>
<td>6/94</td>
<td>10.6%</td>
<td>1/49</td>
<td>0.780</td>
<td>0.118</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Negative</td>
<td>1.8%</td>
<td>8/233</td>
<td>8.4%</td>
<td>93/1094</td>
<td>10.7%</td>
<td>179/1537</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
(b) Mean measurements by HIV status by age group, 2007–08 (weighted to be representative of South Africa)

<table>
<thead>
<tr>
<th>Measure</th>
<th>Unweighted</th>
<th>HIV status</th>
<th>Ages</th>
<th>N</th>
<th>Ages</th>
<th>N</th>
<th>Ages</th>
<th>N</th>
<th>P value</th>
<th>P value (age)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMI</td>
<td>3044</td>
<td>Positive</td>
<td>28.3</td>
<td>53</td>
<td>27.7</td>
<td>93</td>
<td>27.0</td>
<td>50</td>
<td>&lt;0.0001</td>
<td>0.746</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Negative</td>
<td>28.5</td>
<td>233</td>
<td>31.0</td>
<td>1084</td>
<td>30.4</td>
<td>1513</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WHR</td>
<td>2952</td>
<td>Positive</td>
<td>0.86</td>
<td>52</td>
<td>0.85</td>
<td>90</td>
<td>0.89</td>
<td>50</td>
<td>0.028</td>
<td>0.867</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Negative</td>
<td>0.88</td>
<td>221</td>
<td>0.89</td>
<td>1050</td>
<td>0.89</td>
<td>1475</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WHODAS</td>
<td>3161</td>
<td>Positive</td>
<td>6.2</td>
<td>53</td>
<td>21.9</td>
<td>96</td>
<td>25.2</td>
<td>51</td>
<td>0.179</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Negative</td>
<td>8.7</td>
<td>238</td>
<td>15.9</td>
<td>1128</td>
<td>25.6</td>
<td>1595</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grip strength</td>
<td>2836</td>
<td>Positive</td>
<td>45.4</td>
<td>48</td>
<td>34.1</td>
<td>90</td>
<td>32.4</td>
<td>43</td>
<td>0.004</td>
<td>0.029</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Negative</td>
<td>46.7</td>
<td>226</td>
<td>41.1</td>
<td>1024</td>
<td>35.7</td>
<td>1405</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Grip strength: grip strength is measured in mean maximum hand grip strength (kilograms). WHO Disability Assessment Schedule (WHODAS): the composite score -is scaled from 0 (no disability) to 100 (high disability). Note: weights were poststratified by province, sex and age-groups according to 2009 data from Statistics South Africa.

WHR: waist to hip ratio

aHIV comparison compares prevalence (Table 2a) or means (Table 2b) of people aged 50 and older who are HIV-positive and those who are HIV-negative.

bAge comparison compares prevalence (Table 2a) or means (Table 2b) of HIV-positive individuals aged 18–49 and 50 and older.
Table 3. Associations between chronic conditions and HIV status, age and sex by logistic regression models among those aged 50 years and older.

<table>
<thead>
<tr>
<th>Condition</th>
<th>N</th>
<th>Variable</th>
<th>Odds ratio</th>
<th>95% confidence intervals</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertension</td>
<td>2869</td>
<td>HIV</td>
<td>1.27</td>
<td>0.78–2.07</td>
<td>0.346</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sex</td>
<td>1.28</td>
<td>0.98–1.68</td>
<td>0.070</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Age</td>
<td>1.01</td>
<td>0.99–1.02</td>
<td>0.290</td>
</tr>
<tr>
<td>Arthritis</td>
<td>2632</td>
<td>HIV</td>
<td>0.30</td>
<td>0.14–0.65</td>
<td>0.002</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sex</td>
<td>1.17</td>
<td>0.82–1.68</td>
<td>0.388</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Age</td>
<td>1.00</td>
<td>0.99–1.02</td>
<td>0.583</td>
</tr>
<tr>
<td>Stroke</td>
<td>2771</td>
<td>HIV</td>
<td>0.80</td>
<td>0.24–2.64</td>
<td>0.714</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sex</td>
<td>0.92</td>
<td>0.48–1.78</td>
<td>0.806</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Age</td>
<td>1.02</td>
<td>0.99–1.04</td>
<td>0.157</td>
</tr>
<tr>
<td>Angina</td>
<td>2613</td>
<td>HIV</td>
<td>1.29</td>
<td>0.57–2.92</td>
<td>0.537</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sex</td>
<td>2.09</td>
<td>1.28–3.44</td>
<td>0.004</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Age</td>
<td>0.98</td>
<td>0.96–1.01</td>
<td>0.215</td>
</tr>
<tr>
<td>Diabetes</td>
<td>2774</td>
<td>HIV</td>
<td>1.06</td>
<td>0.36–3.06</td>
<td>0.922</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sex</td>
<td>1.66</td>
<td>1.05–2.62</td>
<td>0.029</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Age</td>
<td>1.01</td>
<td>0.99–1.03</td>
<td>0.307</td>
</tr>
<tr>
<td>Asthma</td>
<td>2766</td>
<td>HIV</td>
<td>0.78</td>
<td>0.31–1.95</td>
<td>0.599</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sex</td>
<td>0.73</td>
<td>0.43–1.23</td>
<td>0.238</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Age</td>
<td>1.00</td>
<td>0.98–1.03</td>
<td>0.833</td>
</tr>
<tr>
<td>Depression</td>
<td>2766</td>
<td>HIV</td>
<td>1.47</td>
<td>0.65–3.29</td>
<td>0.354</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sex</td>
<td>1.02</td>
<td>0.55–1.87</td>
<td>0.963</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Age</td>
<td>1.00</td>
<td>0.96–1.04</td>
<td>0.873</td>
</tr>
</tbody>
</table>

*aA model containing HIV status, age (continuous) and sex was run for each condition.*
Table 4. Associations between various measures and HIV status, age and sex by linear regression models among those aged 50 years and older.

<table>
<thead>
<tr>
<th>Condition</th>
<th>N</th>
<th>Variable</th>
<th>b (95% CI)</th>
<th>t/F</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>WHO disability assessment</td>
<td>2869</td>
<td>HIV (positive)</td>
<td>3.79 (−0.35 to 7.93)</td>
<td>1.79</td>
<td>0.073</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sex (female)</td>
<td>5.00 (2.54–7.45)</td>
<td>3.99</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Age</td>
<td>0.64 (0.52–0.78)</td>
<td>9.82</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>BMI</td>
<td>2739</td>
<td>HIV (positive)</td>
<td>−3.86 (−5.55 to −2.17)</td>
<td>−4.48</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sex (female)</td>
<td>3.26 (2.11–4.41)</td>
<td>5.57</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Age</td>
<td>−0.11 (−0.17 to −0.05)</td>
<td>−3.58</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Waist-to-hip ratio</td>
<td>2664</td>
<td>HIV (positive)</td>
<td>−0.02 (−0.06 to 0.02)</td>
<td>−1.08</td>
<td>0.282</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sex (female)</td>
<td>−0.03 (−0.05 to −0.01)</td>
<td>−2.47</td>
<td>0.013</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Age</td>
<td>0.00 (0.00)</td>
<td>1.35</td>
<td>0.176</td>
</tr>
<tr>
<td>Hand grip strength</td>
<td>2561</td>
<td>HIV (positive)</td>
<td>−4.73 (−8.70 to −0.77)</td>
<td>−2.34</td>
<td>0.019</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sex (female)</td>
<td>−7.78 (−9.38 to −6.18)</td>
<td>−6.50</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Age</td>
<td>−0.30 (−0.43 to −0.18)</td>
<td>−4.75</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>

B: beta co-efficient  
t: t-test  
F: F-test  
CI: confidence interval  
*A model containing HIV status, age (continuous) and sex was run for each condition.
The World Health Organization Study on Global Ageing and Adult Health (SAGE) Individual Questionnaire that was used as the basis for Chapter Five is available from:

http://www.who.int/healthinfo/systems/GenericIndividualQ.pdf. It is not reproduced here as the survey is 80 pages.
Conclusion
Summary of findings

The research conducted for this thesis has provided new evidence for a neglected area of the global HIV response. While the ageing of the HIV cohort in developed countries has been well documented – even if the targeted responses have been limited – the fact that many older adults are living with HIV in Africa has been largely ignored. The chapters of this thesis provide information from a number of perspectives that contribute to the understanding of this emerging issue. The chapters cover AIDS-related mortality, continent-wide epidemiological data, HIV-related knowledge, treatment outcomes and a study of national HIV prevalence among older adults and links to non-communicable diseases.

In Chapter One, a community health worker–administered verbal autopsy system in a rural Kenyan village found that AIDS-related causes were the largest single cause of death among people aged 50 years and older. For people aged 50-59 years, 34% of deaths were attributable to AIDS and, among those aged 60-69, 23% of deaths were due to AIDS. These data confirm that HIV and AIDS are prevalent among older adults and that any suggestion that HIV is a disease of the young only is untrue.

Following on from the reality of mortality from AIDS, the question of HIV prevalence among those aged 50 years and older was examined in Chapter Two using UNAIDS data. UNAIDS does not report on prevalence in that age group: their regular reporting is only for those aged 15-49. Chapter Two reveals that there are just under 3 million people living with HIV in sub-Saharan Africa aged 50 years and older as of 2007. The prevalence of HIV infection in the older age group was 4.0%,
compared with 5.0% among those aged 15–49 years. Of the approximately 21 million people in sub-Saharan Africa aged ≥ 15 years that were HIV+, 14.3% were ≥ 50 years old. The data suggest that in some high prevalence countries that have had HIV infection for over two decades, HIV prevalence among those aged 50 and older is actually higher than among younger age groups.

In Chapter Three, an examination of HIV awareness, knowledge and testing across nine rural Millennium Village sites in Africa found that HIV-related knowledge among older adults was significantly lower than among adults aged 25-49. Older women in particular had low levels of knowledge. Older adults were also less likely to be tested for HIV. The high prevalence rates and high mortality coupled with low levels of awareness and knowledge signify the difficulties faced by this group and the damage of the neglect shown to date towards older adults in the HIV response.

The imperative to ensure that older adults are tested and commenced on anti-retroviral treatment (ART) at appropriate times is highlighted by the treatment outcome data from Zomba District in Malawi presented in Chapter Four. Those aged 50-59 survived while on treatment at similar rates as those aged 25-49 demonstrating that older adults respond well to treatment. Those aged 60 years and older however were significantly more likely to die – which is not surprising due to higher rates of all-cause mortality among older people.

Even though the evidence presented here suggests that older adults generally do well on ART, there are some challenges that disproportionately affect older adults that have a direct bearing on the type of care and treatment they should receive. The Fifth
Chapter reveals high rates of non-communicable diseases among HIV-positive older adults (as well as HIV-negative older adults) in South Africa. The rates of co-morbidities have considerable implications for questions of medications, adherence, social support and quality of life. This highlights that efforts are needed to better understand the specific vulnerabilities and challenges faced by this group.

The rest of this Conclusion Chapter will compare the findings presented in this thesis with other literature on the subject and, given that more on the topic of HIV among older adults in Africa has been published since the commencement of this thesis, the section will review the recently published literature. Taking the accumulated knowledge from this thesis and the published literature, the conclusion will then pull together recommendations for improving HIV services specifically for older adults. Lastly, areas of future research will be outlined to further strengthen this emerging field of policy and practice.

Comparison of findings with recently published literature

Since commencement of the thesis, there has been a considerable increase in research evidence available on HIV among older adults in Africa. In part, the published papers included in this thesis have galvanised the wider research community as evidenced by a considerable number of references to the published work. A few of the published pieces have been advocacy articles [1-3] but most have provided substantive new evidence in the field.
One important change that has occurred since the commencement of this PhD has been that some Demographic and Health Surveys (DHSs) conducted in sub-Saharan Africa have begun to include or expand HIV testing among those aged 50 and older. Whereas no DHSs previously surveyed women beyond the age of 49 years, national DHSs from countries such as Mozambique and Rwanda published in 2011 and 2012, do include older women as well as an expanded age range of older men. More on the results of these surveys are provided below but the inclusion of these older adults in the surveys represents a significant expansion of how the research community views older adults and the importance of understanding their health status.

Some of the work included in this thesis has, since publication, been validated by other studies conducted on related topics. A study by Byass and colleagues tracking HIV-related mortality in South Africa found that adult mortality from AIDS had shifted to older ages as the epidemic progressed with a noticeable number of deaths in the over-65 year age group in recent years [4]. Similarly, Birnbaum and colleagues found high levels of misattribution of AIDS deaths in South Africa and their revised calculations found large increases in AIDS deaths among those aged 45-59 and 60+ [5]. A Zimbabwean study found an increase in mortality rates among those aged 45 and older over time that the authors partially attributed to the ageing of the HIV epidemic [6]. These studies largely confirm the findings in Chapter One from rural Kenya of high levels of AIDS mortality among older adults [7].

Research from specific countries or treatment sites has also confirmed some of the data from the continent-wide epidemiologic study published in Chapter Two [8].
Central Africa region cohort data revealed that 15% of those in treatment are aged 50 years and older [9]– similar to the 14% found in Chapter Two. A rural South African treatment site revealed that 10.4% of their cohort was aged 50 and older [10]. But both these studies are among those accessing treatment that might under-represent older people. Other studies from South Africa [11] and Taiwan [12] found considerable numbers of people living with HIV among those aged 50 years and older.

DHS reports from a number of sub-Saharan African countries also provide up to date data on HIV prevalence among older adults. The Mozambique 2009 DHS in particular is notable for its inclusion of both men and women up to the age of 64. Women aged 50-64 had an HIV prevalence of 9.0% and men 8.0% compared to 11.5% among those aged 15-49 [13]. The Malawi DHS 2010 found prevalence of 13.1% among men aged 50-54 compared to 8.1% for men 15-49 [14] and the Lesotho 2009 DHS also found higher rates of HIV among men aged 50-59 than those aged 15-49 [15]. Chapter Two also noted higher HIV prevalence rates among those aged 50 and older compared to those aged 15-49 signifying the ageing of the epidemic.

Another study examined HIV prevalence among the elderly in a high prevalence rural site in KwaZulu-Natal, South Africa [16] demonstrating relatively high rates of HIV that concurs with that found in the analysis of South African prevalence found in this thesis.

A recent study by Hontelez and colleagues took a longer-term view of the ageing trend highlighted in this thesis. In it the authors modelled the impact of HIV over the next 30 years to 2040 in South Africa finding that HIV prevalence in people aged 50+
will nearly double from 2010 to 2040 from 9% to 17% while the fraction of all HIV infected people who are aged 50 and older will go from 1 in 12 now to 1 in 4 [17]. These projections reinforce the importance of understanding HIV among older adults as it will be central to the response over the coming years.

Several studies have been published recently that assess treatment outcomes among older adults in sub-Saharan Africa. These results can be compared to that of Chapter Four of this thesis using data from Zomba District in Malawi [18]. Mutevedzi and colleagues found 32% higher mortality among those aged 50 and older in their rural South African treatment site compared to those aged 25-49 [10]. They found that CD4 count reconstitution was lower among older adults but that virological response was stronger. They did not consider those aged 50-59 separately so direct comparability to Chapter Four is difficult as excess mortality among older adults (especially beyond 60 years) is expected. The South African study did confirm Chapter Four results that HIV-positive older adults are more likely to be male and do not present with more advanced disease than younger adults. The higher percentage of males among HIV-positive older adults was confirmed by the IeDEA Central Africa cohort [9].

The emerging African consensus is that older adults’ treatment outcomes are worse with regard to one year mortality on ART compared to younger age groups [19, 20] and is coupled with slower CD4 count recovery [10, 19, 21]. However, after the first year, outcomes among older adults are quite similar to those of younger age groups. This is perhaps due to higher levels of adherence as shown in the IeDEA Central Africa cohort [9] and lower levels of loss to follow-up [19].
An important study recently released provides emerging evidence on the impact of ART services on the health of older adults in rural South Africa [22]. In the study, HIV-infected older adults actually have better health status than HIV-negative counterparts suggesting that the increased access to general healthcare provided by enrolment in ART programs is having a considerable impact on overall health status. This highlights the poor health access and status of older adults in parts of Africa.

In the area of understanding older adults’ knowledge of HIV and sexual behaviour in general, not much new evidence has been forthcoming. Peltzer and colleagues use data from the 2005 South African HIV prevalence and behavioural survey to describe sexual behaviour of older adults but little else has emerged [11]. The South African study found that of the people aged 50 and older, 41.1% had been sexually active in the past 12 months and 35.9% in the past month with men being significantly more sexually active than women. The study also found that 9.1% of men and 2.7% of women were still sexually active after the age of 70. The authors found that HIV risk perception was low among older adults and that older age and being female were associated with risk behaviour.

A forthcoming paper from Malawi [23] goes into substantial detail on the sexual activity of older adults using the Malawi Longitudinal Study of Families and Health. Levels of sexual activity among those aged 65+ remained considerable with 26.7% and 73.8% of women and men having had sex in the last year and men’s average number of sexual partners per year remained above one. The study also found that HIV prevalence among men aged 50 years and older was higher than among men
aged 15-49, which matches the results found in the study presented in this thesis [8]. A Zimbabwean ethnographic study found a number of elderly adults who had never used a condom in their lives and who felt alienated from current HIV programming [24].

The question of co-morbidities in Africa remains a significant gap in HIV knowledge not just for older adults though comorbidity will affect those aged 50 years and older more than other groups of people living with HIV. Recent research in two sites in Uganda found that of HIV-positive people aged 50 years and older, 15% had depression and over 30% of both men and women had hypertension [25]. Overall, however, the study found that HIV infected older people had a similar health status as older people not living with HIV. This represents an important finding that warrants further examination. There have been suggestions – not yet confirmed by published evidence – that older adults living with HIV actually have better health status than their same-age HIV-negative counterparts due to higher levels of access to general health care (not just HIV-specific services) to help address their problems of ageing. In this context, due to high rates of poverty, isolation and stigma, being HIV-positive provides critical access to HIV and other services that are not available to those who are HIV-negative.

**Recommendations for Improving Services for Older Adults**

The increase in evidence regarding, and interest in, HIV among older adults in Africa demonstrates the beginnings of what is hoped to be an important shift in the global HIV response. As the evidence accumulates, it is hoped that the larger global HIV
agencies including UNAIDS, WHO, the Global Fund for AIDS Tuberculosis and Malaria, and the U.S. President's Emergency Plan for AIDS Relief (PEPFAR) will start to include older adults in their policy documents and funding streams.

In order to do so, however, more guidance will be needed on what approaches will be most effective to improve prevention, testing and treatment among older adults in Africa. The lost opportunities to start providing this guidance – encapsulated by the failure of the aids2031 initiative to acknowledge the ageing of the epidemic [26] – must be overcome in a new era of planning for the long-term strength of the HIV response.

One of the overarching and primary challenges to addressing HIV among older adults is ageist stigma not just in the African context but in the development industry more generally. Studies conducted by WHO and HelpAge International in Africa reveal age discrimination in the health sector that includes denial of medication, neglect and negative attitudes [27]. Nhongo’s review cites cases where older people were turned away from care and told that they were not sick but were just old [27]. A Malawi newspaper article revealed that older adults were told that drugs should be saved for younger people [28]. As long as older adults remain neglected by development programs, they will remain the most vulnerable members of society and among the poorest of the poor.

Focusing on treatment, at present there are no HIV treatment guidelines specifically for older adults in low and middle income settings. In March 2012, for the first time, the United States Department of Health and Human Services’ Guidelines for the Use
of Antiretroviral Agents in HIV-1-Infected Adults and Adolescents included specific content on “HIV and the Older Patient”[29]. Notably, the US guidelines recommend that patients aged 50 years and above are commenced on ART regardless of CD4 cell count “because the risk of non-AIDS related complications may increase and the immunologic response to ART may be reduced in older HIV-infected patients.” Additionally, the guidelines counsel that due to adverse events, the bone, kidney, metabolic, cardiovascular, and liver health of older HIV-infected adults should be monitored closely along with drug-drug interactions. Such guidelines are needed for the African context as well especially given other health system challenges.

In light of recent evidence of the positive impact of ART initiation at higher CD4 counts [30], WHO has recommended putting pregnant women on treatment irrespective of CD4 count [31] and is exploring doing so for other vulnerable groups such as sex workers and men who have sex with men [32]. Given that advanced age has been associated with suboptimal CD4 restoration [33], perhaps the global community should consider adding older adults to the high priority category for early ART initiation. Even if this is not deemed appropriate, there remains a strong imperative to test older adults early and initiate treatment before CD4 count has dropped significantly. Similarly, older adults need to be actively included in emerging initiatives such as circumcision and pre-exposure prophylaxis among sero-discordant couples [34].

Adherence is another challenge for older adults on treatment. As rates of NCDs increase among older adults living with HIV, there is the potential for an increased daily pill burden and medication fatigue [35]. Coupled with cognitive impairment
linked to HIV infection [36], risks for suboptimal treatment outcomes are elevated. More adherence support targeted to older adults will be needed to address these specific challenges.

A recently completed and submitted systematic review that I conducted (attached as an appendix), searched for published evidence on HIV interventions specifically targeted to older adults. Despite the many urgent calls for prevention messaging and specific HIV programs targeted to older people [37-40] rather than simply the application of strategies designed for younger people [41], only 12 relevant articles were identified that actually presented results of such interventions. None of the 12 were from developing countries and the vast majority were American studies. Orel and colleagues stated in 2005 that “more effective HIV/AIDS prevention educational materials for older adults need to be developed, and their effectiveness in reducing HIV infection must be explored”[42] yet the available evidence is paltry. Authors of some of the studies identified needs for specific research projects conducted among older adults with regard to HIV prevention [43], testing, adherence [44] and other social and behavioural areas [45]. There are many hypotheses of what would help adherence or the effectiveness of prevention education among older adults including nutrition, mental stimulation, physical activity and better training among physicians [46] but proof of these approaches has not been compiled and provided to the affected community.

The studies that did emerge in the systematic review highlighted a few areas of possible action in developing prevention and adherence interventions specifically for older adults.
Rose demonstrated that delivery of an age-specific AIDS education program was effective in improving HIV knowledge and perceptions of susceptibility among older Americans [47]. One of the most successful of the few interventions specifically targeting older adults was group educational sessions developed to reduce high-risk sexual behaviours run by a project called ROADMAP (Reeducating Older Adult in Maintaining AIDS Prevention)[48]. After sessions that included practicing condom use skills and role playing condom negotiation, participants in the intervention group decreased unprotected sexual acts compared with the control group.

Heckman and colleagues report that group sessions with trained facilitators that include a focus on coping mechanisms and how to deal with stress are effective in reducing depressive symptoms in HIV-positive older adults [49]. Two studies used telephone-based interventions to reduce risky sexual behaviour [50, 51].

Weekly resistance exercise training sessions trialled in Sao Paulo, Brazil, among HIV-positive older adults, produced increased strength and functional gains superior to those seen in age-matched HIV- controls [52, 53].

All twelve of the studies however were from the Americas with none focused on Africa. Therefore, the critical question of the applicability of the lessons learned from the Americas to the African context remains. African studies have called for more research on prevention evidence for older adults but, as yet, no studies exist [54, 55]. Some of the interventions identified in the systematic review were delivered in old-age homes – a delivery channel less available in the African context. And two studies
used telephones to deliver messages: an intervention that might have applicability in sub-Saharan Africa due to the increasing ubiquity of mobile phones.

From various studies, however, some lessons emerge on appropriate interventions that are relevant for Africa. In many African countries, older adults are regarded as custodians of culture and societal memories and are therefore afforded social status [56]. This element needs to be built into prevention messaging and testing promotion efforts to portray HIV as a threat that requires a response from the senior members of the community. A sense of duty as community leaders and elders might be an appropriate avenue for prevention messaging. This would potentially have impacts not just among older adults but, in their role as grandparents and care-givers, among the younger generation as well [54].

Using older adults as peer educators has been proposed in developed countries [56] and would be very applicable to African settings as well. It is likely that older adults would be less likely to visit voluntary counselling and testing centres if the counsellors were in their early 20s than if some of the counsellors shared their characteristics in terms of age. Training a small number of older counsellors and making it clear to the community which days of the week they would be working would be a possibly low-cost and simple way to increase HIV testing among older adults. Anecdotal evidence from Dr Janet Seeley in Uganda noted that this had been trialled in one site in Uganda in 2010 and had led to increased uptake of testing by older adults.
Furthermore, older adults in Africa are predominantly found in rural areas which generally have lower levels of information access [56]. More concerted efforts to reach people in rural areas and to use messaging designed for those with limited literacy skills will be required. Due to specific stigma associated with HIV and older adults, it might perhaps be more appropriate to label the information sessions as general health forums rather than as HIV-specific sessions. This might lead to higher attendance and will open doors to wider discussions of sexual health.

Success is possible in reaching older adults. The South African national HIV survey of 2008 found a considerable increase in condom use among men aged 50 and older [57]. In 2005, only 8.6% of men aged 50 and older used a condom during last sex but, by 2008, 39.9% had used a condom. Such progress is likely to have been at least partially a result of the increased reach of HIV communication among over 50s where 62.2% had been reached by HIV messages in 2008 compared to 47.2% in 2005 [57].

Other research I conducted during the course of the PhD on the health of older adults in rural Africa (attached in the appendix) revealed that alcohol consumption among women aged 50 and older (45.0%) was more common (P=0.005) than among women under 50 (27.6%) across three rural sites in Malawi, Tanzania and Rwanda [58]. Given these high rates of alcohol consumption and even higher rates among older men and the links between alcohol and risky sexual behaviour [59], there might be scope for alcohol-related interventions to curb HIV transmission among people aged 50 and older.
Another important avenue to explore is educating health workers. Due to presumed ageist stigma on the part of nurses, doctors and community health workers, informing those groups on the levels of HIV prevalence among older adults might lead to more appropriate diagnoses and faster transitions onto treatment for those in need. This intervention has been called for in developed countries [60, 61] and is equally applicable in African settings.

Fundamentally, there is an erroneous ageist assumption that older people are not able to make behaviour change changes [62] and so few people have even tried. Given the trends outlined in this thesis, it is imperative that efforts be undertaken to support prevention, testing and adherence among those aged 50 and older in sub-Saharan Africa.

Integration has been a key term used in discussions about the future of the HIV response. While most of the focus has been on integration with reproductive health services or tuberculosis care, the integration challenge in the future with more people on ART will be with non-communicable disease (NCD) services [63]. Maher and colleagues have called for “integrated management of chronic NCDs with that of chronic communicable diseases”[64, 65]. This re-characterisation of HIV as a chronic disease fits well with Setel et al’s model of classifying diseases as acute versus chronic emphasising the response model rather than the transmission model.

Setel et al asserted that in low-income countries, the “majority of the population clearly need a health system that can provide long-term care and management” [66]. Maher and colleagues proposed “multidisciplinary chronic disease clinics” that could treat HIV, tuberculosis and NCDs in an integrated manner with the added feature of
reducing the stigma associated with visiting HIV clinics for care [64]. Such a model has been piloted in Cambodia across HIV, diabetes and hypertension with initial positive results and synergies being realised [67]. This is a clear area of need with regard to health systems research to establish the feasibility and cost-effectiveness of such an integrated approach [65].

The main features of such an integrated response to HIV and NCDs that would serve older adults living with HIV (as well as others on long-term ART) would include: screening for multiple conditions at health centre level; treatment initiation and continuation at health centre level; ongoing procurement of necessary medication and testing components; lab testing transportation to nearest testing facility; referral mechanism to district hospital; community adherence support; health information systems; and policy stewardship. The health system response model needed for each of these areas would be essentially identical between HIV and NCDs making integration not just feasible but necessary.

The big advantage of integration in the African context is that billions of dollars have been invested in a strong chronic disease diagnosis, care and treatment model through the HIV response. Adapting such a response to include non-HIV NCDs is not a case of starting from scratch but rather building on existing systems [68-70]. Rabkin and el Sadr correctly asked “why reinvent the wheel”[71]? The challenge comes down to developing a strong health system that can provide both acute episodic care as well as longer-term chronic care to populations in developing countries.
The United Nations High-level Summit on Non-communicable Diseases, held in September 2011, might herald a new era of funding and attention to addressing NCDs in developing countries. If so, the development community should not repeat the mistakes of the HIV scale-up which emphasised vertical programs but should rather emphasise integration and strengthening of systems. Such an approach would provide for better quality of care not only for older adults but for all who access healthcare. Integrated HIV and NCDs services would likely be a cost-effective and appropriate health system intervention for older adults in Africa.

**Areas of Future Research**

Over the past thirty years, the response to the HIV epidemic has changed often and dramatically. The response to HIV has swung from a focus on prevention, to an almost complete emphasis on treatment, to the current treatment-as-prevention paradigm [72]. Specific high-risk groups have been the focus for some elements of the global response and UNAIDS is currently seeking to eliminate mother-to-child transmission.

As the epidemic moves into its fourth decade, one of the emerging trends will be the ageing of HIV patients in developed and developing countries. As has occurred with programs that centred on men who have sex with men or injecting drug users or children, the global HIV community has explored and learned what works and what does not. The coming years will see those interested in HIV and ageing go through the same process of exploration and learning.
These areas of future research are particularly relevant for sub-Saharan Africa due to the high number of people living with HIV but will also likely be pertinent for other developing regions of the world that experience similarities with regard to health systems and poverty. Developing Asia and the Caribbean, which both have countries with relatively high HIV prevalence rates and increasing ART coverage, will also host an ageing HIV cohort and will therefore benefit from increased research and information gathering in this area.

One of the first components that will be needed over the coming years is improved data collection. Those aged 50 years and older must be included in routine HIV surveillance including Demographic and Health Surveys and national HIV surveys. If HIV prevalence goes down amongst those aged 15-49, many will assume victory unless the prevalence among older adults is known as millions of older adults will remain infected and affected. The annual UNAIDS epidemic update must begin to include these data routinely. From personal communication, there have been some initial suggestions that UNAIDS is considering doing so.

Of course, making such data available is not only about obtaining a picture of accurate prevalence but the inclusion of older adults in such surveys and reports will signify to the wider HIV community including national AIDS agencies, physicians and policymakers that older adults are part of their remit and that they will be judged on how they address the challenges of HIV among them.

As noted above, one of the primary research needs in this area is to track the efficacy of various HIV-related interventions specifically targeted to older adults. Whether
this is done through training peer educators and counsellors or educating health workers or implementing prevention messaging appropriate for older adults, these will need to be evaluated in rigorous studies to deepen the evidence base for the global community to use. Using control groups (ideally in randomised trials) would be most appropriate for most of these studies as the HIV response is dynamic and ever-changing and thus, without controls, effects of programs would be hard to isolate.

An additional requirement will be operational research to examine the implementation of integration of care [73-75]. The growing emphasis on developing a coherent model of chronic care delivery systems requires research into the ‘how’ of integration, the cost-effectiveness, the training implications and the impacts of such an approach on patient care, health worker satisfaction, health worker burden and ultimately on health outcomes. With possible additional funding emerging as a consequence of the High Level Meeting on Non-Communicable Diseases held in September 2011, such operational research might become better funded and the opportunities to explore integration with HIV services – especially in Africa – cannot be missed.

There remain considerable gaps in the knowledge base regarding the interactions and associations between various non-communicable diseases, HIV infection and ART both among older people and in the wider population. The research included in this thesis represents one of the only studies that examines these linkages. Datasets that include information on HIV status, ART status and are able to report on various NCDs not only relying on self-reported symptoms would be very valuable in this regard. Some of the higher rates of NCDs seen among HIV-positive people in
developed countries are thought to be due to ART and therefore that information is required to develop a robust understanding of the associations between treatment and onset of some NCDs.

As a result of the suspected higher rates of various NCDs among HIV-positive people – especially older adults, there might be scope for investigation into the feasibility and appropriateness of a polypill that would include antiretroviral medication along with treatments for cardiovascular or other chronic conditions. Such possibilities will likely be discussed in greater detail once such epidemiologic associations are better understood.

Other areas of HIV and ageing in Africa that require further investigation are the sexual activity of older adults including condom access and use, intergenerational relationships, widowhood, and practices such as wife inheritance whereby a widow marries a kinsman of her late husband to ensure ongoing social support. Qualitative and quantitative research is needed to examine these issues more deeply and will be critical to developing appropriate programming relevant to older people.

The road forward in the area of HIV and older adults in Africa is one full of possibility and potential for additional learning. This thesis serves as one of the bricks in the foundation of this emerging research and practice area. The research presented here has relevance throughout Africa and into other developing regions of the world.
References


42. Orel NA, Spence M, Steele J. Getting the message out to older adults: Effective HIV health education risk reduction publications. *Journal of Applied Gerontology* 2005, **24**.


68. Kruk ME. HIV and health systems: research to bridge the divide. *J Acquir Immune Defic Syndr* 2011, **57 Suppl 2**:S120-123.


70. Rabkin M, Nishtar S. Scaling up chronic care systems: leveraging HIV programs to support noncommunicable disease services. *J Acquir Immune Defic Syndr* 2011, **57 Suppl 2**:S87-90.


Appendices

Appendix One:

Appendix Two:

Appendix Three:

Appendix Four:

Appendix Five:
Signed co-author certification forms
Risk factors for non-communicable diseases among older adults in rural Africa

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Summary

Objective To expand the evidence base on the prevalence of non-communicable disease (NCD) risk factors in rural Africa, in particular among older adults aged 50 and older.

Methods Cross-sectional study in three rural sites in Malawi, Rwanda and Tanzania. One person was interviewed from each of 665 households selected through a stratified random sampling procedure across the three sites. The questionnaire included socio-demographic characteristics, smoking and alcohol intake as well as a food frequency questionnaire.

Results Smoking rates among older men and women were higher than among adults under 50. While only 2.3% of women under 50 were current smokers, 21.0% of older women smoked (P < 0.0001). Among men, 19.0% of men under 50 smoked versus 36.6% of older men (P = 0.001). Alcohol consumption among older women aged 50 and older (45.0%) was more common (P = 0.005) than among women under 50 (27.6%). Examining a set of five risk factors, more men aged 50 and older (49.5%) had two or more risk factors than men under 50 (25.5%) (P < 0.0001). Similarly, 52.0% of women aged 50 and older had two or more risk factors, versus 24.1% of women under 50 (P < 0.0001).

Conclusion Contrary to what is seen in developed country settings, this study reveals high rates of smoking and alcohol consumption among men and women aged 50 years and older in rural Africa that puts them at risk of NCDs. The health of older adults in rural Africa has been neglected, and these findings highlight the importance of reaching out to older adults with messaging regarding diet, smoking, alcohol use and general health.

Keywords Africa, alcohol, non-communicable disease, risk factors, smoking

Introduction

The health of older people in sub-Saharan Africa (SSA) has largely been neglected (Cohen & Menken 2006; Ferreira & Kowal 2006; Kimokoti & Hamer 2008). This is despite the fact that the percentage growth in the number of those aged 50 and over in SSA from 2005 to 2030 will be the highest of any region of the world with an expected increase of 108% (76–157 million) (United Nations 2009). Part of this neglect is because of the major global emphasis given to addressing pressing priorities among the young including undernutrition and preventable child deaths, the recent focus on maternal mortality, and the scale-up of interventions to address HIV and AIDS. There are major gaps in data on the health of Africa’s elderly (Zimmer & Dayton 2005). For example, Demographic and Health Surveys do not include female participants over the age of 49 and often only include men up to age 54 or 59 (Negin & Cumming 2010).

There has been increasing recognition of the burden of non-communicable diseases (NCDs) in SSA which disproportionately affect people over 50 (Kengne & Anderson 2006; Holmes et al. 2010; Mbanya et al. 2010). Globally, more than 70% of cardiovascular mortality, 40% of chronic respiratory disease deaths, 34% of cancer mortality and about 50% of all chronic disease deaths are attributable to a small number of known modifiable risk factors (Ezzati et al. 2003).

Data on the prevalence of some NCD risk factors – including tobacco use, alcohol consumption, overweight, low fruit/vegetable intake, and physical inactivity – are lacking for some parts of SSA despite the availability of some World Health Organization’s STEPwise approach to surveillance (STEPS) surveys (World Health Organization...
2010a). In particular, the NCD evidence from rural parts of sub-Saharan Africa is limited with more detailed research, including some STEPS surveys, having been conducted only in urban areas (Bovet et al. 2002; Ministry of Health [Zambia] and World Health Organization 2008; Tesfaye et al. 2008; Njelekela et al. 2009). The risk factor evidence for many countries is lacking. Surprisingly, some of the chronic disease risk factor research that has been conducted in SSA has focused on adolescents rather than those at higher risk of NCDs (Kitange et al. 1993; Muula et al. 2008).

The aim of this paper is to expand the evidence base on the prevalence of NCD risk factors in rural SSA, in particular among older adults aged 50 and over. The objective is to examine NCD risk factors by drawing from cross-sectional data collected from rural sites in three African countries.

**Methods**

This cross-sectional study was conducted in three Millennium Villages Project (MVP) sites in East Africa. The MVP is a multi-sectoral health and development initiative launched in 2004 that aims to demonstrate that achievement of Millennium Development Goals in rural Africa is possible through community-based, coordinated delivery of science-based interventions at the village level in agriculture, health, education and infrastructure (Sanchez et al. 2007). The project is implemented in 14 rural sites in ten sub-Saharan African countries and operated under a strict costing model consistent with the internationally accepted target of 0.7% of rich world’s gross national income. This study was conducted in the project’s sites in Malawi (Mwandama), Rwanda (Mayange) and Tanzania (Mbola) from January to March 2007.

The detailed methods employed in this sub-study have been described elsewhere in a study on the prevalence of hypertension and its correlates in the study population (de Ramirez et al. 2010). Briefly, three hundred households were selected in each project site using a stratified random sampling procedure taking into account household income and gender of the head of household to ensure accurate representation of the larger village population. Of 2091 eligible adults aged 18 and older, 1485 (71%), representing 665 households, were available at home when the enumerators arrived and completed the survey. Enumerators visited homes three times before removing the individual from the survey list. One adult from each household was selected to respond to a food frequency questionnaire including dietary and alcohol intake that is reported in this paper. Those who completed the food questionnaire were similar to those who did not in terms of sex, age and type of dwelling. Informed consent was obtained from each study participant, and ethical approval was obtained from Malawi’s National Health Sciences Research Committee, the Institut National de la Statistique du Rwanda, Tanzania’s National Institute for Medical Research and the institutional review board of Columbia University, New York, USA.

Data on socio-demographic characteristics and smoking habits were collected using standardized questionnaires. Physical activity was measured using the World Health Organization’s Global Physical Activity Questionnaire (World Health Organization 2006). Health professionals with additional training measured height and weight for body mass index calculations.

Statistical analysis was conducted using SPSS 17.0 (Chicago, IL, USA) and SAS 9.2 (Cary, NC, USA). Continuous variables such as alcohol, fat, dairy and meat consumption that were heavily skewed were re-categorized as ‘no consumption’ for those who did not consume any and ‘consumption’ for those that did. Heterogeneity across study sites was assessed using the Breslow-Day tests for categorical variables and using regression procedures for continuous variables. A P-value of 0.05 was used to indicate statistical significance.

**Results**

Of the 654 respondents for whom age was recorded, 193 (29.5%) were aged 50 years and older with the oldest respondent being 97 years of age. In total, 361 respondents were women (55.2%) including 100 (51.8%) of those aged 50 years and older (Table 1). Respondents in the Mwandama, Malawi site comprised 286 (43.7%) of the total study sample, with 194 (29.7%) coming from the Mbola, Tanzania site and 174 (26.6%) from the Mayange, Rwanda community. Of those aged 50 years and older, 72 (37.3%) were from the Malawian village, 65 (33.7%) from the Rwandan village and 56 (29.0%) from the Tanzanian community.

Using the Breslow-Day test and logistic regression models, there was no strong evidence of heterogeneity (P < 0.05) across the three countries for differences in risk factors between those aged 50 and older and those aged under 50 thus suggesting appropriateness of pooling the data across the three sites. Doing so, alcohol consumption among older women (45.0%) was significantly (P = 0.005) more common than among women under 50 (27.6%). Drinking of alcohol among men aged 50 and older (36.6%) was higher than among men under 50 (27.0%); though, this difference was not statistically significant (P = 0.25) (Table 2).
Smoking rates among older men and women were higher than among adults under 50. While only 2.3% of women under 50 were current smokers, 21.0% of older women smoked ($P < 0.0001$). Among men, 19.0% of men under 50 smoked compared to 36.6% of older men ($P = 0.001$) (Table 2).

Men aged 50 and older were less physically active than men under 50 ($P = 0.039$) but there was no difference in physical activity between older and younger women (Table 2). Hypertension rates were significantly higher in older men than men under 50 and in older than younger women, as reported in more detail elsewhere (de Ramirez et al. 2010). There were no statistically significant differences in the prevalence of overweight (BMI $\geq 25$) between younger men and older men and between younger women and older women (Table 2). The prevalence of overweight in women aged 50 and older (14.9%) was almost double that among men aged 50 and older (7.7%) ($P = 0.123$). This was particularly pronounced in the Malawi and Tanzanian sites.

Examining these five risk factors further, those aged 50 and above were more likely to have multiple risk factors than those aged under 50. Of the men aged 50 and older, 49.5% had two or more risk factors compared to 25.5% of men under 50 ($P < 0.0001$). Similarly, 52.0% of women aged 50 and older had two or more risk factors compared to 24.1% of women under 50 ($P < 0.0001$). One-quarter of women aged 50 and older had three or more risk factors.

Further breakdown of age groups into 10-year bands revealed additional insights (Figures 1 and 2). While alcohol consumption among men peaked at the age of 50–59, drinking among women increased with age, with the highest prevalence of alcohol drinking (50%) being among women aged 70 years and older. The highest prevalences of smoking were seen among men aged 70 years and older (41.4%) and among women aged 60–69 years (24.2%). BMI among men gradually decreased with age; men aged 70 and older had the lowest mean BMI of any age group (18.87).

Analysis of data from the food frequency questionnaire (Table 3) showed that a large number of respondents did not consume any dairy (73% of women over 50) and quite a few (up to 43% of women over 50) did not consume any meat. Consumption of meat was lower among older adults, both men and women, than among adults under 50 ($P = 0.0014$ for women and $P = 0.0305$ for men). Additionally, women aged 50 and over consumed fewer fruits.

### Table 1 Study population characteristics

<table>
<thead>
<tr>
<th>Age</th>
<th>Mwandama, Malawi</th>
<th>Mayange, Rwanda</th>
<th>Mbola, Tanzania</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Female</td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td>17–29</td>
<td>61</td>
<td>32</td>
<td>34</td>
</tr>
<tr>
<td>30–39</td>
<td>42</td>
<td>38</td>
<td>20</td>
</tr>
<tr>
<td>40–49</td>
<td>20</td>
<td>21</td>
<td>23</td>
</tr>
<tr>
<td>50–59</td>
<td>17</td>
<td>12</td>
<td>17</td>
</tr>
<tr>
<td>60–69</td>
<td>14</td>
<td>11</td>
<td>14</td>
</tr>
<tr>
<td>70+</td>
<td>10</td>
<td>8</td>
<td>11</td>
</tr>
<tr>
<td>Total</td>
<td>164</td>
<td>122</td>
<td>119</td>
</tr>
</tbody>
</table>

### Table 2 Distribution of NCD risk factors by age and gender

<table>
<thead>
<tr>
<th></th>
<th>Female</th>
<th>Male</th>
</tr>
</thead>
<tbody>
<tr>
<td>N, P-value</td>
<td>&lt;50</td>
<td>≥50</td>
</tr>
<tr>
<td>Alcohol intake</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No alcohol consumption</td>
<td>261</td>
<td>100</td>
</tr>
<tr>
<td>One or fewer drinks per day</td>
<td>189 (72.4)</td>
<td>55 (55.0)</td>
</tr>
<tr>
<td>More than one drink per day</td>
<td>65 (24.9)</td>
<td>39 (39.0)</td>
</tr>
<tr>
<td>Smoking</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes, current smoker</td>
<td>6 (2.7)</td>
<td>6 (6.0)</td>
</tr>
<tr>
<td>Vigorous physical activity</td>
<td>164 (62.8)</td>
<td>61 (61.0)</td>
</tr>
<tr>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hypertension</td>
<td>28 (10.7)</td>
<td>41 (41.0)</td>
</tr>
<tr>
<td>Overweight</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>30 (12.1)</td>
<td>14 (14.9)</td>
</tr>
</tbody>
</table>

NCD, non-communicable disease.
and vegetables than women under 50 and fewer than men of any age. Dairy consumption among older adults was also lower than among younger adults. These differences in dietary intake were not statistically significant.

The only evidence of cross-site difference (heterogeneity \( P < 0.05 \)) was for vigorous physical activity among men \( P \) for heterogeneity = 0.08). Whereas older men in Malawi were less physically active than those aged under 50, older men in Rwanda were considerably more active than men under 50 and there was almost no difference in Tanzania.

## Discussion

The study reveals that men and women aged 50 years and older in rural Africa engage in a number of behaviours that put them at high risk of NCDs. While it is well known that hypertension rates generally increase with age, smoking rates and alcohol consumption among older adults were significantly higher than among those aged under 50 contrary to the pattern seen in a number of developed countries (Scollo & Winstanley 2008; Robinson & Bugler 2010; United States Department of Health and Human Services 2010). More than half of those aged 50 and older had two or more NCD risk factors, suggesting that there is need for urgent action to address NCDs.

While no STEPS surveys have been conducted for Rwanda and Tanzania, the 2009 Malawi STEPS Survey provides some similar data to that presented here (Ministry of Health [Malawi] and World Health Organization 2010). The STEPS survey revealed that more men and women aged 55–64 smoked than younger age brackets, confirming the data found in our study. The rates of smoking among Malawian women aged 50 and older in our study were considerably higher than the national figures found in the STEPS survey – some of which might be accounted for by the higher rates of smoking in rural compared to urban areas found in the STEPS report. The Malawi STEPS study confirmed that current drinking was more frequent among older than younger women. Rates of overweight in the Malawian respondents in our study were lower than in the national STEPS data but this can likely be explained by the lower rates of overweight in rural areas confirmed by STEPS.

African studies in younger age groups generally confirm the findings presented in this paper. The large disparity in smoking rates between men and women has been found in

### Table 3 Food consumption by age and gender

<table>
<thead>
<tr>
<th></th>
<th>Female (&lt;50)</th>
<th>Female (\geq 50)</th>
<th>(P)-value</th>
<th>Male (&lt;50)</th>
<th>Male (\geq 50)</th>
<th>(P)-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruit and vegetables</td>
<td>Median daily intake, number of times consumed</td>
<td>11.65</td>
<td>10.49</td>
<td>0.10</td>
<td>11.32</td>
<td>11.66</td>
</tr>
<tr>
<td>Fat consumption</td>
<td>Yes – percentage who consumed fat that day</td>
<td>88.0%</td>
<td>87.1%</td>
<td>0.44</td>
<td>80.5%</td>
<td>84.0%</td>
</tr>
<tr>
<td>Dairy consumption</td>
<td>Yes – percentage who consumed diary that day</td>
<td>35.2%</td>
<td>27.0%</td>
<td>0.14</td>
<td>45.0%</td>
<td>37.6%</td>
</tr>
<tr>
<td>Meat consumption</td>
<td>Yes – percentage who consumed meat that day</td>
<td>74.3%</td>
<td>57.0%</td>
<td>0.001</td>
<td>83.0%</td>
<td>72.0%</td>
</tr>
</tbody>
</table>

### Figure 1

Percentage of respondents who are current smokers by gender and age band.

### Figure 2

Percentage of respondents who consume alcohol by gender and age band.
various studies including Demographic and Health Surveys (DHS). The Tanzania DHS of 2004–05 shows that 0.5% of rural women and 22% of rural men aged 15–49 currently smoke cigarettes (National Bureau of Statistics [Tanzania] and ORC Macro 2005), which matches quite closely to the data presented here from Mbol. Rwanda’s 2005 DHS revealed that while only 3% of women 20–34 smoked, 11% of those 35–49 did (Institut National de la Statistique du Rwanda and ORC Macro 2006). Smoking in Rwanda is also more common in rural areas. The 2000 Malawi DHS showed that only 2% of women aged 15–49 smoked compared to 25% of men aged 15–54 (National Statistical Office [Malawi] and ORC Macro 2001).

The percentage of current alcohol drinkers in our study was at the high end of that seen in a recent cross-Africa study among those aged 18 and older in 20 countries (Claussen et al. 2009). In that study, those who had had a drink in the previous week did not exceed 33% in any country with abstention rates as high as 80% for women. Contrary to our findings, some African studies have found that younger women are more likely to drink than older women (Mamman et al. 2002).

Our study found lower rates of obesity than in studies with data from urban areas. A Tanzania study found obesity rates of 13% in men and 35% in women in urban areas with correspondingly high rates of NCDs (Njelekela et al. 2009). In another urban Tanzania study, levels of BMI increased up to the age of 45–54 years and dropped slightly thereafter in both men and women (Bovet et al. 2002). Another study also found low rates of obesity in rural areas of Tanzania but higher rates in women than men (Njelekela et al. 2001).

The majority of work conducted on NCD risk factors in Africa has not been conducted among older people. Across SSA, the health of older adults has by and large been neglected. At the same time, NCDs have not received sufficient attention by the global community. Older adults in SSA, who are more likely to have higher rates of NCDs, play a significant role as productive labour, as carers and as community leaders and therefore need to be included in health interventions.

The findings reported here highlight the importance of reaching out to older adults with messaging regarding diet, smoking, alcohol use and general health. The higher rates of smoking and alcohol use revealed in these sites have important implications for the health of older people. Beyond putting older Africans at higher risk of NCDs, alcohol consumption is also associated with HIV transmission (Fritz et al. 2010), tuberculosis (Rehm et al. 2009) and intimate partner violence (Nhaganira et al. 2009).

Prevention of NCDs as well as treatment needs to be integrated into rural primary care (Maher et al. 2009, 2010a). Rather than developing vertical NCD programs, policymakers and governments should focus on developing chronic care delivery systems that can leverage the investment in management of chronic HIV and tuberculosis (Setel et al. 2004; Janssens et al. 2007; Bischoff et al. 2009).

This paper fills a gap in the data by focusing on NCD risk factors in remote, impoverished communities in SSA including in two countries where STEPS surveys have not been conducted. The survey covers multiple risk factors and uses validated tools across countries. Despite this, the measures of dietary intake using the food frequency questionnaire are likely to be crude and might misrepresent true consumption. Recent studies have suggested that the internationally established BMI cut-offs for overweight and obesity may not be appropriate indicators of NCD risk in some African populations with waist circumference perhaps being a more sensitive measure (Steyn et al. 2005; Maher et al. 2010b).

More information on NCDs and risk factors will increasingly become available as STEPS surveys are completed but STEPS generally only interview individuals aged up to 64 years of age. More recently, WHO studies on global ageing and adult health (SAGE) have been conducted in countries including Ghana and South Africa and will provide robust data on the health of older people including on NCD risk factors (World Health Organization 2010b). The United Nations General Assembly has agreed to hold a special session on NCDs in September 2011, marking global recognition of the emerging health crisis. It is important that the meeting does not ignore older people in developing countries. In advance of that meeting and the global action that must ensue, it is hoped that the findings of this study will help put NCDs in older adults in SSA in greater focus and help contribute to the required development of appropriate health planning and implementation strategies (Beaglehole et al. 2007).

Acknowledgements

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References


Institut National de la Statistique du Rwanda (INSR) and ORC Macro (2006) *Rwanda Demographic and Health Survey 2005*. INSR and ORC Macro, Calverton, Maryland, USA.


Setel PW, Saker L, Unwin NC, Hemed Y, Whiting DR & Kitange H (2004) Is it time to reassess the categorization of disease...


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Title: HIV Behavioural Interventions Targeted Towards Older Adults: a Systematic Review

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Running Head: HIV Behavioural Interventions Targeted Towards Older Adults: a Systematic Review
Abstract

The increasing number of people living with HIV aged 50 years and older has been recognised around the world yet non-pharmacologic HIV behavioural interventions specifically targeted to older adults are limited. We conducted a systematic review of the available literature. The majority of articles identify and describe behaviours of older adults rather than evaluate an intervention. Twelve articles were identified of which all originated from the Americas. Eight of the interventions were conducted among older adults living with HIV and four for HIV-negative older adults. Five studies included control groups. Of the included studies, four focused on general knowledge of HIV, three emphasised mental health and coping, two on sexual behaviour, two on physical status and one on testing/screening. More evidence is needed on what interventions work among older adults to support prevention, adherence and testing.

Key words: older adults, HIV, interventions, systematic review, effectiveness
**Introduction**

HIV prevalence among those aged 50 years of age and older has been rising over the past few years. In the US, in 2005, 25% of those infected with HIV were older than 50 years of age [1] and recent estimates have noted that around 50% of people living with HIV will be older than 50 by 2015 [2]. The number of adults aged 50 years and older living with HIV in the US grew by 14% a year between 2004 and 2007 [3]. The increase has been seen partly due to widespread treatment access [3]. Articles have highlighted the HIV and ageing phenomenon in New York [4], London [5], Italy [6] and Australia [7].

The increasing trend of ageing is not only the results of longer survival due to treatment; older adults accounted for 15% of new cases of HIV in the US in 2005 [8]. Western European data reveals that 12.9% of newly reported cases of HIV infection in 2007 were among people aged 50 and older compared to 10.4% in 2003 [9]. The percentage of older adults among new infections in Eastern Europe has doubled over the same time frame [9] and the ageing trend has been increasingly recognised in sub-Saharan Africa as well [10-12].

The term “older adults” is used to describe those aged 50 years and older. It is acknowledged that in many countries, people in this age group would not be considered old or elderly. In Australia for example, most studies on the elderly focus on those aged 65 years and above or even 70 [13]. The reason the 50 years cut off point is used here is
because the majority of HIV surveillance and reporting over the first two decades of the HIV response has only covered those aged 15-49 [14-16].

Older adults are engaged in high risk behaviour with Stall and Catania noting that older adults were one-sixth as likely to use condoms during sex and one-fifth as likely to have been tested for HIV compared to a control group of at-risk people in their 20s [17]. Testing rates among older adults are also lower: fewer than 15% of Americans aged over 45 years have been tested for HIV compared to 44% of all adults [18]. Older adults – particularly older women – are at greater physiological risk for HIV transmission [19, 20]. Those aged 50 and older might also enter into new relationships in which unprotected sex is more likely given the absence of pregnancy concerns [19].

When examined, HIV knowledge amongst older adults has been variable; while some exhibit adequate knowledge many do not considers themselves to be at risk as HIV is considered an illness of younger people [21]. Surveys of HIV positive older women have suggested that insufficient HIV prevention information contributes to risk taking behaviours [22]. Because of this, there have been many urgent calls for prevention messaging and specific HIV programs targeted to older people [19, 23-26] rather than simply the application of strategies designed for younger people [27]. This call has extended beyond developed countries to a number of countries in Africa [28, 29].

Strengthening the argument for research focussed on HIV positive older adults are the specific problems faced by this cohort [30]. Older HIV positive adults face the additional
burden of physical and psychological comorbidities [31] and accelerated senescence [32].
Concurrently, HIV positive older adults experience the double stigma of illness and ageism while having fewer support mechanisms from family, friends and community [33].

Given this situation, a number of academics have lamented the paucity of specific studies conducted among older adults with regard to HIV prevention [34], testing, adherence [35] and other social and behavioural areas [36] for older adults with HIV. There are hypotheses of what would help adherence or the effectiveness of prevention education among older adults including nutrition, mental stimulation, physical activity and better training among physicians [37] but evidence regarding these approaches is patchy and few translated into programmatic use. Orel and colleagues [38] found that in 2004, 15 US States had HIV-related publications that were specifically targeted to older adults yet limited evidence is available on their impact on raising awareness and preventing new infections.

The literature provides reviews of the available evidence on HIV behavioural interventions targeted to a range of other affected groups including sex workers [39, 40], children [41], men who have sex with men [42], drug users [43] and in occupational settings [44]. Yet no compilation of evidence exists for older adults despite the recognised trend of an ageing HIV cohort globally. This paper systematically reviews the available published evidence on non-pharmacologic HIV behavioural interventions specifically targeted to older adults.
Methods

Searches were conducted on 6 February 2012 and again on 4 June 2012 in MEDLINE, Embase and the Education Resources Information Center (ERIC). A search strategy was defined with high sensitivity but low specificity. The search strategy consisted of free-text and Medical Subject Headings (MeSH) terms. Search terms for older adults included “elderly,” ”older adults,” “aged,” “geriatric” and “senior citizen” as well as HIV, AIDS and HIV/AIDS. Additional search terms to identify interventions or trials included “intervention,” “trial,” “evaluation,” “intervention studies,” “randomized controlled trials,” “evaluation studies,” “program evaluation” and “prevention”, “testing” and “adherence” to ensure capture of relevant articles. Additionally, references of identified publications and published reviews were hand searched for potential additional relevant articles.

There were no restrictions on language or year of publication or country. We included studies that included those aged 50 years and older or which reported specifically on that age group. Studies that included participants aged, for example, 25-52 were excluded if there was no specific sub-group reporting on those aged 50 and older. The focus of our work was non-pharmacologic, non-biological, behavioural interventions. We did not search for studies that evaluated treatment efficacy among older adults but rather focused on interventions in the areas of prevention, adherence, testing, care and support.
In the first review round, two reviewers (JN, AR) independently scrutinised the list of article titles to narrow the list of inclusions. Another round of exclusions using abstracts of those articles deemed potentially relevant based on titles was conducted and the final selection was based on the full text of potentially relevant articles. In cases of disagreement, a third reviewer (AM) examined the articles. Results and inclusion were discussed until consensus was reached among all three reviewers. Figure 1 outlines the number of studies included at each stage of the review process.

*Figure 1. Selection of manuscripts for systematic review of behavioural HIV interventions targeted to older adults*

Data were then extracted from each relevant study into an excel spreadsheet. Extracted information included year, location of study, brief description, study type, sample size, study population, review of methods, primary outcome measure and focus topic of the study.

**Results**

After removing duplicates, the search revealed 1229 articles. After a review of titles and then abstracts, 12 articles met study criteria and were included in the review.
The majority of articles identify and describe behaviours of older adults rather than evaluating an intervention [30]. For example, there were articles that described specific intervention projects targeted to older adults – for example the Florida Senior HIV Intervention Project – but which did not provide any evidence of success or evaluation of the program [45]. Other papers did not report on those aged 50 and older. For example, one paper provided data for the age group 30-59 but was not included in the review because it did not report on older adults specifically [46].

All twelve of the included studies originated from the Americas: two from Brazil and the rest from the United States. Eight of the interventions were conducted among older adults living with HIV and four for HIV-negative older adults. Five studies included control groups. Of the included studies, four focused on general knowledge of HIV, three emphasised mental health and coping, two on sexual behaviour, two on physical status and one on testing/screening.

The included studies do highlight areas for action in developing prevention and adherence interventions specifically for older adults. Rose demonstrated that delivery of an age-specific AIDS education program was effective in improving HIV knowledge (p<0.001) and perceptions of susceptibility (p<0.01) among older HIV-negative Americans compared to a control group not receiving the education program [47].

Other interventions targeted HIV-infected older adults. One of the most successful interventions was group educational sessions developed to reduce high-risk sexual
behaviours run by a project called ROADMAP (Reeducating Older Adult in Maintaining AIDS Prevention) [48]. After sessions that included practicing condom use skills and role playing condom negotiation, participants in the intervention group (N=149) reported reduced inconsistent condom use (9% at baseline to 1% at 6 month follow-up; p=0.003) compared with the control group (N=92) (4% to 3%; p=.0999).

Heckman and colleagues reported that group sessions with trained facilitators that included a focus on coping mechanisms and how to deal with stress are effective in reducing depressive symptoms in HIV-positive older adults (p values ranging from 0.01 to 0.1 for variety of measures; see table 1) [49]. A study used telephone-based interventions to reduce risky sexual behaviour with controls reporting on average 3.24 times (95% CI 1.79-5.85) as many occasions of unprotected sex at 3 follow-up [50].

Weekly resistance exercise training sessions trialed in Sao Paulo, Brazil [32, 51], among HIV-positive older adults, produced increased strength and functional gains superior to those seen in age-matched HIV-negative controls. Those receiving the intervention (N=11) increased weight lifted compared to controls (N=21) (p<0.01) and were faster at sit-to-stand after training (p=0.005) [32].

Table 1. Summary of included articles
Discussion

This systematic review of behavioural HIV interventions specifically targeted to older adults reveals the paucity of published literature on this topic despite the increases in the number of people living with HIV aged 50 years and older and the increasing prevalence in this group globally. Though there have been many calls for more evidence that specifically address the vulnerabilities and characteristics of older adults, only twelve articles were found that included some evaluation of an intervention for this population.

Only four of the studies were randomised control trials and seven – including all of the studies among HIV-negative older adults – did not include controls at all. A few of the studies conducted statistical testing on samples of 16 or 11 older adults making inference based on the results difficult. A number of the studies – especially those among HIV-negative individuals focused on general HIV awareness and interest as opposed to behaviour change. More methodological rigour is needed in the studies targeting older adults.

Despite the limited number of papers providing evidence on this topic, some lessons do emerge from the review. Due to concerns over stigma and the perception of being low risk, researchers have suggested approaches for older adults through the lens of sexuality and sexual health rather than HIV directly [27]. Providing information on, for example, the impact of medications on sexuality may provide an appropriate time to discuss safe sex and HIV.
Though there is an erroneous ageist assumption that older people are not able to make behaviour changes [52], a number of ideas were expressed as possible avenues to reach older adults with HIV services including using older adults as peer educators [38] and providing training in sexuality counselling to social workers working with this age group [36]. Others advocate for the increased use of internet and mobile phone based HIV programs to reach the elderly who might be uncomfortable discussing HIV in more public settings [53]. A number of authors called for more education of physicians on the topic to ensure that HIV counselling and also testing are carried out among older adults [54, 55].

This systematic review has a number of limitations. The review focused specifically on interventions reporting outcomes among older adults and therefore might have missed interventions designed for adults of all ages that are effective among older adults. The review only included published papers documenting interventions that had been evaluated thus eliminating a large set of publications that only describe interventions.

The review only searched for studies specifically on HIV. There are a number of other studies on medication adherence generally among older adults [56-58] or on sexual health interventions that might be relevant to HIV that were not included here.

Given the trends within the HIV community, much more rigorous evidence is needed on how best to provide services for those aged 50 years and older. A number of
interventions were mentioned in articles, but without evidence of impact, suggesting that there are opportunities for evaluations to add to the base of knowledge in this area [45]. Through which channels to reach older adults most effectively, and how to message to them most appropriately, are critical to effective programming. In particular, encouraging testing, supporting adherence, reducing risky sexual behaviours are all areas where the evidence base is currently insufficient. More operational research is needed to scrutinise the “how” of service delivery for older adults [59] and how to provide it at scale. The other major research challenge will be building an evidence base for older adults living in low and middle income countries where very little currently exists. The applicability of American studies to other parts of the world is likely to be limited and such new research will be critical as the HIV cohort in Africa and Asia ages into the future.
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Conflicts of interest

The authors declare no conflict of interest.
References


39. Wariki WM, Ota E, Mori R, Koyanagi A, Hori N, Shibuya K. Behavioral interventions to reduce the transmission of HIV infection among sex workers and
their clients in low- and middle-income countries. *Cochrane Database of Systematic Reviews* 2012,2:CD005272.


Figure 1. Selection of manuscripts for systematic review of behavioural HIV interventions targeted to older adults

1229 found through search strategy

1039 excluded based on title review

190 potentially relevant based on title

159 excluded based on abstract review

31 potentially relevant based on abstract

21 excluded based on full text review

2 identified from other sources and reference lists

12 studies included in review
<table>
<thead>
<tr>
<th>Article</th>
<th>Participants</th>
<th>Study Design</th>
<th>Intervention</th>
<th>Control Group (Y/N)</th>
<th>Measure</th>
<th>Results</th>
<th>Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AMONG HIV-NEGATIVE OLDER ADULTS</strong></td>
<td></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Small 2010</td>
<td>Individuals aged 50 years and older N=50</td>
<td>Purposive sampling</td>
<td>Both quantitative and qualitative data were gathered during each session and included a pre-survey and immediate post-37-item-survey, a focus group, and an HIV educational curriculum.</td>
<td>Four HIV education training sessions each lasting three hours covering the following topics: (a) Introduction and Overview, (b) Identifying Myths and Stereotypes, (c) HIV Facts, and (d) Provision of Resources.</td>
<td>No</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Orel 2010</td>
<td>89 people aged 60 and older N=11</td>
<td>Before and after questionnaires</td>
<td>“No One is Immune Project” – six-hour education and prevention workshop held at senior centre</td>
<td>No</td>
<td>45-item HIV/AIDS Knowledge Questionnaire</td>
<td>Increase in % answering correct</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- HIV can be spread by mosquitoes (48 to 98)</td>
<td></td>
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<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>- you cannot get HIV when getting a tattoo (25 to 78)</td>
<td></td>
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<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>Workshop increased knowledge of HIV among older adults and 25% of 36 registered participants received HIV test results that day</td>
<td></td>
</tr>
<tr>
<td>Altschuler 2004</td>
<td>Adults aged 50 years and older in California</td>
<td>Purposive sample</td>
<td>Interest in participating in HIV education prevention program surveyed and then specialised curriculum targeting older adults developed and presented</td>
<td>No</td>
<td>Survey with 10 questions concerning interest in prevention and education</td>
<td>Pilot test participants identified learning that HIV was relevant to their lives; feeling empowered to speak up to their health care providers; positive impression being able to discuss a taboo topic. Women were more likely than men (p=.028) to</td>
<td>A majority of participants reported interest in an HIV prevention program for older people. Presentations at centers serving older adults and from physicians are most appropriate.</td>
</tr>
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</tr>
<tr>
<td></td>
<td>Curriculum pilot tested with additional 40 older adults</td>
<td>Verbal feedback from pilot test participants</td>
<td>Curriculum includes overview, myths and stereotypes, facts and resources.</td>
<td></td>
<td></td>
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<tr>
<td>N=249</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

- women are always tested for HIV during their pap smears (12 to 100)
- No data provided on overall changes in scores
<table>
<thead>
<tr>
<th>Study</th>
<th>Participants</th>
<th>Study Design</th>
<th>Intervention</th>
<th>Outcomes</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rose 1996</td>
<td>Individuals aged &gt;60 recruited at senior citizen meal sites in USA. Pre-intervention N=458, Post-intervention N=318</td>
<td>Pre and post-test cross-sectional survey. 20-30 minute age-specific AIDS education program delivered at meal site and educational pamphlet. Consisted of statistics and facts about HIV, prevention measures and case studies of elderly people with HIV.</td>
<td>No Questionnaire measured HIV knowledge and perceptions of susceptibility to HIV (Likert scales)</td>
<td>Significant increase in total knowledge about AIDS (p&lt;0.001), perceived susceptibility (p&lt;0.01) and perceived severity (p&lt;0.001)</td>
<td>Age specific education program significantly increased HIV-related knowledge at senior citizen meal sites</td>
</tr>
<tr>
<td>Lovejoy 2011</td>
<td>HIV-infected adults 45-plus years old who reported engaging in at least one occasion of unprotected sex in the 3 months prior to enrolment. N=100</td>
<td>Randomised control trial 3 arms – 4-sessions, 1 session or nothing. Telephone delivered motivational interviewing (MI) (client-focused and directive form of counselling) to reduce risky sexual behaviour.</td>
<td>Yes Episodes of unprotected sex in past 3 months</td>
<td>Participants in the 4-session MI arm engaged in the fewest occasions of unprotected sex at 3 and 6 month follow-up. Controls had on average 3.24 times as many occasions of</td>
<td>Four sessions of telephone-delivered MI reduces sexual risk behaviour among HIV-positive older adults</td>
</tr>
<tr>
<td>Study</td>
<td>Group Description</td>
<td>Study Design</td>
<td>Intervention Details</td>
<td>Referral Outcomes</td>
<td>Key Findings</td>
</tr>
<tr>
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</tr>
<tr>
<td>Ruiz 2010</td>
<td>HIV-positive patients aged &gt;60 years  N=57</td>
<td>Descriptive</td>
<td>Functional screening for detection of comorbidities and referral for further care if failed in 3 or more domains</td>
<td>No</td>
<td>Unprotected sex (95% CI 1.79-5.85). 17 patients were referred due to problems in multiple domains including cognitive dysfunction (10), problems in daily living (8), nutritional issues (6), depression (5), and mobility (5). Screening for comorbidities among HIV-positive older adults can facilitate referral for further care likely to improve quality of care and outcomes.</td>
</tr>
<tr>
<td>Illa 2010</td>
<td>HIV-positive, 45 or older, sexually active in last 12 months  N=241 (149 intervention group and 92 in control group)</td>
<td>Randomised control trial Follow-up at 6 and 12 months</td>
<td>Project ROADMAP (re-educating older adult in maintaining AIDS prevention). Intervention group: educational brochure and four psycho-educational group sessions designed for HIV-positive older adults. Sessions focused on information, motivation, behavioural skills and risk reduction behaviours.</td>
<td>Yes</td>
<td>Sexual risk (number of partners, partner HIV status, sexual acts, condom use) HIV knowledge (33 item measure) Sexual self-efficacy Inconsistent condom use with partners of negative or unknown serostatus reduced from 9% at baseline to 1.3% at 6 month follow-up among intervention group (p=0.03); 4% to 3% with Group psycho-educational sessions reduced unprotected sexual acts with partners of unknown or negative serostatus.</td>
</tr>
<tr>
<td>Study</td>
<td>Participants</td>
<td>Design</td>
<td>Intervention</td>
<td>Measures</td>
<td>Results</td>
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</tr>
<tr>
<td>Heckman et al 2001</td>
<td>HIV-positive individuals aged 50 years and older attending AIDS service organizations (N=16)</td>
<td>Pilot pre- and post-test cohort study</td>
<td>Coping improvement group intervention: 10 face-face group sessions, each ~75min. Homogenous for sexuality and gender.</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Heckman et al 2006</td>
<td>HIV-positive individuals aged 50 years</td>
<td>Randomised control trial with delayed treatment</td>
<td>12, 90 minute sessions, telephone delivered weekly coping</td>
<td>Yes, delayed treatment, Geriatric depression scale (GDS)</td>
<td>Intervention group reported fewer</td>
</tr>
</tbody>
</table>
and older recruited from AIDS service organizations with diagnosis of depression or dysthymia.  
N=90  
<table>
<thead>
<tr>
<th>treatment control</th>
<th>improvement group intervention to reduce psychological distress</th>
</tr>
</thead>
</table>
| Embedded cohort study | 1) Immediate treatment (n=44)  
2) Delayed treatment (control) (n=46) |

Within cohorts  
IG: significant decrease in depressive symptoms (p<0.003)  
psychological symptoms  
(p=0.05), less life stressor burden (p=0.058), less use of avoidant coping strategies (p=0.05) and marginally higher levels of coping self-efficacy (p=0.10) compared to controls with no effect on depressive symptoms, loneliness or use of engagement coping.
| Heckman et al 2011 | HIV-positive individuals aged 50 years or older with Beck Depression Inventory-II score 10 or more and Modified mini-mental state | Randomised control trial 3 arms | 1) 12 90 minute sessions face-to-face coping improvement (FFCI) group intervention (n=104) 2) 12 session interpersonal support group (IPSG) intervention (n=105) | Yes | Geriatric Depression Screening Scale Completed using audio-computer assisted self interviews (A-CASI) | Both FFCI and IPSG participants reported fewer depressive symptoms than controls post-intervention, 4- and 8-month follow-up. This effect was not (p<0.001), life-stressor burden (p<0.03) and avoidance coping (p<0.04) at 3 months. Delayed group: significant decrease in psychological symptoms (p<0.03), life stressor burdens (p<0.001), loneliness (p<0.03) and greater coping self-efficacy (p<0.04) following intervention. An age-appropriate coping improvement group intervention was effective in reducing depressive symptoms in HIV+ older adults. The effect was more pronounced amongst subjects suffering greater levels of |
examination score of 75 or greater.  
N=295

3) Individual therapy upon request (ITUR) control (n=86). Subjects had access to standard psychosocial services available in the community.

always statistically significant (p’s<0.01-0.1) Effect size greater for subset of participants with mild, mod and severe depression at baseline.

Souza et al 2008
Subjects HIV+, older than 60 (Mean 65.6+/−2.9), sedentary at baseline. 3 subsequently excluded due to >3/12 absence from training program.
N=11
All subjects medical able to complete training and not using cortico- or anabolic steroids
Prospective Case series study 1 year resistance training program
4 exercises targeting major muscle groups
3 sets 8-12 reps at light, mod and heavy resistance respectively
2 sessions/week, one year
No

**Immunological and virological markers:**
T-CD4+
T-CD8+
HIV-RNA PCR

**Anthropometric indices:**
Body mass, circumferences and skin folds
Body composition (DEXA)

**Strength and functional tests:**
Sub-maximum weight lifted
Two functional tests performed every 4 months

Significant increase in CD4+ (388 pre to 539 post, p=0.008) and in CD4+/CD8+ ratio (0.63 to 0.81, p=0.009)

No significant change in weight

Strength improvements of between 74-97% (p’s=0.003-0.021); Functional

Following one year of progressive resistance training HIV positive older adults showed significant improvements in strength and functional capacity, no changes in body composition and improved immunological indices.
Souza et al 2011

Subjects HIV+,
age >= 60 (M= 64.4 +/- 3.0)
Ave. 9 year history of HIV,
recruited at Hospital in Sao Paulo
N=11

All subjects medically able
to complete training and not using cortico- or anabolic steroids

Control trial

Progressive resistance
exercise 2 sessions per week for 1 year.

Five exercises utilised major muscle groups

3 sets 12/10/8 repetitions at sub-maximum load

Yes, age, activity and gender matched HIV–controls (N=21)

Assessing walking speed, and sit-to-stand performance.

Strength and functional tests:
Sub-maximum load monitored bi-monthly

Functional test of walk and sit-stand speeds.

Anthropometric and metabolic indices:
Weight; BMI
Lipid and glycaemic profiles (values registered in clinical record immediately before and after training program)

Although weaker at baseline, HIV+ subjects increased weight lifted from 1.52 to 2.33 times baseline, a significantly greater improvement than controls (1.21-1.48, p<0.01)

HIV+ lighter, significantly lower BMI (p=0.007 pre and p=0.004 post)

Faster at walking tests (significant, p=0.036 pre-,
HIV+ significantly faster at sit-to-stand after training than controls (p=0.005)

Fasting BSL significantly improved in both groups (p’s=0.027-0.037).
HIV and Aging — Preparing for the Challenges Ahead
Edward J. Mills, Ph.D., Till Bärnighausen, M.D., Sc.D., and Joel Negin, M.I.A.

By 2015, half the U.S. population living with human immunodeficiency virus (HIV) infection will be older than 50 years of age. As antiretroviral therapy (ART) coverage continues to expand worldwide, this aging of the HIV epidemic will be mirrored in developing countries. In sub-Saharan Africa, ART has already reduced mortality rates, with 320,000 (or 20%) fewer people dying of HIV-related causes in 2009 than in 2004.3 Currently, HIV-infected Ugandans in their 40s who are receiving ART can expect to live well into their 60s.2 The increased life expectancy of HIV-infected persons will lead to increases in HIV prevalence among older adults. Approximately 1 in 8 HIV-infected adults and 1 in 10 patients receiving ART in sub-Saharan Africa are older than 50 years of age,3 and these ratios are likely to increase manifold in the coming decades (see maps).

Yet the world is unprepared to deal with an aging population with HIV. We are still learning about what determines the success of ART in older age groups, and our understanding of the future needs with regard to treatment for chronic noncommunicable diseases, such as cardiovascular disease and diabetes, in older HIV-infected adults in developing countries is very limited. To date, the focus of the global response to HIV has been on providing care to mothers, children, and the most severely immunocompromised patients. The June 2011 United Nations High-Level Meeting on AIDS emphasized the integration of HIV services with maternal and child health services but neglected the emerging evidence on the aging of the HIV epidemic. Similarly, the September 2011 United Nations High-Level Meeting on Non-Communicable Diseases did not consider the effect of the large-scale provision of ART in developing countries on the age distribution of the population and the future global need for the treatment of noncommunicable diseases. The failure of both meetings to consider the issue of HIV and aging underscores how little attention is being paid to this coming challenge.

Effectively addressing the needs of aging HIV-infected populations will require political will, strengthened health systems, a greater commitment of human resources, and improved clinical infrastructure and expertise.

Political will is needed to put the aging of the epidemic on political agendas worldwide, just as it was necessary before 2004 to mobilize governments and donors to commit to improving access to ART. Political pressure helped drive down the price of ART from more than $10,000 to less than $100 per person per year. Similar action could help address the current high cost of drugs for diseases occurring late in life, including many cancers and end-stage organ diseases such as congestive heart failure and renal failure.

The second major challenge relates to the way in which health systems in developing countries respond to the need for treatment of chronic noncommunicable diseases in HIV-infected patients. Both HIV infection and ART exacerbate a range of diseases that occur in older people, including cardiovascular disease, diabetes, and osteoporosis. In Africa, providers of HIV-related services are unable to meet the health systems challenges of caring for HIV-infected patients with other chronic diseases. Clinics that provide ART are typically minimally stocked with drugs other than antiretrovirals and rarely offer drugs that reduce modifiable disease risk factors (most notably, antiplatelet, antihypertensive, and lipid-lowering medications). Health maintenance through routine assessment of blood pressure, blood glucose levels, and cardiac function through clinical examination, as well as counseling and screening for common cancers, is often overlooked. Clinical visits for HIV care may be the only medical access that a patient has in many African countries. ART programs therefore ought to begin screening for coexisting chronic conditions and ensuring that patients have access to appropriate treatments. Yet few ART clinics can offer laboratory tests to detect risk factors for noncommunicable diseases and to diagnose cardiovascular disease, diabetes, and cancers; and treatments for common chronic diseases of old age are either not integrated into ART services or not available at all.

The third challenge — the need for adequate human resources —
has been largely ignored. There are fewer than 25 geriatric clinicians in all of sub-Saharan Africa, and in most of the region’s countries there are none. In many sub-Saharan African countries, medical schools do not offer courses in geriatrics. Clinicians in HIV service organizations typically do not receive ongoing education about the complexity of HIV in older patients.

One of the great achievements in the organization of the HIV response has been the definition of, training for, and large-scale implementation of appropriate ways of shifting clinical tasks from medical experts to nonphysician clinicians and even lay health workers and patients. Given current shortages in the health workforce in many developing countries, it seems likely that managing chronic diseases in HIV-infected patients will require similar approaches. Task shifting in the provision of clinical services such as hypertension screening, monitoring of adherence to cardiovascular drugs, tobacco cessation programs, and cancer support groups can be a first step while infrastructure is built. However, task shifting is not a long-term solution to aging-related care. Training and recruiting specialist nonphysician clinicians with expertise in geriatrics will be necessary and require the involvement of medical colleges and support from international funding bodies.

Rehabilitation services, including physical therapy, occupational therapy, and mobility aids, will also present an important challenge for HIV service providers. Building rehabilitation infrastructure will require innovative strategies such as turning to resources and talent in the affected communities. For example, makeshift mobility or rehabilitative aids constructed from locally sourced materials could benefit patients when standard equipment is unavailable or in short supply. Even such small advances can have a large positive impact on communities.

Finally, older adults with HIV face a number of distinct clinical challenges, including slower immunologic recovery with ART than is observed in younger populations. According to emerging evidence on survival, patients 50 years of age or older who are receiving ART are 30% (95% confidence interval, 19 to 40) more likely than younger adults to die prematurely within 4 years after beginning treatment.

The reasons for poor survival in this population are not well understood. Insufficient attention has been given to clinical challenges of adherence, drug interactions, and toxicities when older HIV-infected patients are receiving multiple treatments for various conditions such as tuberculosis. These challenges are exacerbated by poor nutrition, high rates of poverty, and the social demands on older adults in many communities in developing countries.

Yet services for HIV-infected patients cannot be provided without also considering the needs of HIV-negative patients with aging-associated diseases. Although there is currently international attention focused on noncommunicable diseases, the level of commitment for treating these conditions is limited. The principles of the HIV-AIDS response — test, treat, retain, adhere, and simplify care — can be useful in addressing aging-associated diseases in Africa.

U.S. Secretary of State Hillary Clinton has called on the world to commit greater treatment and preventive resources in the hope of ushering in an “AIDS-free generation.” This is indeed a laudable goal, yet we must also care for the millions of already-infected people struggling to obtain and cope with long-term ART while dealing with coexisting conditions. Recent modeling using South African data suggests that HIV prevalence among people older than 50 years of age will nearly double in the next 30 years, and the absolute number of similarly aged HIV-infected patients will triple in the same period.

The development of programs for aging HIV-infected populations in developing countries will thus be a critical medical and public health challenge in the near future. How it is addressed may well decide the long-term success of the global ART scale-up, one of the largest public health interventions in history.

Disclosure forms provided by the authors are available with the full text of this article at NEJM.org.

From the Faculty of Health Sciences, University of Ottawa (E.J.M.); the Harvard School of Public Health, Boston (T.B.); the Africa Centre for Health and Population Studies, Mtubatuba, South Africa (T.B.);
and the Sydney School of Public Health, University of Sydney, Sydney, NSW, Australia (J.N.).


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Further analyses of the Myeloma IX Study

Athanassios Kyrgidis and Thrasiououlos-George Tzellos (June 25, p 2177)1 and Tetsuya Tanimoto and colleagues (June 25, p 2178)2 make important comments on our paper3 reporting the results of the Medical Research Council (MRC) Myeloma IX Study.

In response to Kyrgidis and Tzellos, the statistical analyses were done as prospectively planned for the MRC Myeloma IX Study. The additional exploratory analyses were done to verify that the overall survival model was valid despite a model violation detected for one treatment centre (model omitting stratification by treatment centre) and to test a hypothesis that the effect of zoledronic acid on survival was simply due to prevention of skeletal-related events, which was found not to be the case. The outcome from this latter model was consistent when treatment-centre stratification was omitted, although the comparison then fell just short of significance (p=0.0515). The overall survival benefit with zoledronic acid versus clodronic acid seen in the overall population in Myeloma IX was also consistent (though statistically underpowered) when the intensive and non-intensive pathways were analysed separately.

The intention of the different curves presented in figure 2 was not, as implied, to present a favourable impression for zoledronic acid. The overall and progression-free survival curves were initially generated for the entire time course (figures 2A and 2C) per the study protocol. Given the lower rates of early death and generally favourable response profiles in patients treated with zoledronic acid, the first 4 months on study (ie, during chemotherapy) were analysed separately and revealed striking differences.

The cumulative incidence of osteonecrosis of the jaw in patients treated with zoledronic acid was 3.4% across a median follow-up of 3.7 years.

Continued neglect of ageing of HIV epidemic at UN meeting

On June 10, 2011, the UN HIV/AIDS meeting in New York, USA, concluded with a set of commitments including to redouble efforts to achieve universal access to prevention, treatment, and care. As you report (June 18, p 2055),1 integration was highlighted as the way forward for the epidemic’s response. The declaration, however, missed an opportunity to acknowledge the integration needed to address the reality that, as more people are put on treatment and as survival on treatment is enhanced around the world, a growing proportion of people living with HIV will be classified as elderly.2

UN data have focused on those aged 15–49 years but, across the world, the epidemic is affecting those aged 50 years and older more than ever before. By 2015, at least half of those living with HIV in the USA will be aged 50 years and older. In sub-Saharan Africa, there are 3 million people living with HIV aged 50 years and older, representing more than 13% of the region’s HIV cases.3

With the ageing of the epidemic, HIV/AIDS has become a complex chronic disease characterised by increasing rates of comorbid conditions including liver and renal disease, cancers, osteoporosis, and neurocognitive and cardiovascular diseases.4 The vertical AIDS funding approach has meant that AIDS clinics have training and resources to deal with AIDS-specific conditions, but lack access to effective diagnostics and treatments for these comorbid disorders.

The UN meeting was tasked with charting the future course of the global HIV response, yet failed to mention the ageing of the pandemic. It acknowledged the need for a more integrated approach, but centred mainly on infectious diseases and reproductive and child health. The call for integration is appropriate, but should focus on strengthening the response to non-communicable diseases in developing countries, building on existing efforts to develop HIV chronic-care models.5 We declare that we have no conflicts of interest.

*Joel Negin, Edward J Mills, Rachel Albone
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School of Public Health, University of Sydney, Sydney, NSW 2006, Australia (JN); British Columbia Centre for Excellence in HIV/AIDS, University of British Columbia, Vancouver, BC, Canada (EJM); Faculty of Health Sciences, University of Ottawa, Ottawa, ON, Canada (EJM); and HelpAge International, London, UK (RA).


Publication: High rates of AIDS-related mortality among older adults in rural Kenya

Journal: Journal of Acquired Immune Deficiency Syndromes (JAIDS)

Authors: Negin J, Wariero J, Cumming R, Mutuo P, Pronyk P

As a co-author, I acknowledge that the above named publication is to be submitted as part of Joel Negin's PhD thesis. I certify that Joel Negin contributed the bulk of the raw data analysis, subsequent critical analysis of the data, the direction of the paper and wrote the first draft and coordinated the final draft. James Wariero and Patrick Mutuo guided the data collection and provided comments on the drafts. James Wariero reviewed early analyses. Robert Cumming reviewed analyses and provided comments on drafts. Paul Pronyk reviewed and commented on early and final drafts.

Signed: 

Name (please print): WARIERO, JAMES OGOLO

Date: 08th MARCH 2012.
Publication: High rates of AIDS-related mortality among older adults in rural Kenya

Journal: Journal of Acquired Immune Deficiency Syndromes (JAIDS)

Authors: Negin J, Wariero J, Cumming R, Mutuo P, Pronyk P

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Signed: [Signature]

Name (please print): ROBERT CUMMING

Date: 12/4/2012
Publication: High rates of AIDS-related mortality among older adults in rural Kenya

Journal: Journal of Acquired Immune Deficiency Syndromes (JAIDS)

Authors: Negin J, Wariero J, Cumming R, Mutuo P, Pronyk P

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Signed: 

Name (please print): DR. PATRICK K. MUTUO

Date: 02/04/2012.
Publication: HIV Attitudes, Awareness and Testing Among Older Adults in Africa

Journal: AIDS and Behavior

Authors: Negin J, Nemser B, Cumming R, Lelerai E, Ben Amor Y, Pronyk P

As a co-author, I acknowledge that the above named publication is to be submitted as part of Joel Negin’s PhD thesis. I certify that Joel Negin contributed to data collection, conceived of the study, performed the raw data analysis and guided further analyses, and wrote the first draft and coordinated the final revisions. Bennett Nemser contributed significantly to the data preparation and analysis with support from Eliud Lelerai. Robert Cumming reviewed analyses and provided comments on drafts. Paul Pronyk and Yanis Ben Amor reviewed and commented on drafts.

Signed: __________

Name (please print): ______Paul Pronyk_________________________

Date: ___March 4, 2012________________
Publication: Quantifying HIV prevalence in older adults in sub-Saharan Africa: extrapolating from existing data

Journal: Bulletin of the World Health Organization

Authors: Negin J, Cumming R

As a co-author, I acknowledge that the above named publication is to be submitted as part of Joel Negin’s PhD thesis. I certify that Joel Negin conceived of the study, contributed the bulk of the study design and data analysis and wrote the first draft and coordinated the final draft. Robert Cumming reviewed analyses and provided comments on drafts.

Signed: __________________

Name (please print): ROBERT CUMMINS

Date: 12-14/2012
Publication: HIV Attitudes, Awareness and Testing Among Older Adults in Africa

Journal: AIDS and Behavior

Authors: Negin J, Nemser B, Cumming R, Lelurai E, Ben Amor Y, Pronyk P

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Signed: [Signature]

Name (please print): Bennett Nemser

Date: 5/7/2012 (May 7, 2012)
Publication: HIV Attitudes, Awareness and Testing Among Older Adults in Africa

Journal: AIDS and Behavior

Authors: Negin J, Nemser B, Cumming R, Lelerai E, Ben Amor Y, Pronyk P

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Name (please print): ROBERT CUMMING

Date: 12/14/2012
Publication: HIV Attitudes, Awareness and Testing Among Older Adults in Africa

Journal: AIDS and Behavior

Authors: Negin J, Nemser B, Cumming R, Lelerai E, Ben Amor Y, Pronyk P

As a co-author, I acknowledge that the above named publication is to be submitted as part of Joel Negin’s PhD thesis. I certify that Joel Negin contributed to data collection, conceived of the study, performed the raw data analysis and guided further analyses, and wrote the first draft and coordinated the final revisions. Bennett Nemser contributed significantly to the data preparation and analysis with support from Eliud Lelerai. Robert Cumming reviewed analyses and provided comments on drafts. Paul Pronyk and Yanis Ben Amor reviewed and commented on drafts.

Signed: [Signature]

Name (please print): Yanis Ben Amor

Date: 6 March 2012
Publication: HIV Attitudes, Awareness and Testing Among Older Adults in Africa

Journal: AIDS and Behavior

Authors: Negin J, Nemser B, Cumming R, Lelerai E, Ben Amor Y, Pronyk P

As a co-author, I acknowledge that the above named publication is to be submitted as part of Joel Negin’s PhD thesis. I certify that Joel Negin contributed to data collection, conceived of the study, performed the raw data analysis and guided further analyses, and wrote the first draft and coordinated the final revisions. Bennett Nemser contributed significantly to the data preparation and analysis with support from Eliud Lelerai. Robert Cumming reviewed analyses and provided comments on drafts. Paul Pronyk and Yanis Ben Amor reviewed and commented on drafts.

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Name (please print): _____ Paul Pronyk__________________________

Date: ____March 4, 2012________________
As a co-author, I acknowledge that the above named publication is to be submitted as part of Joel Negin’s PhD thesis. I certify that Joel Negin conceived of the research, performed the raw data analysis, led the subsequent critical analysis of the data, wrote the first draft and coordinated the final draft. Monique van Lettow, Medson Semba and Adrienne Chan supported data collection and provided comments on drafts. Alexandra Martiniuk and Robert Cumming supported data analysis and provided comments on all drafts.

Signed: __________________________

Name (please print): ______Monique van Lettow____________________

Date: ______March 29th 2012____________________
Publication: Anti-Retroviral Treatment Outcomes among Older Adults in Zomba District, Malawi

Journal: PLoS One

Authors: Negin J, van Lettow M, Semba M, Martiniuk A, Chan A, Cumming RG.

As a co-author, I acknowledge that the above named publication is to be submitted as part of Joel Negin’s PhD thesis. I certify that Joel Negin conceived of the research, performed the raw data analysis, led the subsequent critical analysis of the data, wrote the first draft and coordinated the final draft. Monique van Lettow, Medson Semba and Adrienne Chan supported data collection and provided comments on drafts. Alexandra Martiniuk and Robert Cumming supported data analysis and provided comments on all drafts.

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Name (please print): Medson Semba

Date: 29-03-2012
Publication: Anti-Retroviral Treatment Outcomes among Older Adults in Zomba District, Malawi

Journal: PLoS One

Authors: Negin J, van Lettow M, Semba M, Martiniuk A, Chan A, Cumming RG.

As a co-author, I acknowledge that the above named publication is to be submitted as part of Joel Negin’s PhD thesis. I certify that Joel Negin conceived of the research, performed the raw data analysis, led the subsequent critical analysis of the data, wrote the first draft and coordinated the final draft. Monique van Lettow, Medson Semba and Adrienne Chan supported data collection and provided comments on drafts. Alexandra Martiniuk and Robert Cumming supported data analysis and provided comments on all drafts.

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Name (please print): ALEXANDRA MARTINIUK

Date: 26/04/2012.
Publication: Anti-Retroviral Treatment Outcomes among Older Adults in Zomba District, Malawi

Journal: PLoS One

Authors: Negin J, van Lettow M, Semba M, Martiniuk A, Chan A, Cumming RG.

As a co-author, I acknowledge that the above named publication is to be submitted as part of Joel Negin’s PhD thesis. I certify that Joel Negin conceived of the research, performed the raw data analysis, led the subsequent critical analysis of the data, wrote the first draft and coordinated the final draft. Monique van Lettow, Medson Semba and Adrienne Chan supported data collection and provided comments on drafts. Alexandra Martiniuk and Robert Cumming supported data analysis and provided comments on all drafts.

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Name (please print): Adrienne K. Chan

Date: __March 29, 2012_______
Publication: Anti-Retroviral Treatment Outcomes among Older Adults in Zomba District, Malawi

Journal: PLoS One

Authors: Negin J, van Lettow M, Semba M, Martiniuk A, Chan A, Cumming RG.

As a co-author, I acknowledge that the above named publication is to be submitted as part of Joel Negin's PhD thesis. I certify that Joel Negin conceived of the research, performed the raw data analysis, led the subsequent critical analysis of the data, wrote the first draft and coordinated the final draft. Monique van Lettow, Medson Semba and Adrienne Chan supported data collection and provided comments on drafts. Alexandra Martiniuk and Robert Cumming supported data analysis and provided comments on all drafts.

Signed: [Signature]

Name (please print): ROBERT CUMMING

Date: 12/14/2012
Publication: Prevalence of HIV and chronic co-morbidities among older adults in South Africa using SAGE nationally representative data

Journal: AIDS

Authors: Negin J, Martiniuk A, Cumming RG, Naidoo N, Phaswana-Mafuya N, Madurai L, Williams S, Kowal P

As a co-author, I acknowledge that the above named publication is to be submitted as part of Joel Negin’s PhD thesis. I certify that Joel Negin conceived of the research question, cleaned the HIV data, performed the raw data analysis, led the subsequent critical analysis of the data, wrote the first draft and coordinated the final draft.

Signed: _____________________________

Name (please print): ALEXANDRA MARTINIUK

Date: 26/04/2012
Publication: Prevalence of HIV and chronic co-morbidities among older adults in South Africa using SAGE nationally representative data

Journal: AIDS

Authors: Negin J, Martiniuk A, Cumming RG, Naidoo N, Phaswana-Mafuya N, Madurai L, Williams S, Kowal P

As a co-author, I acknowledge that the above named publication is to be submitted as part of Joel Negin's PhD thesis. I certify that Joel Negin conceived of the research question, cleaned the HIV data, performed the raw data analysis, led the subsequent critical analysis of the data, wrote the first draft and coordinated the final draft.

Signed: R. Cumming

Name (please print): ROBERT CUMMING

Date: 2/4/2012
Publication: Prevalence of HIV and chronic co-morbidities among older adults in South Africa using SAGE nationally representative data

Journal: AIDS

Authors: Negin J, Martiniuk A, Cumming RG, Naidoo N, Phaswana-Mafuya N, Madurai L, Williams S, Kowal P

As a co-author, I acknowledge that the above named publication is to be submitted as part of Joel Negin’s PhD thesis. I certify that Joel Negin conceived of the research question, cleaned the HIV data, performed the raw data analysis, led the subsequent critical analysis of the data, wrote the first draft and coordinated the final draft.

Signed: Sharon Williams

Name (please print): Sharon Williams

Date: 5/7/12
Publication: Prevalence of HIV and chronic co-morbidities among older adults in South Africa using SAGE nationally representative data

Journal: AIDS

Authors: Negin J, Martiniuk A, Cumming RG, Naidoo N, Phaswana-Mafuya N, Madurai L, Williams S, Kowal P

As a co-author, I acknowledge that the above named publication is to be submitted as part of Joel Negin’s PhD thesis. I certify that Joel Negin conceived of the research question, cleaned the HIV data, performed the raw data analysis, led the subsequent critical analysis of the data, wrote the first draft and coordinated the final draft.

Signed:

Name (please print): Paul Kowal

Date: 07 May 2012