An investigation into the health and well-being of older people in South Africa

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A thesis submitted in fulfilment of the requirements for the degree of Doctor of Philosophy in Population Studies, in the Department of Statistics & Population Studies

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Declaration

I declare that this thesis is my own independent work and that I have not previously submitted it at another university. I furthermore cede copyright of the thesis in favour of the University of the Western Cape. The contents of this thesis are entirely my work, or in the case of multi-authored manuscripts, constitute work for which I was the lead author.

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Abstract

Populations are rapidly growing older across the globe. In South Africa, life expectancy has been on the increase over the past decade, and the proportion of older people is projected to increase dramatically over the coming years. Whilst this is a remarkable achievement, it does not mean that additional years of life will be healthy. To this end, the question being asked by researchers and policy makers is whether people are living longer and healthier lives? In order to answer this important question, health expectancies have been developed which combine morbidity and mortality data into a single index that measures population health. The health expectancies have become standard measures of population health across first world countries. Unfortunately, there is little awareness about their use in developing countries, including South Africa. The aim of this study was to estimate health expectancies based on various objective and subjective measures, in order to give a first comprehensive analysis of the health and wellbeing of older people in South Africa. The data were drawn from two nationally representative surveys namely; the WHO-Study on Global Ageing and Adult Health (SAGE) and the South African National HIV Incidence, Prevalence, Behaviour and Communication Survey (SABSSM) surveys.

The results are presented in the form of five manuscripts each submitted for publication. The first manuscript estimates sexually active life expectancies and factors associated with sexual activity. The results show that older people are gaining more years of sexual activity. HIV in older women and chronic conditions in older men reduced odds of sexual activity. The second manuscript found that there was both absolute and relative compression of morbidity in older people between 2005 and 2012, based on self-rated health measure. The third manuscript estimates happy life expectancy and examines factors associated with happiness in older people. Happy life expectancy was greater for men than women, and wealth status was the strongest predictor of happiness. In the fourth manuscript, subjective and objective measures were used to estimate health expectancies. The former showed a more positive outlook compared to the latter. Gender differentials were evident in that although women live longer than men, they spent a greater part of their lifetime in

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poorer health than men. The fifth manuscript goes a crucial step further, to estimate the contribution of specific diseases to disability. This is important for policymakers as this identifies entry points of interventions aimed at reducing the onset and burden of disability in the elderly population. The most contributors of disability were musculoskeletal and cardiovascular diseases. The thesis concludes that the health of older people is complex and multidimensional, and therefore requires several measures to give a comprehensive analysis. When measured using subjective measures, it can be concluded that the health of older people has been improving. However, a different conclusion could be reached, if objective measures are used. It is important to continue to monitor the health status of older people, and make appropriate interventions in order to improve their health, wellbeing and quality of life.

Key words: health, health expectancy, older people, aging, South Africa

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Chapter 1 Introduction

"Increased longevity without quality of life is an empty prize - that health expectancy is more important than life expectancy"

Dr. Hiroshi Nakajima - Former Director-General of WHO (WHO 1997)

1.1 Introduction

Globally, populations are rapidly aging and life expectancy continues to increase (Kinsella & Phillips 2005). This aging process is a result of both declining fertility rates and mortality rates at the older ages (Christensen, Doblhammer *et al* 2009). Whilst populations in developed countries have been aging for over a century now, the process has recently begun in developing countries (Hyde, Higgs *et al.* 2009). In South Africa, recent estimates show that life expectancy at birth has increased from; 54.6 to 58.5 (men) and 59.7 to 64.0 (women) between 2009 and 2012 (Dorrington, Bradshaw *et al.* 2014). This upward trend is projected to continue in the future (Actuarial Society of South Africa (ASSA) 2011).

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Whilst the gains in life expectancy seem to be a success story to celebrate, important questions have been raised about the health status of life gained at the older ages. In other words – are people living longer and healthier lives? This question arises from the speculation that increasing longevity could be prejudicial of health and quality of life – i.e. people might be living longer but in ill health. Hence, there is need for a paradigm shift from solely focusing on the quantity (number of years) to focusing on the quality of life. And, the focus should not only be on 'adding years to life', but 'adding life to years' as well (World Health Organisation 1998).

Traditionally, mortality data has been used as an indicator of health or for monitoring population health (Jagger & Robine 2011; Molla, Madans *et al* 2003). As such, mortality based indicators i.e. life expectancy has widely been used for this purpose. However, in order to answer the question above, a different set of measures is required since life expectancy is not sufficient to provide the answer. Health expectancies have been developed specifically to address the question about the

relation between increasing longevity and health (Salomon, Wang *et al* 2013). The health expectancies can be defined as the average number of years an individual at a given age can be expected to live in good health, based on the prevailing age-specific mortality and morbidity status (Jagger, Cox *et al* 2006). Health expectancy is an umbrella term for all population based measures that combine information on morbidity and mortality into a single index, but are different in the way health outcomes are defined and evaluated (Salomon, Wang *et al* 2013).

Health expectancies have become standard measures of measuring population health in most European countries and the USA (Jagger, Cox *et al* 2006) . In these countries, health planners and policymakers have shifted their focus to using health expectancies instead of life expectancy as a policy tool and primary measure of population health and monitoring health outcomes (Robine, Romieu *et al* 1999). However, there is no such awareness in using the health expectancies for monitoring processes and policy making in Africa including South Africa. As a result, little is known about the health states lived in by older people. This is in spite of the rapid ageing processes mentioned above, which calls for immediate attention on the well-being of older people. There is a fundamental difference between the contexts in which aging is occurring between developed and developing countries. The difference is that, the former developed socio-economically before aging, whilst the later are rapidly aging before they become developed (WHO 2011). This implies that the aging process in developing countries is happening before they become ready to deal with the challenges that come with it. Further, on another note, developing countries have been, and justifiably so, preoccupied by other health challenges such as infant, child and maternal health problems. As a result, the health of older people has largely been neglected (Cohen & Menken 2006; Ferreira & Kowal 2006; Negin *et al.* 2011). This highlights the urgency as well as complexities faced with developing countries with regards to population aging.

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1.2 Relevance of Study

Overall, the motivation and justification for this study is well captured in the open remarks of this chapter – a statement from the former Director of the WHO: "*Increased longevity without quality of life is an empty prize - that health expectancy is more important than life expectancy*" (WHO 1997). Whilst achieving longer life is indeed a

success of humankind, it can be an empty prize if this is attained at huge penalties such as increased burden of frailty, disability, disease and dependency, which all require costly long-term self-care and healthcare services. It is paramount therefore to understand if gains in life years are being accompanied by good health and quality of life. This forms the basis of this thesis.

Little is known about the health and well-being of older in developing countries including South Africa. It is expected that the findings from this study will incite and stimulate further research into health and functioning of older people.

1.3 Aim and Objectives

Overall, the aim of this study is to estimate the health expectancies in South Africa using different measures of health. The specific objectives are;

- To estimate sexually active life expectancy for older men and women, and examine the association between sexual activity and self-rated health status
- To examine trends in healthy life expectancy based on the self-rated health measure among older people for the period 2005 to 2012.
- To estimate happy life expectancies and examine factors associated with happiness among older people in South Africa
- To estimate healthy expectancies in the following domains: self-rated health, functional limitations and quality of life
- To determine the contribution of specific diseases to the burden of disability among older persons in South Africa

1.4 Reader's orientation

In accordance with the regulations of the University of the Western Cape, this thesis is presented in the form of five self-contained manuscripts, each as a chapter. Overall, the manuscripts attempt to address the overall aim of the study, and each manuscript specifically addresses one of the respective objectives outlines above. Although the five manuscripts have been written and will be published independently, there could be a sense of repetition in the methods applied since they are similar, especially cross the first four manuscripts. This however is not unusual in

academic research, where several manuscripts from a single study are published independently.

A review of literature and methods used in health expectancy research are presented in Chapter 2. The rest of the chapters are presented in the following sequence;

- Chapter 3: *Gender differences in Sexually Active Life Expectancy for Older Adults in South Africa* – estimates sexually active life expectancy and factors associated with sexual activity in older people.
- Chapter 4: *Compression of morbidity in older South Africans? Trends in Healthy Life Expectancy between 2005 and 2012* – analyses health-expectancies based self-rated health measure.
- Chapter 5: *Gender Differences in Happiness and Well-being among Older Adults in South Africa* – reports happy life expectancy and factors associated with happiness among older people.
- Chapter 6: *Estimation of Healthy Life Expectancies: a novel approach to studying population health in South Africa* - this chapter estimates health expectancies based on several measures; self-rated health, quality of life, functional limitations (and disability).
- Chapter 7: *Contribution of specific chronic diseases to disability among Older Adults in South Africa* – this follows up on chapter 6 and examines the contributions of diseases to disability burden among older people in South Africa.

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The last section (Chapter 8) synthesises the results from the five chapters, and gives an overall conclusion. The overall strengths and limitations of the thesis, and potential avenues for future research are described.

Other aging and health related work which the candidate contributed as co-author are presented in Appendix 2. In all, these are four articles written and published during the past four years of the candidate's doctoral research work.

Chapter 2 Review of Literature and Methods

2.1 Introduction

The purpose of this chapter is to establish the background to and conceptual framework for, this study. The chapter also introduces the various methods used in health expectancy research.

2.2 Aging of populations

Globally, populations are getting older at a faster pace than ever before. Table 2.1 below depicts the pace of aging across the globe, and specifically narrowing down to sub-Saharan Africa, South Africa and a few other countries (Tanzania, Kenya and Ghana). According to this Table, the proportions of the population aged 50+ and 60+ will increase globally and more importantly in developing countries including South Africa by 2030. Further, according to the United Nations (United Nations, Department of Economic and Social Affairs 2009), the proportion of people above age 60 in South Africa will double from 7 per cent (2005) to 16 per cent (2050).

Table 2.1 Population totals and proportions of older people –Globally, sub Saharan Africa and selected countries, 2009 to 2030

	2009			2030		
	Total N ¥	**50+, N (%)**	**60+, N (%)**	**Total, N**	**50+, N (%)**	**60+, N (%)**
World	6,829	1,379 (20.2)	737 (10.8)	8,309	2,283 (27.5)	1,370 (16.5)
Sub-S. Africa	843	110 (10.9)	54 (5.3)	1,308	157 (12.0)	78 (5.9)
South Africa	50	8 (15.0)	4 (7.1)	55	10 (19.1)	6 (11.1)
Tanzania	44	4 (9.5)	2 (4.8)	75	8 (10.6)	4 (5.3)
Kenya	40	3 (8.8)	2 (4.1)	63	7 (11.5)	3 (5.5)
Ghana	24	2 (11.2)	1 (5.7)	35	5 (15.3)	3 (7.7)

¥ - **N** in millions
Sources: UN (United Nations, Department of Economic and Social Affairs 2009)
World bank (World Bank 2009)

Adult mortality - ${}_{45}q_{15}$ (the probability of dying between age 15 and age 60) has also been falling in South Africa, as shown in Table 2.2 below, whilst life expectancy at birth has increased for both men and women between 2009 and 2012.

Table 2.2 Life expectancy at birth and 65, and adult mortality from 2009-2012 for men and women in South Africa

	2009	2010	2011	2012
Life expectancy at birth – Male†	57.1	58.5	60.5	61.3
Life expectancy at birth – Male†	54.6	56.0	57.7	58.5
Life expectancy at 65 - Male¶	11.9	12.0	12.0	12.0
Life expectancy at 65 - Male¶	15.8	15.8	15.8	15.9
Adult mortality (${}_{45}q_{15}$) Male†	51%	48%	46%	44%
Adult mortality (${}_{45}q_{15}$) Female†	40%	38%	35%	23%

†source (Dorrington & Bradshaw 2014)

¶source (Actuarial Society of South Africa (ASSA) 2011)

Figure 2.1 shows the projections of the proportion of population aged 50+ and 65+ from 2000 to 2025. The upward trajectory of the graphs indicates that the proportion of the female population 65+ would double in three decades i.e. from about 15 per cent in 2000 to approximately 10 per cent in 2030. The proportions of those aged 50+ will also rise significantly by the year 2025.

Life expectancy beyond age 65 has also been increasing since 2000 (Actuarial Society of South Africa (ASSA) 2011). According to Figure 2.2, females would have gained an additional year of survival beyond age 65 by the year 2025. The gains in men are projected to be marginal and fairly constant. In summary, both Figure 2.1 and Figure 2.2 show us that the proportion of older people is going to be increasing over time, and older people are also living longer.

Population aging is occurring very rapidly across the globe, more so in less developed than developed countries. In the former, aging is a subject of growing concern for public health and policy especially because they may not have the policies and sufficient infrastructure in place to deal with the growing needs of their aging population. Population aging comes along with both opportunities and challenges, depending on how the process is addressed. One of the dynamics – the epidemiological transition is discussed in the next section.

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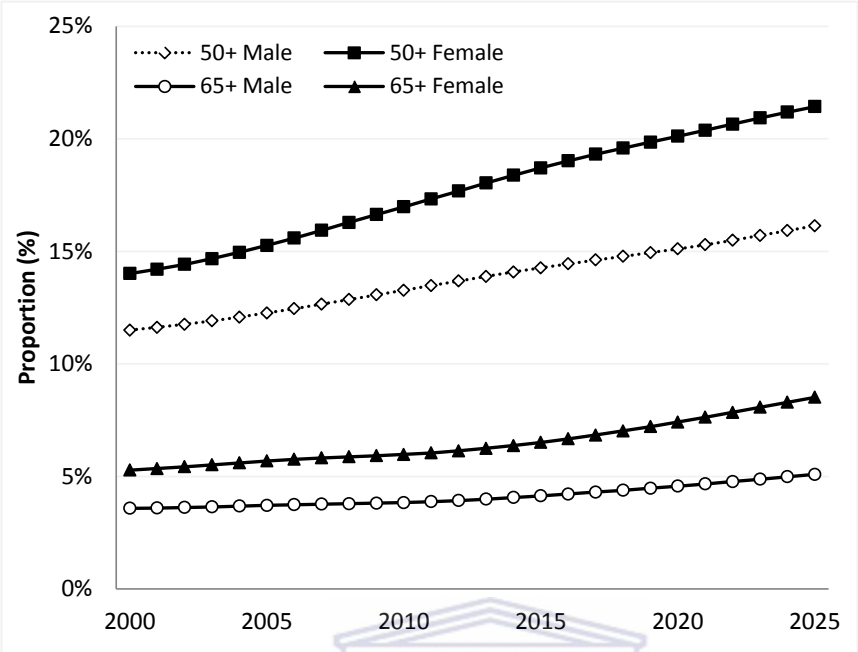
Figure 2.1 Proportion of population aged 50+ and 65+ by gender, 2000-2025



Source ASSA2008 (Actuarial Society of South Africa (ASSA) 2011) own calculation

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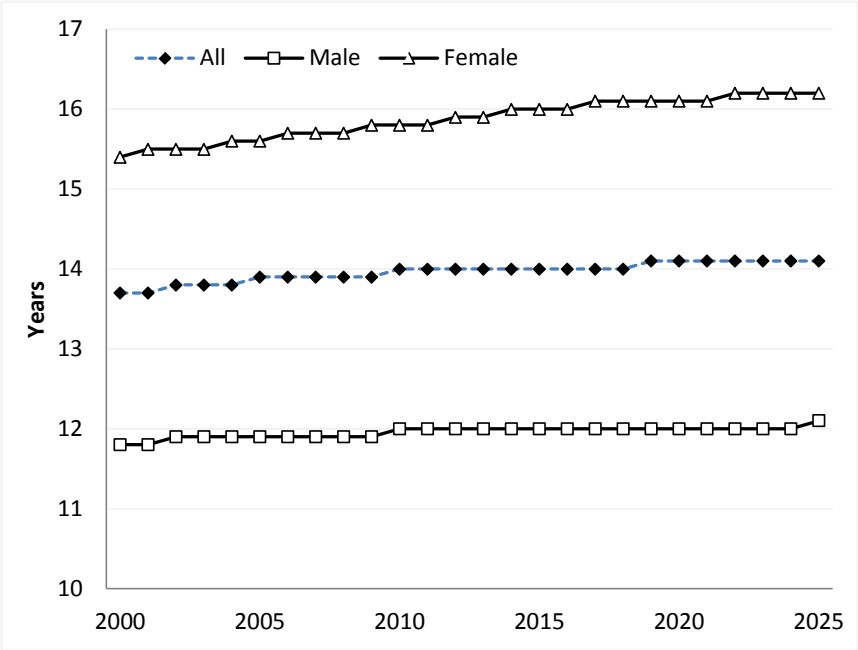
Figure 2.2 Life expectancy at age 65 for males, females and total population, 2000-2025



Source ASSA2008 (Actuarial Society of South Africa (ASSA) 2011) own calculation

2.2.1 Epidemiological transition

As populations grow older, the burden of illness shifts from communicable diseases (CDs) towards chronic, non-communicable disease (NCDs) and injuries (Omran 2005). This is referred to as the epidemiologic transition. Most European and North American countries have followed this epidemiological transition. However, most developing countries, especially those in Africa, have been trapped in the transition, and are now hard hit by the advent of the HIV/AIDS. Recent estimates for South Africa predict that HIV prevalence in older adults aged 50 and above will almost double in the next three decades from 9% in 2010 to 17% in 2040 (Hontelez, Lurie *et al.* 2011), while the proportion of people living with HIV in the same age group will triple over the same period (Hontelez, Lurie *et al.* 2011). According to this prediction there will be an increase in HIV infected older men from 1 in 12 in 2010 to 1 in 4 in 2040 (Hontelez, Lurie *et al.* 2011). As a result, there is still an unfinished agenda of communicable diseases in many African countries (Heuveline, Guillot *et al.* 2002), and therefore, developing countries are not likely to follow the path taken by developed countries in the epidemiological transition (McKeown 2009). South Africa has been said to be encountering a quadruple burden of disease, including chronic diseases, injuries and HIV and AIDS (Bradshaw, Groenewald *et al.* 2003; Mayosi, Flisher *et al.* 2009).

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While chronic diseases are still responsible for the largest burden of disease in most developing (low income) chronic NCDs are becoming a significant burden in middle income developing countries including South Africa (Boutayeb & Boutayeb 2005; Mayosi, Flisher *et al.* 2009; UNPD 2011). Chronic NCDs progressed from 18.7% in 1990 to 25% in 2000 and this is projected to further increase to 36.6% in 2020 (Unwin & Alberti 2006). This situation has been described as 'a race against time' (Meyrowitsch & Bygbjerg 2007). The major categories of groups of chronic NCDs in Sub-Saharan Africa are diabetes mellitus (DM), cardiovascular diseases (CVD), cancers, and chronic pulmonary disease (CPD) which together account for around 50% of global mortality (Dalal, Beunza *et al* 2011). The increasing prevalence of NCDs in developing countries is attributed to rapid urbanization, globalization and industrialization, population ageing which result in marked changes in patterns of consumption of food and alcohol, increased tobacco use and sedentary lifestyles, high levels of stress and low levels of physical activity (Steyn & Damasceno 2006).

2.2.2 Who is old?

The definition of 'old' or 'elderly' varies from one place to another, and across cultures and time (Kinsella & Phillips 2005). The Minimum Data Set (MDS) project on Ageing (funded by WHO and National Institute on Ageing) has set age 50 or older as the cut-off for defining older people (World Health Organization & U.S. National Institute on Ageing 2001; World Health Organization 2014a). Similarly, the WHO-Study on Global Ageing and Adult Health (SAGE) (Kowal, Kahn *et al.* 2010; He, Muenchrath *et al.* 2012) uses the same definition. On the other hand, the South African Policy on Aging defines old people as 65 (Republic of South Africa 2006). Nonetheless, for the purposes of this study, age 50 and above is used to refer to older people. The reason for this is that, SAGE data is mainly used in the analysis, and hence, for consistence, the same definition is used. Further, existing evidence shows that the proportion of the population aged 50 years and above is expected to increase from 21 to 30 per cent in 2050 (United Nations, Department of Economic and Social Affairs 2009; Ameh, Gómez-Olivé *et al.* 2014).

2.3 Health of older people

Historically, mortality has been used to monitor population health (Molla, Madans *et al.* 2003; Jagger & Robine 2011). In particular, life expectancy has been commonly used because it summarizes mortality across the entire age range. Along this line, the fall in mortality over the past decades was presumed to signify improvements in health. This presumption was reasonable during the period of pandemics of acute communicable diseases. However, with the current epidemiological transition, the burden of diseases has shifted from acute to chronic diseases (Omran 2005; McKeown 2009). People now live longer with non-fatal chronic conditions which include cardiovascular diseases, musculoskeletal diseases, diabetes and dementia, among others.

Hence, mortality measures no-longer correlate well with diseases burden (Jagger & Robine 2011). This has subsequently necessitated new population health measures that combine both mortality and morbidity data into a single index. Health expectancies are such measures. Health expectancies are appropriate summary measures of population particularly at the older ages. They address the concern that,

at the old ages, mortality decline and increasing longevity may not be equivalent to extension of healthy of life. Health expectancies therefore, address the need to capture not only the quantity or length of life, but also the quality of life lived. The following section introduces the concept of health expectancies and various methods used.

2.4 Health expectancies

Life expectancy (LE) is the average number of years remaining at a given age, taking into account prevailing mortality. Health expectancy (HE) partitions life expectancy into years lived in different health states. By definition – health expectancy is the average number of years a person can is expected to live in various health states. Health expectancy is therefore a natural extension of life expectancy. As such it has the same statistical attributes as life expectancy, which is that; it summarizes mortality across the entire age range, and is not affected by age structure, since age standardization is embedded (Jagger & Robine 2011). This makes it possible to make comparisons between two populations different population subgroups at a single time point, or the same groups at different time points (Jagger & Robine 2011).

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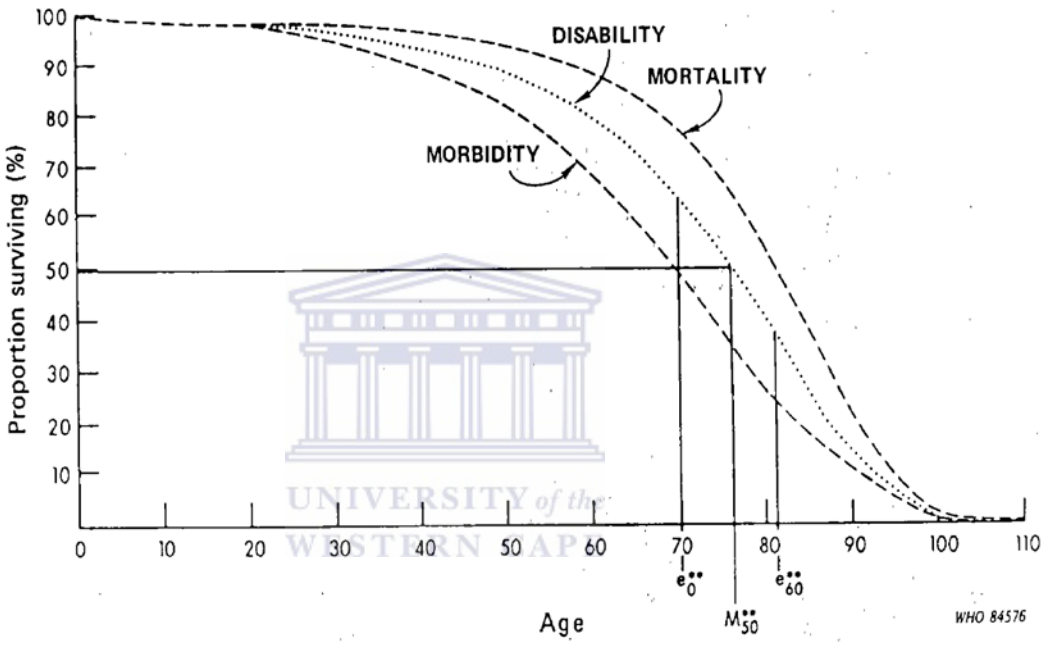
Health expectancies were first developed to address the fundamental question paused in Chapter 1 – of whether increase in life expectancy are being accompanied by increase in lifetime in better or poorer health. The idea of health expectancy was initially introduced by Sanders in 1964 (Sanders 1964), and 5 years latter Sullivan (Sullivan 1971) applied the idea to data from the USA. Since then, several countries across Europe and the USA have been using this index to assess the evolution of population health with specific focus on older people. Health expectancy is a powerful tool for monitoring population health, and identifying the interaction between morbidity and mortality (Jagger & Robine 2011).

2.4.1 Relationship between mortality and morbidity

As mentioned above, health expectancies were developed to address the relationship between mortality and morbidity. Figure 2.3 illustrates this relationship (World Health Organization 1984). Specifically, it illustrates the relationship between mortality, morbidity and the health outcomes of increased longevity (World Health Organization 1984). A distinction is made between; total survival, disability free

survival and chronic disease free survival. The following can be calculated as follows; life expectancy (LE) – area under mortality curve; disability free LE (DFLE) – area under morbidity curve. Therefore: - LE with disability (DLE) = LE – DFLE (area between mortality and disability curves). LE – disease free LE=LE with at least one disease (but with no disability). At the end, the sum of all life expectancies in different health states adds up to LE (World Health Organization 1984).

Figure 2.3 Relationship between mortality and morbidity



e_0^{**} and e_{60}^{**} are the number of years of autonomous life expected at birth and at age 60, respectively.
M_{50}^{**} is the age to which 50% of females could expect to survive without loss of autonomy.

Source (World Health Organization 1984)

2.4.2 Scenarios for future course of morbidity and mortality

The relationship between mortality and morbidity has gained huge interest over the past decades, and debates have focused on the future course scenarios of these interactions. This led to three hypotheses being put forward. The first hypothesis was suggested by Fries (Fries 1980), and it says that additional years gained at the old ages were healthy years, as a result of 'compression' of duration with chronic conditions to the last few years of life. This is referred to as 'compression of morbidity' (Fries 1980). The other hypothesis is more pessimistic and is referred to as the 'expansion of morbidity' (Gruenberg 1977; Olshansky, Rudberg *et al.* 1991). According to this

hypothesis, gains in life expectancy are achieved by prolonged periods living with disease and disability. This is characterised by a decrease in the proportion of health expectancy to life expectancy (Gruenberg 1977; Olshansky *et al.* 1991). The third hypothesis is referred to as 'dynamic equilibrium' (Manton 1982). According to this hypothesis, the decrease in disease progression will result in a simultaneous increase in life expectancy and years in poor health. In this scenario, the poor health is mainly characterised by less severe disabilities (Manton 1982).

The time trend in the proportion of total life lived in 'good health' – i.e. - ratio of health expectancy (HE)/life expectancy (LE) is often taken as a measure of compression or expansion of morbidity (Saito, Robine *et al.* 2014). Hence, although health expectancy is a sufficient measure in itself, it is important to also report proportions of health expectancy. Further, total life expectancy and healthy expectancy can actually increase whilst proportions of heath expectancy is decreasing (Saito, Robine *et al.* 2014).

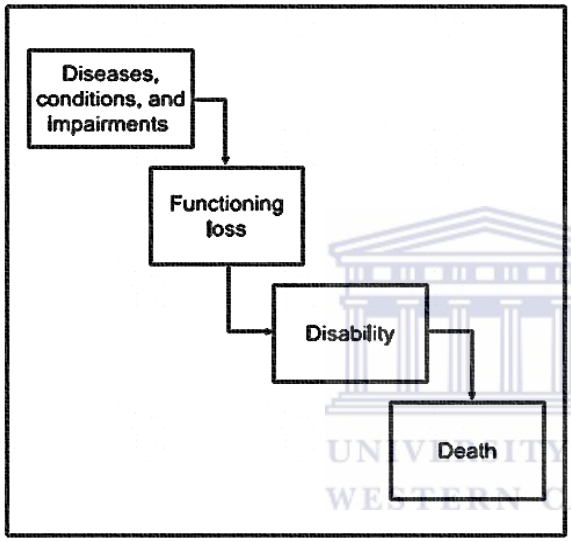
2.4.3 Definition of 'health'

Since health expectancies combine mortality and health measure, several health expectancies can be derived depending on the definition of 'healthy' used. Therefore, a key consideration in health expectancy research is the definition of 'health'. The concept of health is complex and multifaceted, and has many operational definitions (Molla, Madans *et al.* 2003). This is in contrast to life expectancy which is simply measured by deaths. The complexity of the concept of health is evident in how it is defined by the WHO (World Health Organization 1946) :- "*a state of complete physical, mental and social well-being, and not merely the absence of disease or infirmity*". From this definition, health is a multidimensional phenomenon which therefore, requires several indicators to give a comprehensive analysis. This is the conceptual basis for the analytical framework applied in this thesis.

Health status measures range from objective measures of; physiologic, functional status (e.g. eating, bathing, walking, and climbing) and disease, to subjective measures of; self-rated health and quality of life. They also include single question (e.g. self-rated health), global evaluation of overall health status to assessments across multiple health domains, including functional status, physical and mental health (Fryback *et al.* 2007). Figure 2.4 illustrates the process of health change in a simplified model

(Verbrugge & Jette 1994). According to this model, diseases (chronic conditions) precede functional loss or ability to perform some actions (e.g. sitting, climbing or walking). This can result in disability which is defined as the inability to perform social roles (Molla, Madans *et al.* 2003). Disability is usually defined differently by age. For middle aged persons – disability refers to inability to work, whilst for older persons – it refers to self-care or independent living (Molla, Madans *et al.* 2003). The process eventually ends with death.

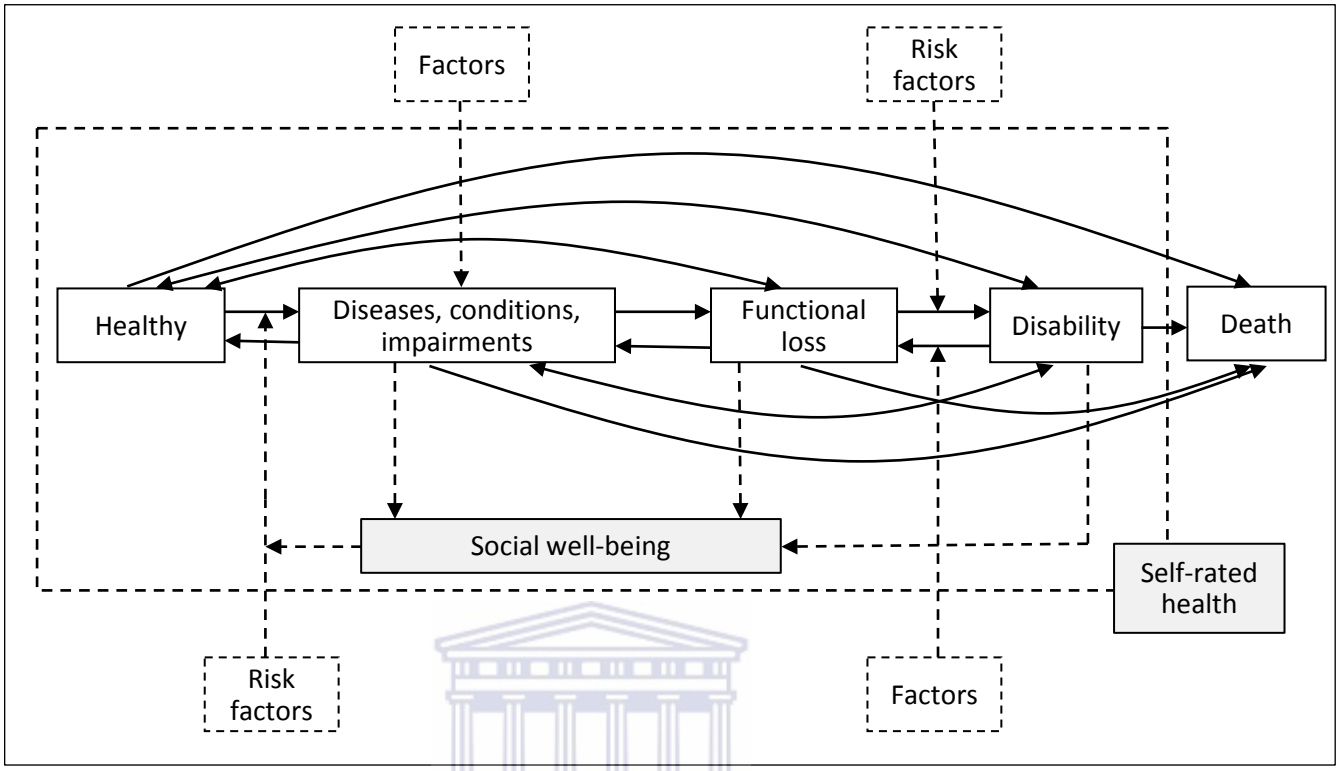
Figure 2.4 Population health change



Source:(Verbrugge & Jette 1994)

A more complex conceptual model of health transitions is illustrated in Figure 2.5 below. This model is based on the definition of health by the WHO (World Health Organization 1946). The model shows how 'disease', 'functional loss' and 'disability' interact with 'social wellbeing' and self-rated health. From this model, health expectancies can be derived based on; 'self-rated health', 'disease', 'functional loss', 'disability' or 'social wellbeing' (Saito, Robine et al. 2014).

Figure 2.5 Model of Health States and Transitions according to the Disablement Process



Source: (Saito, Robine *et al.* 2014)

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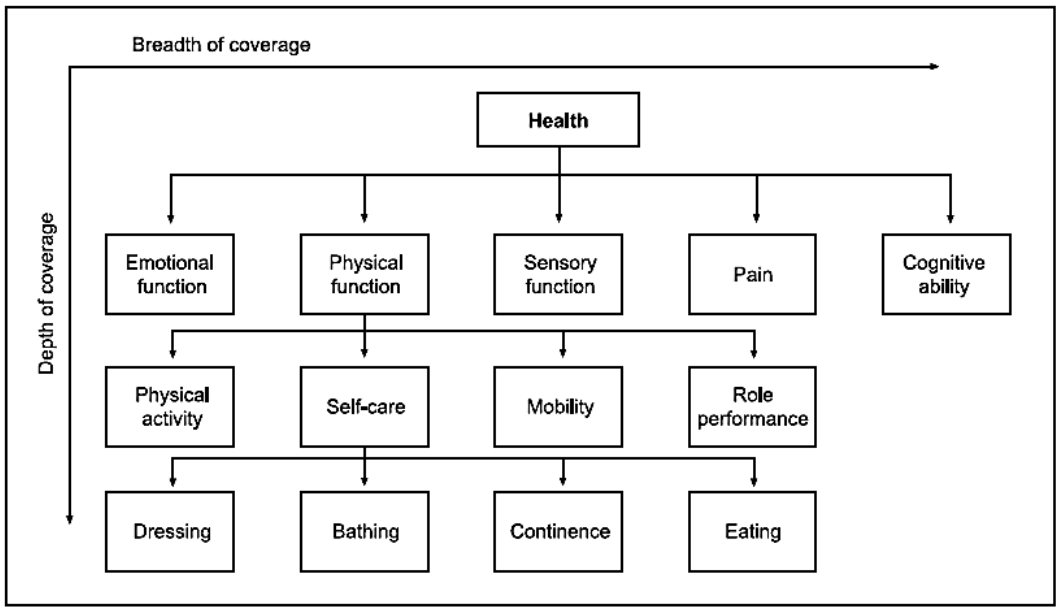
Boyle & Torrance (1984) developed a 'health state classification system' which illustrates the range of items that can be used to characterize health. This was adapted by Molla *et al.* (2003), and is illustrated in Figure 2.6 below. According to this classification system, the health attributes are considered as hierarchical with breadth and depth dimensions. For example, physical functioning is one of the primary attributes, and is shown to be having four secondary attributes namely; physical activity, self-care, mobility and role performance. Going one step further, at the third level of the hierarchy – self-care – can be sub-categorized further into specific health attributes namely; dressing, bathing, continence and eating.

Figure 2.6 Attributes for health classification system



Source: Molla *et al.* (2003)

The estimates of health expectancy vary with the health measure used, and different measures show different trends and patterns in health (Saito *et al.* 2014; Jagger & Robine 2011; Molla *et al* 2003; Christensen, Doblhammer *et al.* 2009). It is important, therefore, for researchers to clearly state and articulate the definition of health used.

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The following section gives an overview of some of the measures commonly used, and also presents the ones used in this study. Further descriptions are given in the respective results chapters.

2.4.3.1 Self-rated health

Self-rated health (also called self-assessed or self-perceived health) is a widespread measure used in health expectancy research. It is considered a summary measure related to all health domains (Crimmins 2004). Self-rated health has been shown to be a good predictor of several health outcomes e.g. falls, healthcare utilization and mortality (Frankenberg & Jones 2004; Idler & Angel 1990; Idler & Benyamini 1997). The term healthy life expectancy is usually used to refer to health expectancies derived based on self-rated health domain. However, the term self-rated health life expectancy (SRHLE) is also used in some places (Karcharnubarn *et al.* 2013). Self-rated health is a subjective measure, which is contrasted from other measures such as

disease and disability, which are more objective. As such, self-rated health is prone to variations, and comparisons between heterogeneous populations should be done with caution (Brønnum-Hansen 2005a). A theoretical framework for self-rated health is shown in Figure 2.7. Several studies have used this measure in calculating health expectancies, after the recommendations of the WHO for harmonization of measures (Jagger & Robine 2011).

2.4.3.2 Disease

The WHO Global Burden of Disease (GBD) works on developing estimates of "disability-adjusted life years" (DALY). This approach measures health status in terms of disease prevalence, adjusted by specific disability weights in a population (Murray & Lopez 1996) Based on the DALY approach, WHO computed health expectancy called "disability-adjusted life expectancy" in 2000 and 2001 (Saito *et al* 2014). The WHO uses weights based on the expected disabling burden of various conditions in the estimation of DALYs. A limited number of studies have calculated "disease-free" life expectancies. A few examples include dementia-free life expectancy (Perenboom *et al.* 1996), life expectancy without diabetes (Laditka & Laditka 2006) and life expectancy without depression (Peres *et al* 2008).

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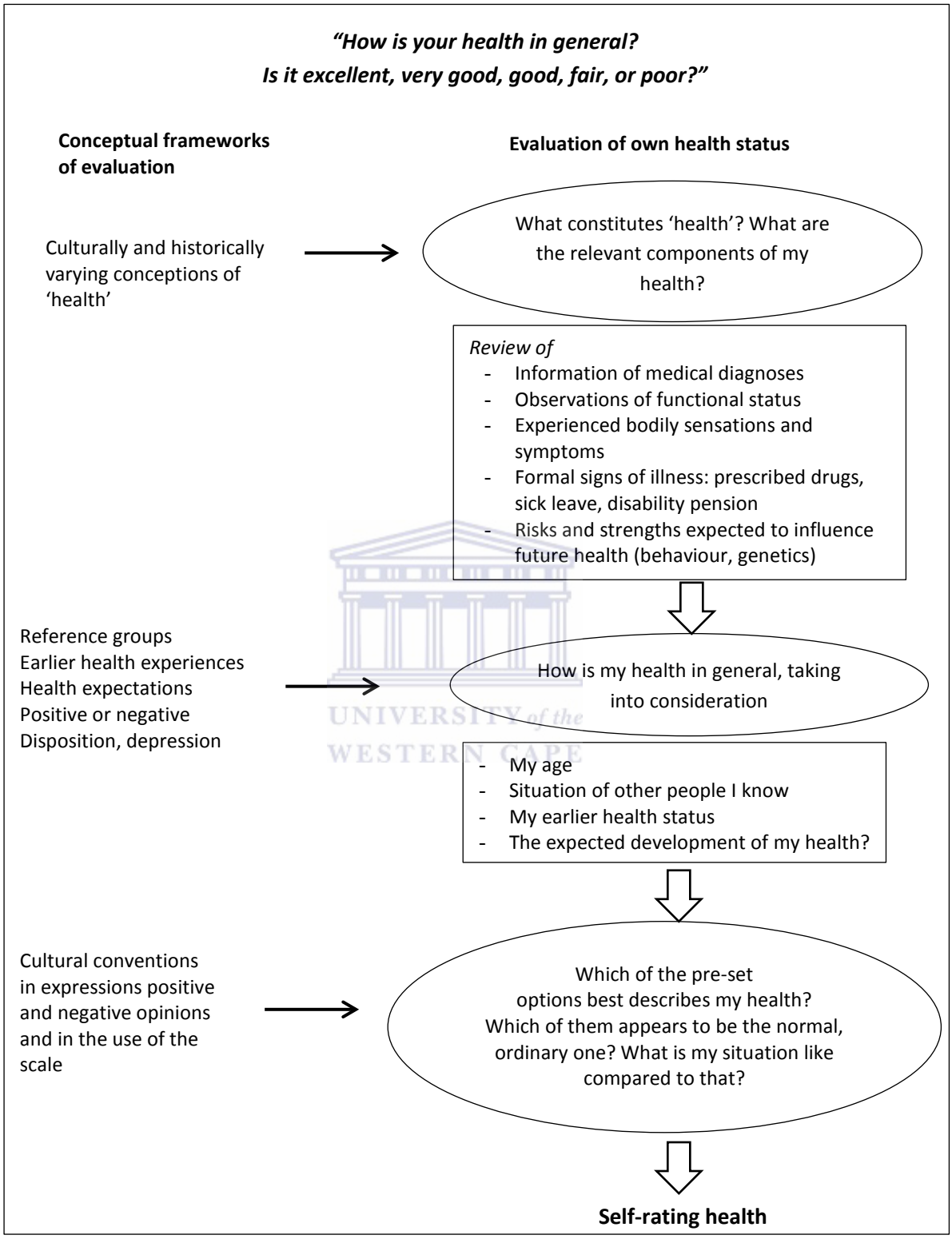
Figure 2.7 Theoretical framework for self-rated health



Source: Jylhä 2009

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2.4.3.3 Functional limitations

A more objective measure of disability is independence in respect of activities of daily living (ADLs). The list of ADLs usually includes eating, bathing, dressing and walking. In most of the research on health expectancy, dependency in at least one ADL is used to define poor health (Klijs *et al.* 2011). However, research specific on long-term care costs puts the cut-off at least two ADLs – to define poor health (Macdonald *et al* 2006). Further, in some cases e.g. long-term care insurance policies – a threshold of three ADLs is used as a criterion for claiming full amounts of funds assured (Macdonald *et al* 2006).

The ILE can further be sub-categorized on thresholds of functional limitations (Ministry of Health and Statistics New Zealand 2009). Figure 2.8 is an illustration of how this can be done. In this case, the thresholds of functional limitations were defined as; dependent – need for assistance with daily activities (either from someone else or a complex assistive device). This can either be intermittently or on a daily basis, and three support need levels can be classified as follows:

Level		**Assistance required?**	**Frequency**
1	Low	No	---
2	Moderate	Yes	Intermittently
3	High	Yes	Continuously

From this framework, three health state expectancies can be derived, namely: limitation free life expectancy (LFLE), independent life expectancy (ILE) and active life expectancy (ALE), as shown in Figure 2.8 below. These different health states life expectancies are a decomposition of the total life expectancy (TLE), and therefore the sum of lifetime spent in the various health states will add up to TLE (Ministry of Health and Statistics New Zealand 2009).

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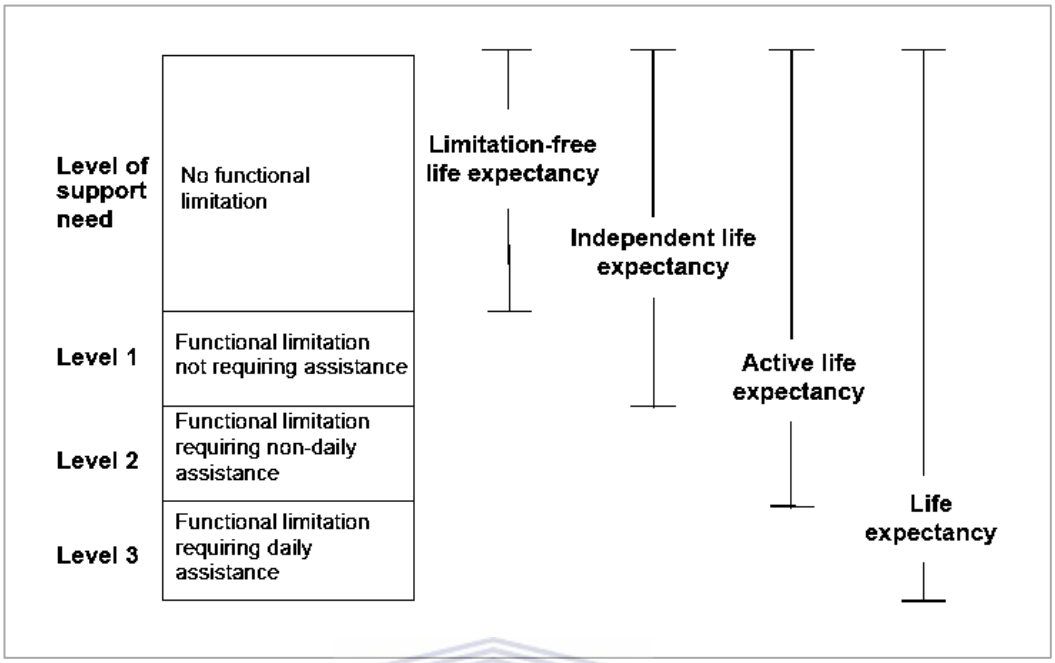
Figure 2.8 A model of health expectancies based on different health states



Source: (Ministry of Health and Statistics New Zealand 2009)

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2.5 Methods of calculating health expectancies

Murray and colleagues (Murray *et al.* 2000), came up with different ways of classifying health expectancies. One way is to classify by period or cohort measures. The period method is the most common, and it calculates healthy expectancies for a hypothetical birth cohort assuming it will be exposed to the prevailing observed event rates. The cohort method is less common because it is rare to find long time series of population health data.

Health expectancies can also be distinguished depending on whether prevalence or incidence data is used for the non-fatal health outcomes. In most cases the choice of method for calculating health expectancies is largely determined by the types of data available. When data available are from a cross-sectional survey – the prevalence based method also called Sullivan method is used. When longitudinal or panel data are available – the incidence based life tables or multistate method is used.

Another key distinguishing feature is the definition of health state used. Various definitions of health exist as discussed in the preceding sections. These range from

single dimensions of health e.g. disability, diseases and handicap; multidimensional health state measures e.g. quality of life, health utility index, to global measures such as self-rated health (Mathers 2002).

Health expectancies can further be classified by the health state valuations or weights used. Dichotomous weights are frequently used e.g. in the case of Disability Free Life Expectancy (DFLE) – where a weight of 1 is given to no disability and 0 to any level of disability. Polychotomous weights – also called continuous weights are used in the case of health-adjusted life expectancy (HALE).

Three methods namely; Sullivan, multistate and double decrement life table method are discussed in the section below.

2.5.1 Sullivan Method

As mention above, this method uses prevalence data to calculate healthy life expectancies. The morbidity information is the age-specific prevalence of healthy or unhealthy states, which is usually obtained from surveys and censuses. The mortality data is obtained from life tables. The age-specific prevalence rates are used to divide the person-years lived in the life table into healthy and unhealthy years. The Sullivan method can be used to compare the same population at two different time points, or two different populations at a single time point, regardless of any differences in age structure (European health expectancy monitoring unit 2007).

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In order to calculate healthy life expectancy, the number of people of each age interval (x, $x+n$) is partitioned into the proportion of those experiencing poor health $({}_n\pi_x)$ and those in good health $(1-{}_n\pi_x)$. The partitioning can either be dichotomous i.e. good or poor health, or polychotomous whereby varying degrees of health or severity are used. Since ${}_nL_x$ is the number of person years lived in the interval (x, $x+n$), the proportion of these years lived in healthy state $({}_n\tilde{L}_x)$ is;

$${}_n\tilde{L}_x = (1-{}_n\pi_x)\,{}_nL_x$$

Healthy life expectancy is then computed by the equation below;

$$HLE_x = \frac{1}{l_x}\sum_{i=1}^{\omega}(1-{}_n\pi_x).{}_nL_i$$

Where;

HLE_x	is healthy life expectancy at age
l_x	is the number of survivors at age x
$(1-{}_n\pi_x)$	is age-specific rate of being in good health
ω	is the oldest age group
${}_nL_x$	is the number of person years lived in interval (x, $x+n$)

The expected number of unhealthy life is obtained by: $LE_x - HLE_x$.

Since the age-specific prevalence of health states are obtained from surveys, they are subject to sampling variation. The variance S^2 is obtained as follows;

$$S^2(HE_x) \approx \frac{1}{l_x^{\,2}} \sum_{x=0}^{\omega} L_x^{\,2} S^2(1-\pi_x) \approx \frac{1}{l_x^{\,2}} \sum_{x=0}^{\omega} L_x^{\,2} \frac{\pi_x(1-\pi_x)}{N_x}$$

The Sullivan method remains the most widely used and popular method mainly because the data required are in most cases easily accessible, i.e. age-specific prevalence rates of ill health from a cross-sectional survey. The other advantages of this method are that; it is the preferred method when analysing trends over time – and examining if there has been expansion or compression of morbidity (Jagger & Robine 2011). The estimates from this method have been found to be consistent and unbiased under stationary assumptions (Jagger & Robine 2011; Mathers & Robine 1997; Imai & Soneji 2007). The drawback of using the Sullivan method is that it requires life tables matching with sub populations of interest. For example – if the subgroups are province, education, income or race – then the life tables should be disaggregated by these variables. In most cases though, published life tables are usually disaggregated by sex only.

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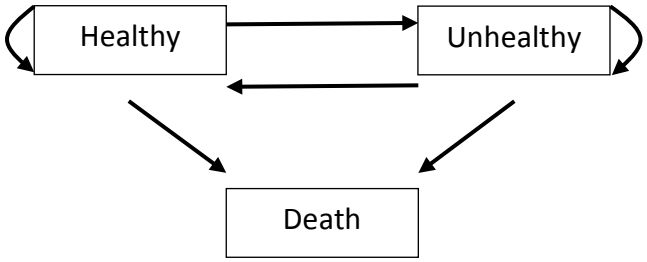
2.5.2 Multi-state life tables

Unlike the Sullivan method, this method applies incidence, recovery and mortality rates to a given population to derive health expectancies. This method was proposed by Rogers and colleagues (Rogers *et al.* 1989). This method analyses the transitions from one single state to another state and allows reversible transitions between two or more non-absorbing 'alive' states. The 'absorbing' state is death and hence not reversible. For example one can move from 'healthy' to 'unhealthy' in both directions, and finally 'death'. These transitions are illustrated in the Figure 2.9 below;

Figure 2.9 Illustration of possible transitions between health states



Source: Saito *et al* (2014)

Table 2.4 illustrates the possible transitions between three states i.e. 'not disabled' to 'disabled' or 'death', in life table notation. The function i_x is the transition probability that an individual not disabled at age x will become disabled at age x+5. This is related to the incidence rate of disability for the age interval (x, x +5) (Mathers 2002). On the other hand r_x is the transition probability of an individual not disabled at age x becoming 'not disabled' at age x+5. This also, as with the incidence rate of disability, is related to the recovery rate from disability for the age interval (x, x +5) (Mathers 2002). From here, the survivorship functions l_x can be calculated based on the assumptions made with regards to the initial population distributions in the two health states (Mathers 2002).

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Table 2.3 Transitions in a two-state multistate life table

Age	1 Not disabled	2 Disabled	3 Dead
x	l_{x1}	l_{x2}	
	i_x	r_x	q_{x2} q_{x1}
x+5	$l_{x+5,1}$	$l_{x+5,2}$	

Source: Mathers (2002)

2.5.3 Multiple decrement methods

The multiple decrement (also called double decrement (Mathers 2002)) life tables are different from the preceding method in that they include transitions from health to poor health and death, but do not take into account recovery of health (i.e. return to initial state of good health). They are based on the incidence of disability or death during the period of investigation (Katz, Branch *et al* 1983). The type health state used with this method must be either irreversible or have negligible recovery and remission rates (Mathers 2002; Jagger & Robine 2011).

2.6 Temporal comparisons of health expectancies

A number of studies have computed health expectancies with the intention of identifying inequalities between sub populations (Jagger & Robine 2011). However, the ideal way to obtain definitive answers on whether gains in additional years lived are years of healthy life i.e. compression of morbidity – is to analyse time trends within countries. Table 2.4 shows the list of countries that have studies done reporting chronological series of health expectancies. This list has been extended from the one compiled by Jagger & Robine (2011). In total, there are 18 countries, and the majority of the studies have been conducted in Europe and the USA. Few have been done in Asia and recently the Middle-East. Africa is conspicuously missing from the list. Virtually, there are no studies done in Africa reporting trends in health expectancies. This highlights the gap in knowledge and further provides a motivation and justification for this present study.

A second observation is that almost all the studies have used the prevalence-based Sullivan method in their analysis. This further demonstrates scarcity of longitudinal data from which to obtain chronological series of health expectancies (Jagger & Robine 2011). In terms of health domains; the majority of the studies are based on self-rated health, few on activity limitations, and even fewer on chronic diseases. Very few to none are based on other measures such as social wellbeing, happiness and sexual health. This present study is therefore critical in that it brings new knowledge on the evolution of these neglected health domains – i.e. sexual health, happiness and quality of life.

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Table 2.4 Temporal comparisons of Health Expectancies within countries/Trends in health life expectancies

Authors & reference	Year	Country	Period	Domain	Method
Doblhammer & Kytir 2001	2001	Austria	1978-1998	Self-Rated Health	Sullivan
Van Oyen, Cox *et al.* 2008	2008	Belgium	1997-2004	Self-Rated Health Long-Standing Illness Activity limitation	Sullivan
Liu *et al.* 2009	2009	China	1987-2006	Impairment	Sullivan
Lai 2009	2009	China	1987-2006	Impairment	Sullivan
Hrkal 2004	2004	Czech Republic	1993-2202	Self-Rated Health	Sullivan
Brønnum-Hansen 2005b	2005	Denmark	1987-2000	Self-Rated Health Long-Standing Illness Functional Limitation	Sullivan

Jeune & Brønnum-Hansen 2008	2008	Denmark	1987-2005	Self-Rated Health Long-Standing Illness Functional Limitation	Sullivan
Cambois *et al.* 2006	2006	France	1980-2003	Activity limitation	Sullivan
Cambois *et al.* 2008	2008	France	1980-2003	Activity limitation	Sullivan
Kroll, Lampert *et al.* 2008	2008	Germany	1984-1998	Self-Rated Health Activity limitation	Sullivan
Burgio *et al.* 2009	2009	Italy	1991-200	Self-Rated Health Activity limitation	Sullivan
Egidi, Salvini *et al.* 2009	2009	Italy	1994-2005	Self-Rated Health Activity limitation	Sullivan
Yong & Saito 2009	2009	Japan	1986-2004	Self-Rated Health	Sullivan
Kalediene & Petrauskiene 2004	2004	Lithuania	1997-224	Self-Rated Health	Sullivan
Bruggink, Lodder *et al.* 2009	2009	Netherlands	1981-2007	Self-Rated Health Long-Standing Illness Functional Limitation	Sullivan
Perenboom *et al.* 2004	2004	Netherlands	1989-2000	Long-Standing Illness Activity limitation Wellbeing	Sullivan
Perenboom *et al.* 2005	2005	Netherlands	1989-2000	Long-Standing Illness Activity limitation Wellbeing	Sullivan
Sagardui-Villamor *et al.* 2005	2005	Spain	1986-1999	Activity limitation	Sullivan
Gomez Redondo *et al.* 2006	2006	Spain	1987-2003	Self-Rated Health	Sullivan
Guilley 2005	2005	Switzerland	1992-2002	Self-Rated Health	Sullivan
Jitapunkul, Chayovan 2000	2000	Thailand	1986-1995	Activity limitation	Sullivan
Crimmins & Saito 2001	2001	USA	1970-1990	Activity limitation	Sullivan
Manton *et al.* 2006	2006	USA	1982-1999	Activity limitation	Sullivan
Cai & Lubitz 2007	2007	USA	1992-2003	Activity limitation	Multistate
Manton 2008	2008	USA	1982-1999	Activity limitation	Sullivan
Manton *et al.* 2008	2008	USA	1982-2004	Activity limitation	Sullivan
Yang 2008	2008	USA	1970-2000	Happiness	Sullivan
Crimmins *et al.* 2009	2009	USA	1984-2000	Activity limitation	Multistate
Kelly, Baker 2000	2000	UK	1980-1996	Self-Rated Health Long-Standing Illness	Sullivan
Office for National Statistics 2006	2006	UK	1981-2002	Self-Rated Health Long-Standing Illness & Disability	Sullivan
Smith *et al.* 2008	2008	UK	2004-2006	Self-Rated Health Long-Standing Illness & Disability	Sullivan
Office for National Statistics 2008	2008	UK	2000-2006	Self-Rated Health Long-Standing Illness & Disability	Sullivan
Karcharnubarn *et al.* 2013	2013	Thailand	2002-2007	Self-rated health Mobility Self-care	Sullivan
Qlalweh *et al.* 2012	2014	Palestine	2006-2010	Chronic disease	Sullivan

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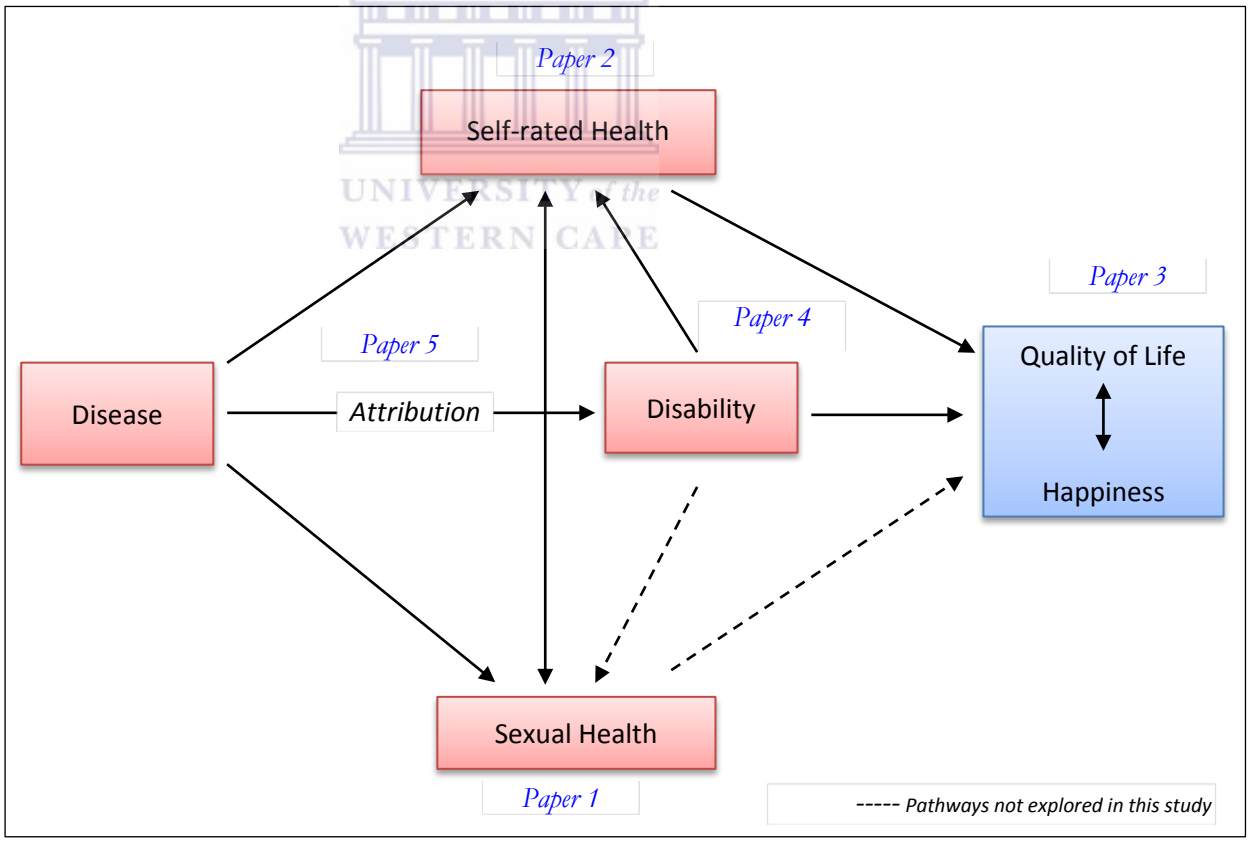
2.7 The current PhD research work

As mentioned in Chapter 1, the overarching aim for this thesis is to compute health expectancies for South Africa, and by so doing, characterizing older people by health status. In this section, the conceptual framework for the study is presented and also the methods applied in the analysis.

2.7.1 Conceptual framework

This project is based on the conceptual framework illustrated below Figure 2.10. This framework is based on the WHO definition of health (World Health Organization 1946). This framework is novel and comprehensive in that it includes social wellbeing and sexual health which are usually left in the operationalization of the defining health. The constructs or health domains are further described in the results chapters and the preceding section.

Figure 2.10 Conceptual framework for scope of the PhD project



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2.7.2 Study methods

The purpose of this section is to give an overview of the methods used in this study, without necessarily repeating the descriptions given further in the results chapters. Each chapter provides a detailed description and discussion of the methods applied in addressing the respective objective(s). Table 2.5 gives a summary of the health measures, analytical methods and data sources used in this thesis.

2.7.2.1 Data sources

Two datasets were used in the study, namely; the WHO-Study on Global Ageing and Adult Health (SAGE) and the South African National HIV Incidence, Prevalence, Behaviour and Communication Survey (SABSSM) surveys. The two are briefly described below.

WHO-SAGE data

SAGE is a longitudinal survey organized by World Health Organization and conducted in 6 countries, China, Ghana, India, Mexico, Russia and South Africa (World Health Organization 2014b). The countries selected are diverse geographically and demographically. And, generally, these countries are representative of low- to upper-middle income countries and are at different stages of demographic and epidemiological transitions (He, Muenchrath *et al* 2012). The South African data from wave 1 (baseline) conducted from 2007-2008 was used in this study. Therefore, in essence, this is cross-sectional data. SAGE aims to collect comprehensive and nationally representative information on the health and well-being of adult populations and the ageing process (World Health Organization 2014; He, Muenchrath *et al* 2012). The core SAGE collects data on adults aged 50 years and over and includes a smaller comparison sample of younger adults aged 18-49 years.

SABSSM data

SABSSM is a repeated cross sectional survey conducted in South Africa by the Human Sciences Research Council (HSRC) after every two to five years since 2002. Subsequent surveys were conducted in 2005, 2008, and 2013. This study used data from 2005 and 2012. The surveys are mainly used for surveillance of HIV incidence

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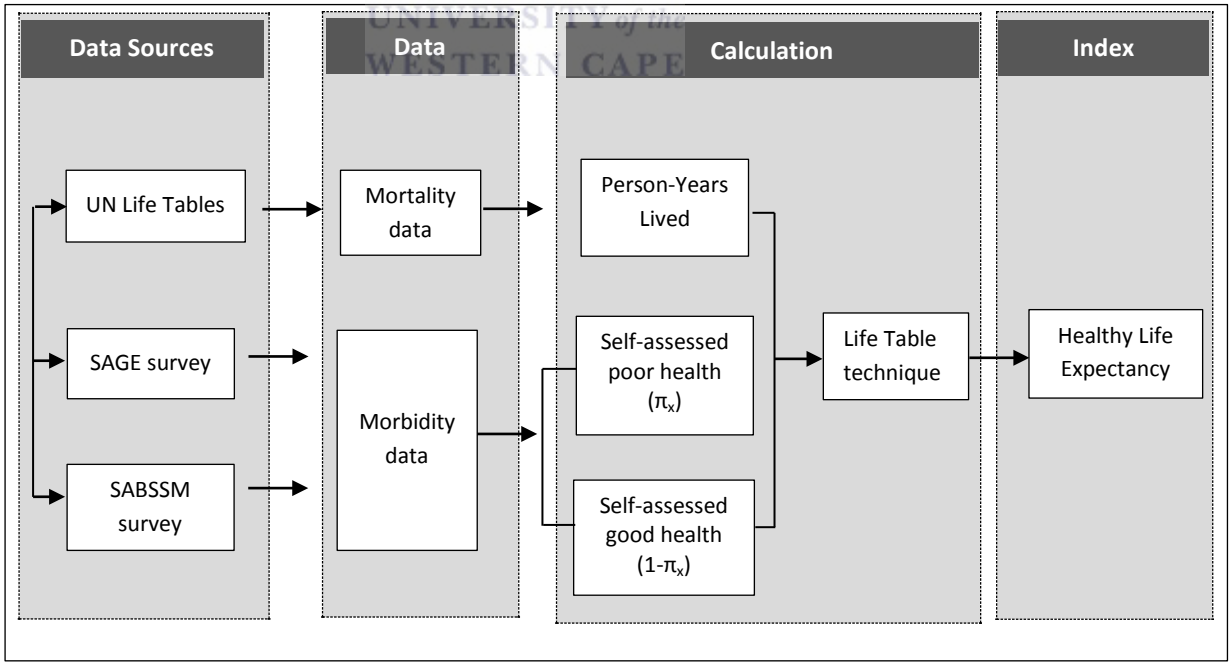
and prevalence in the population. Other data on socio-demographics and behavioural risk factors are also collected. Two main behavioural and health outcomes of interest to this present study were; sexual activity and self-rated health. The sample used in this study includes persons aged 50 years and older.

2.7.2.2 Analytical approach

Since data used in this study (i.e. SAGE and SABSSM) are all coming from cross-sectional surveys, the prevalence-based Sullivan method was used in the computation of health expectancies. Mortality data were obtained from the UN published period Life Tables (United Nations Population Division 2013). Figure 2.11 below gives a schematic illustration of how the computations were done, taking self-rated health as an example. The methods applied in addressing each objective are dealt with in more detail in each of the respective results chapters. In this study the health expectancies are estimated according to gender because several studies (Arber & Cooper 1999; Jagger *et al.* 2008) have found gender differentials in this regard.

Figure 2.11 Schematic framework for estimating health expectancies



Adapted from Molla *et al* (2003)

In all, there are five (5) manuscripts developed based on the different ways of looking at or defining health (see Table 2.5). In the first manuscripts, the outcome of

interest is sexual health. This is based on self-reported prevalence of sexual activity by the respondents. From this, sexually active life expectancies are derived. In the same manuscript, the association of self-rated health and disease, self-reported health and other covariates is investigated. The second manuscript estimates time trends in health expectancies based on self-rated health. The third manuscript estimates happy life expectancies (HapLE), and also investigates factors associated with happiness, which is a proxy measure of quality of life. The fifth manuscript goes a step further to single out the contribution of each disease to the disablement process.

Table 2.5 Summary of manuscripts, health outcomes, and methodological approaches used in the preparation of the PhD thesis

	Title	Health domain	Analytical Method	Data source
1	*Gender differences in Sexually Active Life Expectancy for Older Adults in South Africa*	Sexual health Sexual activity	- Sullivan method - Multiple logistic regression	SABSSM
2	*Compression of morbidity in older South Africans? Trends in Healthy Life Expectancy between 2005 and 2012*	Self-rated health	- Sullivan method	SABSSM
3	*Gender Differences in Happiness and Well-being among Older Adults in South Africa*	Happiness Quality of life	- Sullivan method - Multiple logistic regression	SAGE
4	*Estimation of Healthy Life Expectancies: a novel approach to studying population health in South Africa*	Self-rated health Quality of life Functionality	- Sullivan method - Multiple logistic regression	SAGE
5	*Contribution of specific chronic diseases to disability among Older Adults in South Africa*	Disability Diseases	- Attribution technique - Multivariate Additive regression	SAGE

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Chapter 3

Gender Differences in Sexually Active Life Expectancy for Older Adults in South Africa

3.1 Abstract

Introduction: Little is known about sexual activity in old age, particularly in Africa. The objectives of this paper is to estimate years of sexually active life for older men and women, and examine the association between sexual activity and self-rated health status

Methods: Data came from two large cross sectional HIV household surveys conducted in 2005 and 2012 in South Africa. The main outcomes were sexually active life expectancy and sexual activity. The factors of interest were self-rated health and gender. The Sullivan method was used to estimate sexually active life expectancy, whilst logistic regression was used to assess associations with sexual activity.

Results: Sexually active life expectancy was higher among men across all the age groups in both surveys. At age 50 years the values for men were double than of women – 2005 (12.6 vs. 5.9 years), 2012 (12.7 vs. 7.2 years). Wider gender gaps in trends were observed in proportions of remaining life spent sexually active. Self-rated health was significantly associated with sexual activity in men (AOR 1.56; 95% CI 1.11-2.19; $p<0.001$). HIV infection, moderate exercises were significantly associated with sexual activity among women, whilst presence of chronic conditions was associated with reduced sexual activity among men.

Conclusions: Older adults are sexually active, and this is associated with health especially in men. The wide gender differences should be looked into, as they might be reflective of other broader social disparities. HIV among women and chronic conditions among men are areas of intervention to improve sexual activity in old people

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3.2 Background

The sexuality of older people is generally neglected (Walker 1997). Little is known about the sexual activity of older people, especially in African context where social norms are conservative. Further, data on different sexuality measures including HIV prevalence, which are collected in major surveys such as the Demographic and Health Surveys (DHS) are typically collected only for individuals who are within the reproductive age group i.e. from 15 to 49 years (Negin & Cumming 2010). It is seemingly assumed that people cease to be sexually active or have sexual desires once they go beyond 50 or 60 years of age. However, evidence from five cohorts in South Africa, Uganda, and Zimbabwe revealed that most men and fewer women remained sexually active in their 50s and 60s (Todd, Cremin *et al* 2009). Elsewhere, data from the US national social life, health and aging project (NSHAP) also showed that many older men and women were still sexually active even in their 80s (Lindau, Schumm *et al* 2007).

Sexual activity in old age is affected by age-related physiological and psychosocial factors which might alter sexual function (Pfeiffer, Verwoerdt *et al* 1972). Some of these factors have their antecedents in younger and middle ages, where measures can be taken to prevent or delay onset of sexual dysfunction in the older ages. It is important therefore to study sexual health since it is an important component of overall health and quality of life (WHO 2006). As life expectancy increases and older populations grow in developing countries, projecting years of sexual activity is important in informing public health policy and programmes aimed at improving sexual health of older people. Studies have also shown that people are actually growing older with HIV as a result of successful rollout of treatment efforts (Negin, Bennett *et al* 2011). Whilst this is welcome news, the paucity of information on sexuality of the older people is worrisome in this context of aging with HIV. Intergenerational sex and age-disparate relationships can be cited as examples of behavioural risks factors involving older people. Therefore, getting an idea of how long older people will be expected to be sexually active is crucial in designing informed prevention programmes targeting various risky behaviours. Further, at an individual level, knowledge of sexual life expectancy can motivate individuals to

adopt healthy life styles e.g. healthy diet and regular exercises that can prolong sexually active lifespan.

The objective of this paper is twofold, firstly to estimate sexually active life expectancy, which is the average number of remaining years for an individual to be sexually active. The paper will also examine the association between sexual activity and self-rated health status.

3.3 Methods

3.3.1 Data sources

The study is based on secondary analysis of the 2005 and 2012 South African National HIV Incidence, Prevalence, Behaviour and Communication Survey (SABSSM) surveys conducted in South Africa by the Human Sciences Research Council. Both surveys targeted all persons above two years of age and residing in community dwellings. The sampling frame for the survey was based on a master sample consisting of 1 000 census enumerator areas (EA) and 15 households were randomly selected per EA. The selection of EAs was stratified by province and locality type (formal urban settlements, informal/ unplanned urban settlements, formal rural settlements, and tribal authority areas) and race (in urban localities). The survey excluded institutionalized individuals (including those in educational institutions, military barracks, old-age homes, or hospitals), and hence were excluded from the study. The surveys include a multistage cluster sample stratified by province, settlement geography (geotype), with the predominant population group in each area used. Further details about the sampling procedures are explained elsewhere 2005 (Shisana, Rehle *et al* 2005) and 2012 (Shisana, Rehle *et al* 2014). The main sample used in this analysis included the ages 50 years and older. The household response rates were; 84.1 per cent (2005) (Shisana, Rehle *et al* 2005) and 87.2 per cent (2012) (Shisana, Rehle *et al* 2014).The individual response rates were; 96.0 per cent (2005) (Shisana, Rehle *et al* 2005)and 89.1 per cent (2012) (Shisana, Rehle *et al* 2014). In both surveys, socio-demographic and behavioural information was collected with participant's consent through face-to-face questionnaires administered by trained fieldworkers.

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3.3.2 Measures

Sexually active

Sexual activity was assessed by responses to the question asked "*Have you had sex during the past 12 months*", which was asked with same wording in both surveys. Individuals responding in the affirmative were considered to be "sexually active". This follows other studies (Lindau & Gavrilova 2010).

Self-rated health

Self-rated health which was assessed from the question "*In general, would you say that your health is excellent, good, fair or poor*?" The same wording of the question was used in both the 2005 and 2012 surveys. A binary variable was created by categorising; excellent and good as 'good health' and fair and poor as 'poor health'.

Chronic conditions

In the SABSSM surveys a general question was asked on the presence of any chronic condition; "*Do you have any chronic medical condition that is affecting what you do or how you feel?*" This assessment is based on self-reports, and respondents who answered 'Yes' were considered to be having a chronic condition.

HIV status

Dried blood spot (DBS) specimens for HIV testing were collected from each participant who assented or consented using finger prick. Samples were tested for HIV using an enzyme immunoassay (EIA) and samples which tested positive were retested using a second EIA. A third EIA was used for any samples with discordant results on the first two EIAs.

Exercises

Two questions were asked to assess whether the respondent did any form of exercises. The first question was; "*Do you do any vigorous intensity sport, fitness or recreational activities in your leisure or spare time, that cause large increases in breathing or heart rate (like running or strenuous sports, weightlifting) for three times a week at least 30 minutes at a time?"* And the second question was – *"Do you do any moderate-intensity sport, fitness or*

recreational activities in your leisure or spare time that cause small increases in breathing and heart rate (like brisk walking, cycling or swimming) for three times a week at least 30 minutes at a time?"

3.3.4 Analysis

Sexually active life expectancy was used to estimate the average number of years remaining sexually active. This is a new concept recently introduced by Lindau & Gavrilova (2010). It is an extension of healthy expectancy indicators which have become important measures of summarising population health. The Sullivan method (Sullivan 1971) was used to calculate the sexually active life expectancies. This method utilises age-specific prevalence on sexual activity to partition the number of person-years into years with and without sexual activity. The prevalence data was obtained from the 2005 and 2012 national HIV household surveys mentioned above. The purpose of using the two surveys was to establish the trend of sexual activity over time. Life expectancy estimates were obtained from UN Life Tables (United Nations Population Division 2013) for 2005-2010 and 2010-2015, i.e. for the corresponding 2005 and 2012 surveys. Standard errors and confidence intervals were calculated from the formulae suggested by the International Network on Health Expectancy (Jagger, Cox *et al* 2006).

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Multiple logistic regression was used to model the likelihood of being sexually active. The main variable of interest was self-rated health which was assessed from the question "In general, would you say that your health is excellent, good, fair or poor?" The same wording of the question was used in both the 2005 and 2012 surveys. A binary variable was created by categorising; excellent and good as 'good health' and fair and poor as 'poor health'. Covariates included; age, marital status, exercises (vigorous or moderate intensity) and chronic medical conditions. The data were analysed using STATA 12 (StataCorp 2011), incorporating the complex sampling design of the two surveys by using the 'svy' commands in obtaining all estimates. The analysis here was restricted to older people aged 50 years and over. The association between the outcome and exposure variables was assessed by the odds ratios (OR) and 95% confidence intervals (95% CI). All variables statistically significant ($p<0.05$) in univariate analyses were included in the multivariable models. The models were fitted separately for men and women.

3.4 Results

3.4.1 Sample characteristics, self-rated health and sexual activity

Table 3.1 shows the distribution of the sample of older adults (50 years and above) across socio-demographic and behavioural characteristics. In both surveys, the majority of adults were in the younger age group (50-59 years). The majority were still married, although a significant proportion was widowed. Wide gender differentials existed in widowhood i.e. the proportion of adult women who were widowed was four and three times that of adult men who were widowed in the 2005 and 2012 surveys, respectively. Most of the adults had attained primary education, with more men having matric and tertiary education than women. Almost two thirds of the adults across gender were Africans in both surveys. The prevalence of poor and fair health was higher among women, although not much difference is noted, especially among men between the two surveys. Older men were significantly more likely to be sexually active ($p<0.001$), although the prevalence of sexual activity slightly dropped from 70 (2005) to 68.9 per cent (2012). On the other hand, the prevalence of sexual activity increased from 28.8 (2005) to 33.8 per cent (2012) among older women.

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3.4.2 Factors associated with sexual activity

Sexual activity was strongly associated with good health in older men. The same was found in older women, although the association was not significant in adjusted models. As expected, increasing age was strongly associated with reduced odds of being sexually active for both gender groups. Similarly, older people who were single were less likely to be sexually active. Moderate exercise doubled the odds of sexual activity in older women. Non communicable diseases (NCDs) among men significantly reduced sexual activity, whilst HIV almost reduced sexual activity in older women by half (Table 3.2).

3.4.3 Sexually active life expectancies

The total life expectancy is higher for women than men across all the ages (Table 3.3). In 2012, a 50 year old man would be expected to live on average an additional 24 years compared to 29 years for women. However, Figure 3.1 and Table 3.3 show

men to be having consistently higher sexually active life expectancy in both surveys. A 50 year old man would expect to live a sexually active life for another 12.7 years in 2012, whilst a woman of the same age would only expect half of this duration (7.2 years). Similar gender differences persist up to the older ages although the gap widens further, for example at age 70 the estimates are 3.0 years for men and 1.0 for women. In women, the positive change in sexually active life expectancies across the ages between the years of surveys (2005 and 2012) reflects a gain in more years of sexual activity. The gains were all significant in the exception of the last age group. In men, there were losses in years of sexual activity at ages 50 and 70, although not significant. On the other hand, men in good health at age 80 and above had significant gains in sexually active life in the period 2005-2012. Figure 3.2 and Figure 3.3 show the sexually active life expectancy by health status and gender for 2005 and 2012 respectively. In both surveys, men and women in good health had higher sexually active life expectancy compared to those in poor health. The gap between the curves (good and poor health) appears to be much wider in men, especially from the 2012 survey (Figure 3.3). Table 3.3 shows that in 2012 men in good health at age 80 years were projected to gain on average 3 years and women in good health were projected to gain on average 1 year of sexually active life.

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Table 3.4 gives a summary of proportion of remaining years spent as sexually active. This was derived as years of sexual activity as a fraction of total remaining years of life. From the 2012 survey, the proportion in men is actually double that of women (65.7 vs. 29.4 per cent) at age 50. Figure 3.4 shows a very huge gap between men and women across all ages in the proportion of remaining life spent sexually active. However, when comparing the two surveys, it can be seen that the proportion dropped among men, whilst some increases can be seen among women, especially at the oldest ages (Figure 3.4). Figure 3.5 and Figure 3.6 show the gender differences in the proportion of remaining life spent sexually active by health status in 2005 and 2012, respectively. In both surveys, it can be seen that the gap in proportions between good and bad health is wider for men than women. The estimates at the oldest ages are less stable and need to be interpreted with caution due to the smaller sample sizes at these ages.

3.5 Discussions

This study was aimed at projecting estimates of sexually active life expectancy, and examining factors associated with sexual activity in older people. The results show that older people are still sexually active, and if anything, they are actually gaining more years of sexual activity over the years. This means that the myth that older people are 'asexual' needs to be dispelled. HIV and AIDS prevention, mitigation and support programmes need to be spilled over beyond the conventional reproductive age group to the old and even oldest ages. Total life expectancy in South Africa has started to steadily rise again after being brought down by AIDS during the last decade 2000-2010. Along with these gains, sexually active life expectancy seems to be increasing as well.

The estimates of sexually active life expectancy found in this study are lower than those found in the national social life, health and aging project (NSHAP) from the USA (Lindau & Gavrilova 2010). Whereas the estimates from the 2012 survey in this study at 55 years were 12.1 (men) and 5.5 (women), the corresponding estimates from the USA study were 14.9 (men) and 10.6 (women). This shows that older people in the USA remain sexually active for a longer time beyond age 55 compared to older people in South Africa. For men, the estimates from the two studies are close, whilst the estimates for USA women are double that of South African women. These differences can be attributed to socio-economic, health and mortality differences between the two countries and other socio-cultural dynamics. Nevertheless, regardless of these differences, the gap in women between the two studies is worth noting.

Similar to other studies (Lindau & Gavrilova 2010), this study has shown that poor health status is associated with decreased sexual activity. This further supports other studies which have found that it is poor health, rather than age *per se*, that is associated with decline in active sex life (Taylor & Gosney 2011). This is an important finding which goes along with new understanding among demographers and policy makers that aging is not about numbers, but rather more about other dimensions of life such as health, functioning and well-being. In other words,

defining aging based on chronological age might be misleading (Sanderson & Scherbov 2008; Sanderson & Scherbov 2010).

The study has come up with some findings with significant policy implications. It is interesting to note that HIV reduces sexual activity amongst older women, whilst chronic conditions seem to limit sexual activity among older men. This implies that there is need for gender responsiveness and sensitivity when addressing sexual health among the elderly since the underlying determinants are different. Studies have shown that chronic conditions lead to declines in sexual activity (Taylor & Gosney 2011). These include diabetes mellitus which can lead to impotence and osteoarthritis which cause poor mobility and other conditions such as depression which are prevalent at these ages. Further, medications taken for chronic conditions have been known to reduce libido, hence limiting sexual activity (Kessel 2001). Risk factors for chronic conditions are largely behavioural, and can be mitigated at an earlier age. It is important therefore to ensure prevention programmes for chronic conditions among young men. Based on the results of this study, there is need to raise awareness about the negative effect chronic conditions might have on sexual activity later in life.

Male HIV mortality is higher than that for females (Morna, Michael *et al* 2012). Therefore, it can be insinuated from the results that HIV infected women are less likely to be sexually active because most are likely to be widows who might have lost their husbands to AIDS. On the other hand, HIV does not seem to deter men from sexual activity. Although not significant, HIV infected men are actually more likely to be sexually active. These results have important implications on public health policies aimed at prevention of HIV infections, especially given the aging of people with HIV. Older men living with HIV may continue engaging in sexual activities, some of which might be risky e.g. age disparate relationships which may continue to put younger people at risk. The erectile dysfunction (ED) among women is poorly understood (Taylor & Gosney 2011). Therefore, further research is needed to further understand the sexuality of older women, especially in the context of HIV.

Physical activities need to be promoted in older people. The results give hope in that just moderate exercises are effective in doubling sexual activity in women. Post

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menopause the sexual activity of women declines, and studies have found that regular exercises can improve sexual activity (Wang, Lu *et al* 2008).

The gender differences in sexually active life expectancy found in this study are equally striking. Whilst young girls get sexually active at a younger age than boys (Chirinda, Peltzer *et al* 2012), this study shows that at the older ages, men are more sexually active than women. Further, the study shows that although women have higher demographic life expectancy than men, they spend fewer years being sexually active than men at the old ages. However, although this is the case, a caution to men is that the results also show that they lose more of their sexually active life expectancy to poor health. This has also been found in other studied (Lindau & Gavrilova 2010).

3.6 Strengths and limitations

The strength of this study is that it is based on two cross-sectional surveys, with relatively larger sample sizes of older people. This helps to check trends of estimates over the years. The two surveys asked similar question for the outcome and main exposure variables, which strengthens the content validity. Further the Sullivan method used here has been found to give estimates close to those from other methods e.g. multi-state life tables which utilize longitudinal data. However the limits of cross sectional data exist. The SABSSM surveys did not include institutionalized individuals in the sample. The exclusion of older people living in institutions means that the results are not representative of this important segment of the elderly population. Unfortunately, there are no surveys on sexuality of older institutionalized populations where this information could possibly have been obtained from. Further, although not mentioned anywhere, bias in reporting sexual activity cannot be ruled out. It can be suspected that older women are less likely to report sexual activity especially if they are not married or in union, due to possibilities of being labelled as having 'loose' morals. On the other hand, men can over-report sexual activity because it is associated with manhood, and for covering up sexual dysfunction. However, from the consistence of the results from the two surveys, these shortcomings are unlikely to bias the results

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3.7 Acknowledgements

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Table 3.1 Descriptive characteristics of sample 50 years and older by gender, 2012 and 2005 SABSSM survey

Characteristic	2005			2012		
	Men (n=1291) N (%)	Women (n=2504) N (%)	p-value	Men (n=3096) N (%)	Women (n=4751) N (%)	p value
Age (year)			p=0.001			p<0.001
50-59yrs	653 (46.1)	1222 (44.0)		1480 (54.7)	2202 (46.9)	
60-69yrs	438 (38.3)	783 (33.0)		1003 (29.7)	1481 (31.2)	
70-79yrs	154 (12.3)	385 (17.0)		466 (12.6)	755 (17.0)	
80+	46 (3.4)	114 (6.0)		144 (3.0)	310 (4.9)	
Marital status			p<0.001			p<0.001
Single	70 (4.6)	237 (10.6)		176 (5.4)	496 (10.8)	
Married	919 (74.7)	1141 (43.2)		2155 (68.8)	2092 (43.9)	
Cohabiting	43 (3.2)	40 (1.6)		253 (9.7)	212 (5.1)	
Separated	93 (8.1)	187 (6.6)		136 (4.8)	300 (7.6)	
Widow	141 (9.4)	864 (38.0)		321 (11.3)	1569 (32.6)	
Education			p=0.001			p=0.001
Primary	610 (55.5)	1403 (63.6)		770 (36.6)	1328 (38.6)	
Secondary	330 (18.2)	637 (20.9)		795 (28.0)	1277 (32.8)	
Matric	182 (13.4)	275 (9.6)		546 (20.2)	594 (17.6)	
Tertiary	160 (12.9)	170 (5.9)		332 (15.5)	323 (10.9)	
Race			p<0.001			p=0.027
African	606 (63.2)	1335 (74.9)		1390 (64.5)	2407 (68.6)	
White	281 (24.4)	457 (15.7)		621 (21.5)	710 (18.8)	
Coloured	216 (8.8)	402 (6.7)		550 (10.2)	866 (9.4)	
Indian	186 (3.6)	304 (2.7)		528 (3.8)	764 (3.3)	
Self-rated health			p<0.001			p<0.001
Excellent	117 (7.9)	168 (6.2)		483 (16.1)	535 (11.1)	
Good	716 (60.9)	1223 (48.5)		1594 (53.1)	2428 (52.3)	
fair	370 (26.3)	935 (38.9)		824 (26.4)	1490 (31.2)	
Poor	66 (4.9)	130 (6.4)		144 (4.4)	231 (5.4)	
Sexual activity			p<0.001			p<0.001
Not active	404 (30.0)	1569 (71.2)		1007 (31.1)	2852 (66.2)	
Active	814 (70.0)	745 (28.8)		1835 (68.9)	1494 (33.8)	

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Table 3.2 Factors associated with sexual activity among older adults (50 years and older), 2012 SABSSM survey

	Males		Females	
	UOR (95% CI)	**AOR (95% CI)**	**UOR (95% CI)**	**AOR (95% CI)**
Self-rated health				
Poor	1	1	1	1
Good	1.86 (1.41-2.47)***	1.56 (1.11-2.19)**	1.63 (1.31-2.03)***	1.01 (0.75-1.37)
Age				
50-59	1	1	1	1
60-69	0.53 (0.39-0.74)***	0.43 (0.30-0.62)***	0.44 (0.33-0.58)***	0.43 (0.30-0.62)***
70-79	0.14 (0.96-0.21)***	0.11 (0.07-0.17)***	0.94 (0.06-0.15)***	0.11 (0.06-0.19)***
80 +	0.13 (0.06-0.26)***	0.06 (0.03-0.13)***	0.04 (0.02-0.10)***	0.05 (0.01-0.17)***
Marital status				
Married	1	1	1	1
Single	0.09 (0.06-0.13)***	0.06 (0.04-0.10)***	0.03 (0.02-0.05)***	0.04 (0.03-0.06)***
Vigorous Exercises				
No	1	1	1	1
Yes	1.83 (1.21-3.00)*	1.34 (0.78-2.31)	1.61 (1.13-2.28)**	1.00 (0.60-1.53)
Moderate Exercises				
No	1	1	1	1
Yes	1.26 (0.89-1.78)	0.95 (0.54-1.69)	1.89 (1.41-2.53)***	1.99 (1.32-3.00)**
Chronic Conditions				
None	1	1	1	1
At least one	0.67 (0.50-0.86)**	0.64 (0.46-0.91)*	0.79 (0.62-1.00)*	0.91 (0.62-1.32)
HIV status				
Negative	1	1	1	1
Positive	1.42 (0.88-2.29)	1.78 (0.98-3.24)	0.62 (0.39-0.98)*	0.52 (0.27-0.98)*

UOR – Unadjusted Odds Ratio;
AOR – Adjusted Odds Ratio;
CI – Confidence Interval;
****P<.001; **P<.01;*P<0.5*

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Table 3.3 Gender differences in sexually active life expectancy by health status at ages 50, 60, 70 and 80, based on the 2005 and 2012 SABSSM surveys

Age	Expectation of life	Men				Change 2005-2012	Women				Change 2005-2012
		2005		2012			2005		2012		
		Years	95% CI	Years	95% CI		Years	95% CI	Years	95% CI	
	Total LE	18.4		24.0		5.6	22.9		28.5		5.5
	Sexually Active LE	12.7	[12.0; 13.4]	12.7	[12.2; 13.3]	0.1	5.9	[5.4; 6.4]	7.2	[6.6; 7.8]	1.3*
50	Self-rated health										
	Bad Health	10.5	[9.4; 11.6]	11.3	[10.3; 12.2]	0.7	4.7	[3.9; 5.5]	6.1	[5.3; 6.9]	1.4
	Good Health	13.7	[12.9; 14.5]	13.5	[12.8; 14.2]	-0.2	6.9	[6.2; 7.6]	7.8	[7.1; 8.6]	0.9
	Total LE	12.9		17.9		5.1	17.2		21.8		4.6
	Sexually Active LE	7.0	[6.2; 7.8]	7.3	[6.8; 8.4]	0.3	2.0	[1.6; 2.4]	3.2	[2.7; 3.7]	1.2*
60	Self-rated health										
	Bad Health	5.4	[4.2; 6.5]	5.9	[5.1; 6.8]	0.6	1.6	[1.1; 2.2]	2.5	[1.9; 3.1]	0.9
	Good Health	7.9	[6.9; 8.9]	8.1	[7.4; 8.7]	0.2	2.4	[1.8; 3.0]	3.7	[3.0; 4.4]	1.3*
	Total LE	8.4		12.9		4.5	11.5		15.3		3.8
	Sexually Active LE	3.3	[2.4; 4.3]	3.0	[2.5; 3.6]	-0.3	0.4	[0.1; 0.6]	0.8	[0.5; 1.1]	0.4*
70	Self-rated health										
	Bad Health	2.2	[1.1; 3.3]	1.9	[1.3; 2.6]	-0.3	0.2	[0.0; 0.4]	0.4	[0.1; 0.6]	0.2
	Good Health	4.0	[2.7; 5.3]	3.8	[3.0; 4.5]	-0.2	0.6	[0.2; 1.0]	1.1	[0.6; 1.5]	0.5
	Total LE	5.3		8.2		2.9	6.9		9.1		2.3
	Sexually Active LE	0.8	[0.1; 1.4]	1.8	[1.0; 2.6]	1.0*	0.1	[0.0; 0.2]	0.3	[0.0; 0.5]	0.2
80	Self-rated health										
	Bad Health	0.7	[0.1; 1.6]	0.6	[0.1; 1.1]	-0.1	0.1	[0.0; 0.2]	0.2	[0.1; 0.4]	0.1
	Good Health	0.9	[0.2; 1.9]	2.6	[1.6; 3.6]	1.8*	0.2	[0.1; 0.6]	0.2	[0.1; 0.6]	0.0

LE- Life Expectancy
95%CI – 95% Confidence Interval
*significantly different at 5% level from previous time period

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Table 3.4 Gender differences in proportion (%) of remaining sexually active life by health status at ages 50, 60, 70 and 80, based on the 2005 and 2012 SABSSM surveys

Age	Expectation of life	Men			Women		
		2005	2012	change 2005-2012	2005	2012	change 2005-2012
50	All	69.0	65.7	-3.3	25.8	29.4	3.5
	Self-rated health						
	Bad Health	57.2	58.0	0.8	20.5	24.8	4.3
	Good Health	74.6	69.6	-4.9	30.1	32.0	1.8
60	All	54.3	54.2	-0.1	11.7	17.8	6.1
	Self-rated health						
	Bad Health	41.6	43.9	2.4	9.4	13.8	4.4
	Good Health	61.1	59.9	-1.3	14.0	20.3	6.3
70	All	39.8	34.5	-5.3	3.2	6.7	3.4
	Self-rated health						
	Bad Health	26.5	22.0	-4.5	1.6	3.0	1.4
	Good Health	48.0	43.3	-4.7	5.1	8.9	3.8
80	All	14.8	32.7	17.8	1.1	3.7	2.6
	Self-rated health						
	Bad Health	13.8	11.0	-2.8	0.0	2.2	2.2
	Good Health	16.4	48.2	31.8	3.1	3.3	0.1

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Figure 3.1 Sexually active life expectancy in South African men and women, based on 2005 and 2012 SABSSM surveys

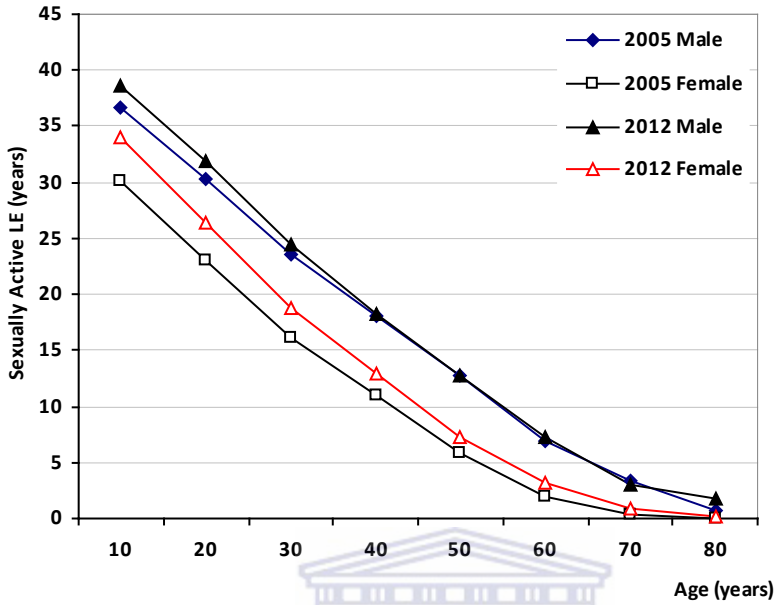

Figure 3.2 Sexually active life expectancy in South African men and women in Good or Bad Health, based on 2005 SABSSM surveys

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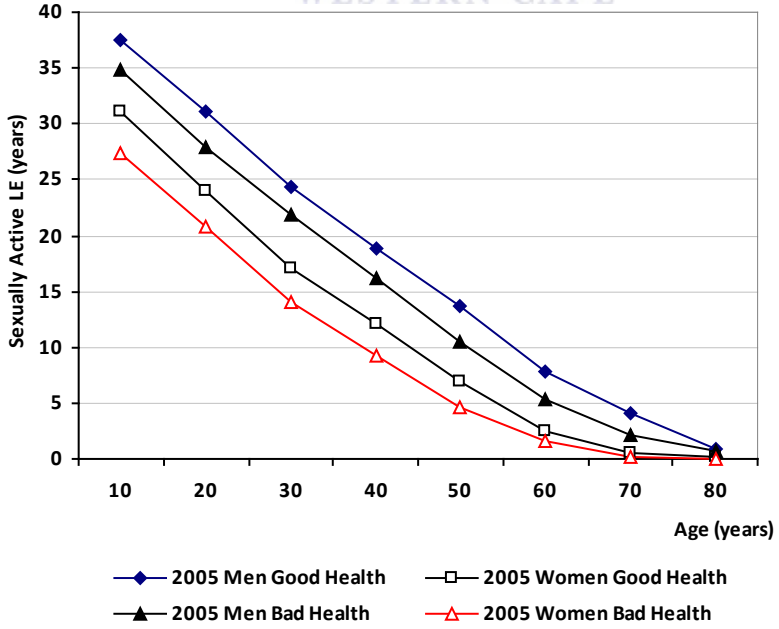

Figure 3.3 Sexually active life expectancy in South African men and women in Good or Bad Health, based on 2012 SABSSM surveys

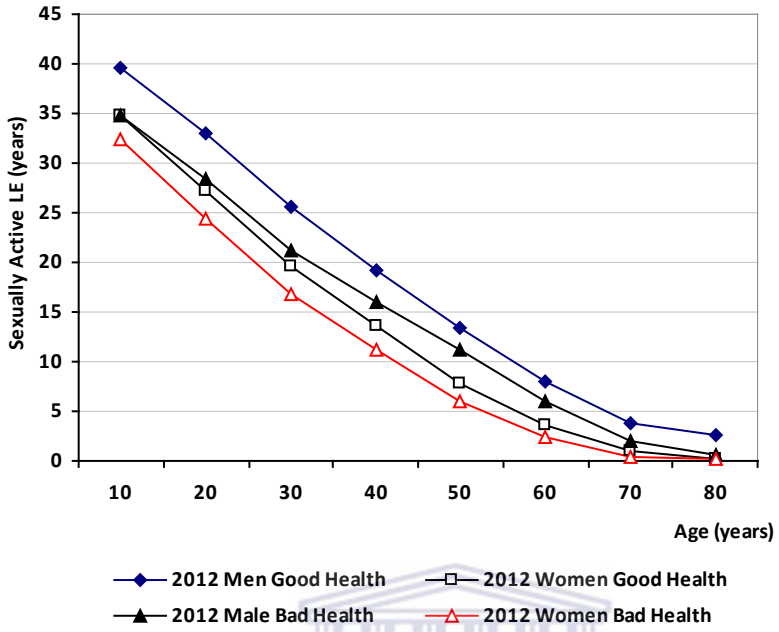

Figure 3.4 Proportion of remaining sexually active life for men and women, 2005 and 2012

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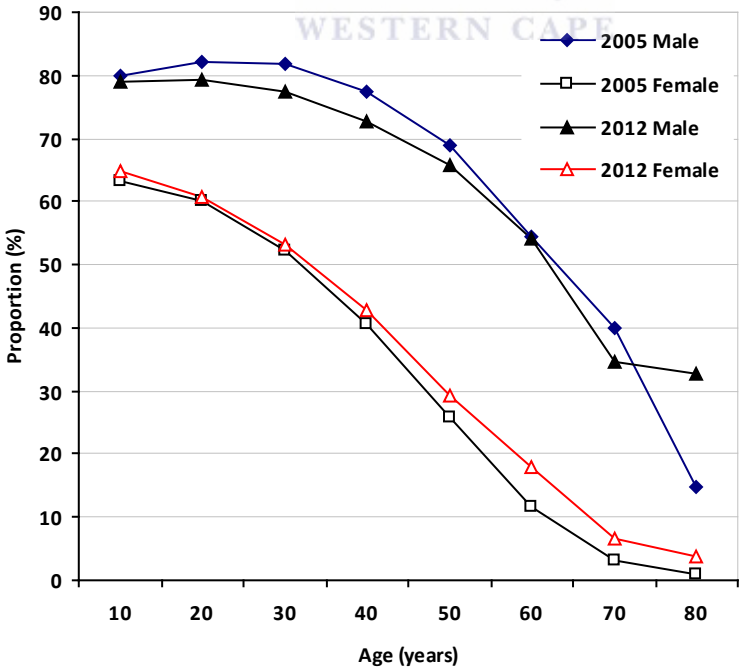

Figure 3.5 Proportion of remaining sexually active life for men and women by health status, 2005

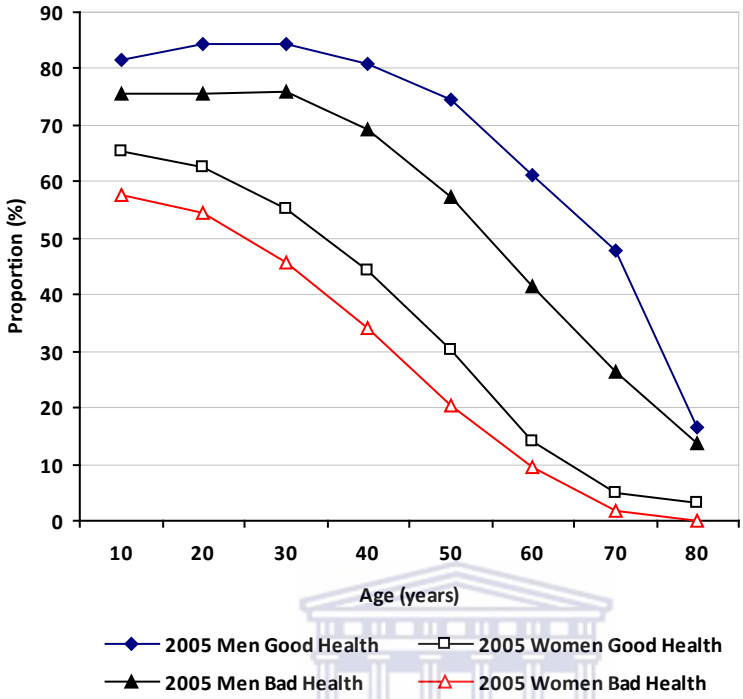

Figure 3.6 Proportion of remaining sexually active life for men and women by health status, 20012

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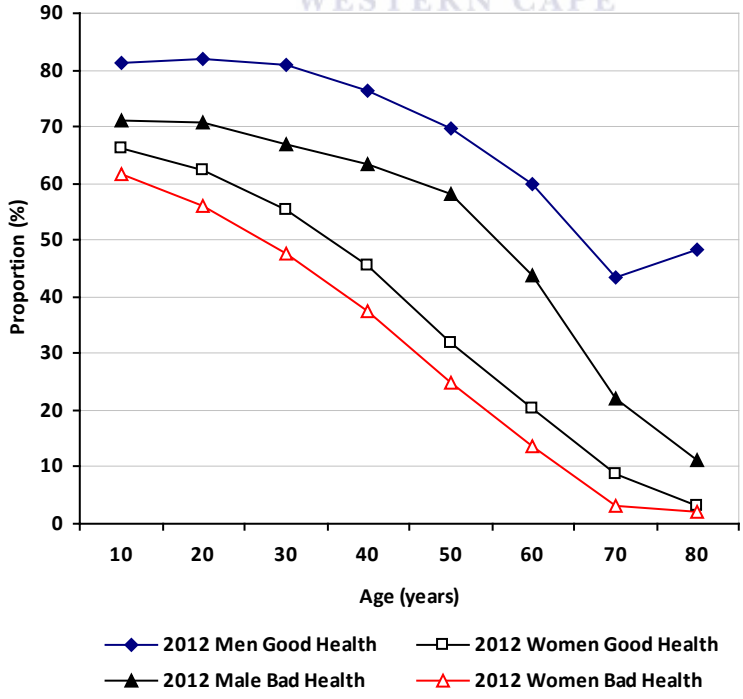

Chapter 4

Compression of Morbidity in Older South Africans? Trends in Healthy Life Expectancy between 2005 and 2012

4.1 Abstract

Whilst it is known that life expectancy in South Africa has been increasing over the past years, little is known about the trends in health status of older people. The objective of this paper is to provide a better understanding of trends and gender differences in healthy life expectancy for older people in South Africa for the period 2005 to 2012. We use self-rated health measure to estimate healthy-life expectancies using data from three repeated cross sectional surveys conducted in 2005, 2008 and 2012. The Sullivan method was used in the calculations. Our findings show that unhealthy life expectancy decreased, whilst healthy-life expectancy and proportion of life spent in good health increased more than total life expectancy over this time period. This suggests both absolute and relative compression of morbidity for both men and women across all ages, in the exception of the 'young old' men. We conclude that, based on self-rated health measure, health of older people has been improving over the period under investigation. We demonstrate the feasibility of using the national HIV household surveys for this analysis. We recommend that a question on more objective disability measures be included in the next surveys, as this will enable a comprehensive assessment of older people's health in the future.

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4.2 Introduction

Populations are rapidly growing older across the globe. The proportion of people aged 60 years and over is growing at a faster rate than any other age groups (UNPD 2011). Coupled with this, the length of life has also increased dramatically in most parts of the world. Initially, this demographic transition was experienced in developed countries, but of late it has become a global phenomenon which is being experienced by less developed regions as well. Looking at South Africa, life expectancy at birth has increased from 51.1 (male) 55.7 (female) in 2002 to 59.1 (male) and 63.1 (female) in 2014 (Statistics South Africa 2014b). Between 2002 and 2005, life expectancy had declined due to the HIV epidemic, however, there has since been an upward trend partly due to the successful roll-out of antiretroviral treatment (ART) (Bor *et al.* 2013; Statistics South Africa 2014b; Shisana, Rehle *et al* 2014; Mayosi & Benatar 2014). According to the United Nations, the proportion of South Africans aged 60 years and over is projected to double from 7.0 per cent in 2005 to 15.6 per cent in 2050 (UNPD 2011). Against this background, researchers have begun to ask important questions if the gains in longer life are being accompanied by healthy and productive life, or by periods of illness, frailty and more dependency. In other words, is the quantity in number of years gained being matched by quality in terms of health and well-being?

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In attempting to answer this question, at least three hypotheses have been put forward to explain the relationship between increasing longevity and quality of life. The first theory postulates that the increase in years of life will be accompanied by increase in age-related chronic conditions and disability, which will require costly long term health care. This pessimistic view is referred to as the 'expansion of morbidity', which signifies the 'failure of success' (Gruenberg 1977; Olshansky et al. 1991). Subsequently, a more optimistic theory was suggested by Fries (Fries 1980), and it states that the onset of poor health and disability will be postponed and 'compressed' into the last few years before death. This is referred to as the 'compression of morbidity' which signifies the 'success of success' (Fries 1980). The third theory is referred to as 'dynamic equilibrium' (Manton 1982), and is somewhat intermediate between the first two theories. It suggests that the number of years lived in morbidity would increase, but they will be offset by a decrease in the level of

severity of disease. As a result, the proportion of life spent in good health would generally remain constant (Manton 1982).

In order to answer the question about trends in mortality and morbidity, there is need to obtain a health measure that combines the two components together into a single measure (Mathers & Robine 1997). This means conventional measures solely based on mortality such as life expectancy are not sufficient to summarise population health. Progress has been made over the past decades in developing new summary measures of population health which are called health expectancies (Jagger, Cox *et al* 2006). The health expectancies can be defined as the average number of years an individual at a given age can be expected to live in good health based on the prevailing age-specific mortality and morbidity status (Jagger, Cox *et al* 2006). The health expectancies can be derived based on various health measures which vary from objective ones e.g. disability to subjective ones such as self-rated health and wellbeing. Therefore, a different conclusion can be reached depending on the health measure used (Doblhammer & Kytir 2001; Christensen, Doblhammer *et al* 2009).

In this present study, self-rated health measure was used to calculate healthy-life expectancies. The self-rated health measure , albeit its subjectivity, has been widely accepted as a reasonable measure of population health status (Doblhammer & Kytir 2001). In fact, its use dates back more than 50 years ago, initially in sociology (Suchman, Phillips *et al* 1958) and later in medical and epidemiological research (Kaplan & Camacho 1983). Further, self-rated health has been found to be a good predictor of mortality by longitudinal studies (Ardington & Gasealahwe 2014; Idler & Benyamini 1997; Mossey & Shapiro 1982), and of health care expenditure (DeSalvo *et al.* 2009). There are some perceptions though that self-rated health measure is too subjective (Jagger *et al.* 2010), and questions have been raised about its reliability in developing areas where people have low awareness of health (Sabatini 2014). This is due to 'health illusions', a scenario whereby people 'normalize' health deficits because of their low health expectations (Sen 2002), which is likely in low income settings. As a result, people may rate their health as good even if they have substantial diseases burden and poor health facilities. Another view is that in the case of the elderly, they can underrate the level disability and health challenges because they may subconsciously rate themselves better compared to their elderly peers (Jagger *et al.*

2010). On the other hand, Jylha's theoretical framework for self-rated health (Jylhä 2009), says that a cognitive process is involved in an individual's rating of their own health status. This cognitive process is essentially subjective and also influenced by ones contextual environment (Jylhä 2009). Therefore, despite its limitations, self-rated health is a useful global health indicator that can summarize all specific domains into a single health measure (Crimmins 2004). The applicability of self-rated health in low income settings has been established (Burström 2012), and its construct validity has been confirmed through its association with socio-economic status(Subramanian *et al.* 2009). Such a simple and single measure becomes even more efficient in resource limited settings, where it can substitute detailed composite measures which are more expensive.

Major interest has developed over the past years in using the health expectancies by researchers and policy makers mainly from European countries and the USA to monitor population health over time (Jagger, Cox *et al.* 2006) . Policymakers in these countries have shifted their focus to using health expectancies instead of life expectancy as a policy tool and primary measure of population health and monitoring health outcomes (Robine, Romieu *et al.* 1999). Further the indicator is also used for assessment of inequalities, planning of healthcare and social services, and allocation of resources (European health expectancy monitoring unit 2007). Unfortunately, there is no such awareness in using the health expectancies for monitoring processes and policy making in Africa including South Africa. This is in spite of the rapid ageing processes mentioned above, which calls for immediate attention on the well-being of older people. All we know is that people are living longer, but we do not know how healthy the older people are. Studies are required which can generate the type of data required for the estimation of health expectancies. This study intends to explore the utility of using national HIV household data collected by the Human Sciences research council in describing the health state of older people in South Africa. To the best of our knowledge, this is the first study to estimate health expectancies for South Africa using repeated cross sectional surveys. The objective of this paper is to examine trends and investigate gender differences in healthy life expectancy for older people in South Africa for the period 2005 to 2012. The research question posed by this study is - has the recent increase in total life expectancy observed in South Africa been accompanied by an increase or decrease in

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health problems amongst older people? Through answering this question, we will also be simultaneously testing the hypotheses of compression or expansion of morbidity based on the data on elderly population of South Africa.

4.3 Methods

4.3.1 Data sources

The study is based on secondary analysis of the 2005, 2008 and 2012 South African National HIV Incidence, Prevalence, Behaviour and Communication Survey (SABSSM) surveys conducted in South Africa by the Human Sciences Research Council (HSRC). These are repeated cross sectional surveys aimed at surveillance of HIV incidence and prevalence in South Africa. The individual response rates for each survey were; 96.0 per cent (2005) (Shisana, Rehle *et al.* 2005), 89.5 per cent (2008) (Shisana, Rehle *et al.* 2009), and 89.1 per cent (2012) (Shisana, Rehle *et al* 2014). All the three surveys included persons residing in community dwellings and aged two years and above. Institutionalized individuals (i.e. those in educational institutions, military barracks, old-age homes, or hospitals) were not included in all the three surveys, and hence as a result they were also excluded from this study. The surveys include a multistage cluster sample stratified by province, settlement geography (geotype), with the predominant population group in each area used. In our analysis, the design characteristics of the three surveys were adjusted for by using weighted prevalence rates. Further details about the sampling procedures are explained elsewhere 2005 (Shisana, Rehle *et al.* 2005), 2008 (Shisana, Rehle *et al.* 2009), and 2012 (Shisana, Rehle *et al* 2014). A questionnaire was administered through face-to-face interviews conducted by trained fieldworkers. Information on socio-demographic and behavioural was collected from consenting individuals. The surveys were approved by the HSRC Research Ethics Committee (REC). We restrict our analysis to older adults aged 50 years and older.

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4.3.2 Analysis

Healthy-life expectancy were calculated using the Sullivan method (Sullivan 1971). This method utilises age-specific prevalence of population in different health states at a certain point in time to calculate person-years of life lived (PYL) in the respective health states in a period life table. The next step is to derive the total person years

lived by summing up the person years lived from age *x* upwards until the last age group in the life table. The total person years lived is then divided by the number of survivors in order to get the healthy-life expectancy (HLE). The limitation of the Sullivan method is that it is not suitable for detecting sudden fluctuations or changes in population health (Jagger, Cox *et al.* 2006). However, the results from the Sullivan method have been shown to be similar to those from other methods, provided the transition rates have been fairly constant over time (Mathers & Robine 1997). The other method commonly used in computing health expectancies is the multistate life table method. The major difference between this method and the Sullivan method is that it utilises incidence data to calculate transitional probabilities between health states and death using longitudinal data (Rogers et al. 1990). The Sullivan method therefore indicates current population health structure, whereas multistate life table method gives us hypothetical population health structure following observed health transition schedules. Most researchers use the Sullivan method because the data required are readily available, and further, it is simple to use and interpret, and the results are relatively accurate health (Jagger, Cox *et al.* 2006).

In this particular study, the healthy life expectancy derived is based on self-rated health measure, obtained from the 2005, 2008 and 2012 SABSSM surveys described above. In the three SABSSM surveys, self-rated health was asked using the question *"In general, would you say that your health is excellent, good, fair or poor?"* The same wording of the question was used in the 2005, 2008 and 2012 surveys, which makes it feasible to evaluate trends in population health. A binary variable was created by categorising; excellent and good as 'good health' and fair and poor as 'poor health'. The estimates of life expectancy used in this study were based on the mid-year sex-specific complete life tables that were interpolated and smoothed from the abridged life tables published by the UN (United Nations Population Division 2013). We presented life tables in 10 year intervals for each gender, beginning with age 50 and having an open interval from age 80 and above. The reason for collapsing the ages was that the age-specific prevalence of health states would be very small to tabulate by single year of age, which would make the estimates imprecise. The UN life tables were available for the years – 2003, 2008 and 2013. We used linear interpolation following a lexis diagram approach to obtain the life tables for the missing years - 2005 and 2012 in order to correspond with the survey years (i.e. 2005, 2008 and

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2012). Standard errors and confidence intervals were calculated from the formulae suggested by the International Network on Health Expectancy (Jagger, Cox *et al.* 2006). We calculate healthy life expectancy (HLE) and the proportion of HLE to total life expectancy (TLE), in order to establish if there was an absolute or relative expansion or compression of morbidity (European health expectancy monitoring unit 2009), for the period 2005 to 2012.

4.4 Results

The results are presented at selected ages (50, 60, 70, and 80), and stratified by gender. Table 4.1 summarizes the background characteristics of the sample aged 50 years and older who participated in the 2005, 2008 and 2012 national HIV household surveys. In all surveys, the majority of the respondents; were women, self-rated their health as 'good' or 'fair', were in the 50-59 age category, and were predominantly Black African.

Table 4.2 shows that total life expectancy is higher for women than men across all ages and time periods (2005, 2008 and 2012). For example, in 2012, a 50 year old woman would expect to live for another 24 years, whilst a man of the same age would expect to live an additional 19 years. Further, in terms of absolute figures, women had higher expected lifetime in good health across all the ages and time periods. For example, the expected lifetime in good health for a 50 year old woman was 15 years. The equivalent for a man of the same age was 13 years. However, women also had greater expected lifetime in bad health across all the ages. For example, in 2012 the expected lifetime in bad health at ages 50 and 80 for women was 9 and 4 years, respectively, whilst for men it was 6 and 2 years respectively. As expected, both total life expectancy and healthy life expectancy decreased with age for both men and women in all the time periods.

Table 4.2 also shows the absolute difference in total, healthy and unhealthy life expectancies between the time periods 2005, 2008 and 2012. These changes are further presented in Figure 4.1 between the first year (2008) and last year (2012). Our results show that total life expectancy has increased over the whole time period. This has been accompanied by increases in healthy life expectancy (good health) and remarkable declines in unhealthy life expectancy (poor health). This implies that

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older people in South Africa not only live longer but the absolute number of years lived in good health increased. Figure 4.1 clearly shows that, in the exception of the young old men (50-59), increases in healthy life expectancy were greater than the increases in total life expectancy across the ages. This is even more evident when looking at the figure for women (Figure 4.1b). There has been absolute reduction in unhealthy years (years spent in bad health) for both men and women across all the ages for the whole time period 2005-2012. However, for men, there would appear to be marginal gains in unhealthy years at the young ages (50-59). The improvements in health years for the period 2005-2012 are statistically significant across all ages for women, whilst for men the difference is significant at the oldest ages. However, the change in healthy life expectancy was also significant for the period 2008-12 for ages 60-69 in men. The change in healthy years from 2005-2012 at the oldest ages (80+) was the same for both genders i.e. a gain of 1.3 years.

It is important to note that not only absolute numbers of life expectancy and healthy life expectancy increased but also the proportions of life in good health increased over the period 2005-2012 across all ages for both men and women. In 2005, an 80 year old South African woman could expect to live about a third of her remaining lifetime in good health, by 2012 approximately half (Table 4.3). On the other hand, a man of the same age could expect to live more than a third (36.8 per cent) of his remaining lifetime in good health in 2005, and by 2012 approximately two thirds (61.5 per cent) (see Table 4.3). It is also evident that although women live longer than men, they spent much of their lifetime in poor health.

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4.5 Discussions

Our focus in this study was to investigate changes in population health in terms of a single domain (self-rated health) in relation to increase in total life expectancy. The findings show interesting trends and differentials in healthy life expectancy for the period 2005-2012. An increase in the proportion of healthy life expectancy indicates the compression of morbidity (European health expectancy monitoring unit 2009). A closer look at this indicator shows that there was compression of morbidity for both men and women across all ages from 2005-2012. However, there was a drop in the proportions between 2005 and 2008 in 'young old' men (ages 50-59 and 60-69), although the proportions for the same ages increases again between 2008 and 2012.

We conclude therefore that there was compression of morbidity in the period 2005-20102. It is important to note that the conclusion reached on whether there is an expansion or compression of morbidity partly depends on the health measure used (Doblhammer & Kytir 2001; Robine 2002; Christensen, Doblhammer *et al.* 2009), and how "healthy" is defined. For example, other studies based on self-rated health found a 'compression of morbidity' (Doblhammer & Kytir 2001; Crimmins 2004). On the other hand studies based on self-reported disability found different results based on levels of severity (Robine, Romieu *et al.* 2003). A study on healthy life expectancies in Thailand found stagnation when using self-rated health and improvements in health status when using disability measure based on activities of daily living (ADLs) limitations (Karcharnubarn & Rees 2009). It has been acknowledged that self-rated health and disability can actually follow different trends (Crimmins 1996; Robine & Michel 2004; Spiers *et al.* 1996). So, in our case we concluded that there was a 'compression of morbidity', but it is possible to have concluded otherwise had we used other measures e.g. disability. Unfortunately, this measure is not included in the SABSSM surveys questionnaire. We can at this point recommend that questions on more objective measures such as disability or "limitation of activities" be included in the SABSSM survey questionnaire. Usually, disability is measured through ADLs and instrumental activities of daily living (IADLs). The ADLs and IADLs are in most cases a set of five or more questions, which makes it more expensive to collect. Our recommendation is for a single item that can capture disability in older people. For example the Global Activity Limitation Index (GALI) asks one simple question - *"For the past six months at least, to what extent have you been limited because of a health problem in activities people usually do?"* the response categories are: *not limited, moderately limited*, or *severely limited*. The GALI, like the self-rated measure, has been found to be a good indicator in most European countries where it has been used (Jagger *et al.* 2010). Further, a disability measure is important in determining health care needs including long-term care needs in older people (Verbrugge 1997).The incorporation of the GALI will strongly enhance the general health components of the surveys especially looking at older people, and such data would augment and validate the healthy life expectancy calculated in this study in the future. The simplicity of the GALI, as with self-rated health measure, makes it possible to collect crucial information in a parsimonious way.

Our results are in keeping with findings from the Rapid Mortality Surveillance (Dorrington, Bradshaw *et al.* 2014) which, based on mortality indicators over the same period as this present study, also concluded that the country is progressing well towards the improvement of the population's the health status. Further, although we did not specifically analyse HIV and ART data, our results lend support to the recent findings that people living with HIV (PLHIV) are living longer and healthier lives partly due to the successful roll-out of antiretroviral treatment (Bor *et al.* 2013; Shisana, Rehle *et al.* 2014). Important policy recommendations can be made from our positive findings that elderly people are living in self-rated good health. For example, the government can opt for a flexi retirement scheme which will encourage older people in good health to continue working instead of forcing them into retirement. Some of the modalities for applying this include engaging older people in part time jobs that require less physical effort. Such policies will ensure that older people remain part of labour force and contribute to the economy, hence averting economic implications of aging (Christensen, Doblhammer *et al.* 2009). A good example to follow with regards to social participation is Japan, where older people continue to be engaged in temporary postretirement employment and lifelong learning and continued education even at the oldest ages. Studies have found this active social participation to have a positive effect on overall health and wellbeing, and a protective effect on mortality (Minagawa & Saito 2014). Retiring older people in good health is disposing a potential capacity that could otherwise be effectively used in labour force participation. In fact, it has been suggested that there could be a 'wealth dividend' accompanying the aging process if more years of lifetime at the old ages is spent in good health (Suhrcke, Fumagalli *et al.* 2010). It is important therefore, to prioritise policies and programmes that enhance the health and well-being of older people, and hence keeping them physically and economically active for a prolonged time period, which is called 'active aging' (WHO 2001).

The results demonstrate that the health indicator 'healthy life expectancy' can be used in monitoring changes in health at population level. This can subsequently be used in formulation of population health policies targeting older people, designing of interventions, and planning of healthcare facilities and social amenities for elderly people. The stratification done in this study was by gender. This can be expanded to include other differentials such education and race. The only drawback would be the

unavailability of mortality data disaggregated by these variables, which would be required to apply the method used in this study. This study also demonstrated the feasibility of using the SABSSM surveys in estimation of healthy life expectancies. The surveys are nationally representative and they also include sufficient large numbers of older people in their samples which makes it possible to estimate population parameters with sound degree of precision. This allowed us to do a detailed analysis from the 'young old' to the 'oldest old'. However, because the samples at the oldest ages are few, we had an open interval at 80 years and above, in order to have reliable estimates. It is important though, to study the health of those 80-90 and centenarians (100 years and older) since their health status would be different from the younger old adults. The consistence in survey design, data collection methods and same wording questions make it possible to evaluate trends in health of older people with reasonable degree of accuracy. Traditionally, the surveys are used for monitoring HIV prevalence and incidence in the general population. We suggest that this functionality can be expended to also monitor population health, in particular aging health, since they also collect information on self-rated health. Other health measure can also be included in the survey modules to allow the estimation of other health expectancies. The exclusion of institutionalized individuals from the SABSSM surveys can bias prevalence of self-rated health and healthy life expectancy estimates upwards. It is important to include this segment of the elderly population since they are likely to be different from those residing in the community in terms of health. Unfortunately, there are no similar surveys collecting information on health among institutionalized elderly populations in South Africa.

Table 4.1 Descriptive characteristics of sample 50 years and older by gender, 2012 and 2005 national HIV household survey

	2005		2008		2012	
	Men (n=1291) N (%)	**Women (n=2504) N (%)**	**Men (n=1291) N (%)**	**Women (n=2504) N (%)**	**Men (n=3096) N (%)**	**Women (n=4751) N (%)**
Self-rated health						
Excellent	117 (7.9)	168 (6.2)	165 (18.4)	225 (13.7)	483 (16.1)	535 (11.1)
Good	716 (60.9)	1223 (48.5)	441 (48.3)	826 (48.8)	1594 (53.1)	2428 (52.3)
Fair	370 (26.3)	935 (38.9)	241 (25.0)	531 (31.5)	824 (26.4)	1490 (31.2)
Poor	66 (4.9)	130 (6.4)	59 (8.3)	100 (5.9)	144 (4.4)	231 (5.4)
Age (year)						
50-59yrs	653 (46.1)	1222 (44.0)	481 (48.8)	826 (45.5)	1480 (54.7)	2202 (46.9)
60-69yrs	438 (38.3)	783 (33.0)	296 (32.8)	547 (30.4)	1003 (29.7)	1481 (31.2)
70-79yrs	154 (12.3)	385 (17.0)	119 (13.0)	286 (18.1)	466 (12.6)	755 (17.0)
80+	46 (3.4)	114 (6.0)	50 (5.3)	97 (6.0)	144 (3.0)	310 (4.9)
Race						
African	606 (63.2)	1335 (74.9)	478 (64.8)	1042 (74.3)	1390 (64.5)	2407 (68.6)
White	281 (24.4)	457 (15.7)	164 (20.4)	247 (15.5)	621 (21.5)	710 (18.8)
Coloured	216 (8.8)	402 (6.7)	199 (10.7)	297 (6.7)	550 (10.2)	866 (9.4)
Indian	186 (3.6)	304 (2.7)	105 (4.1)	247 (3.7)	528 (3.8)	764 (3.3)

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Table 4.2 Total life expectancy, expected lifetime in self-rated good health and bad health for men and women at ages 50, 60, 70 and 80 in South Africa in 2005, 2008 and 2012

Age	Life years	Men						Women					
					change						change		
		2005	2008	2012	2005-08	2008-12	2005-12	2005	2008	2012	2005-08	2008-12	2005-12
50	Total LE	18.4	18.4	19.1	-0.1	0.7	0.7	23.0	23.0	24.1	-0.1	1.2	1.1
	Unhealthy LE	5.9	6.1	6.0	0.2	-0.1	0.1	10.8	8.9	9.1	-1.8	0.2	-1.6*
	Healthy LE	12.6	12.3	13.1	-0.3	0.9	0.6	12.3	14.1	15.0	1.8*	1.0*	2.7*
60	Total LE	13.1	12.9	13.3	-0.2	0.5	0.3	17.5	17.3	17.9	-0.2	0.6	0.4
	Unhealthy LE	4.7	5.2	4.4	0.6	-0.9	-0.3	8.7	7.4	7.3	-1.3*	-0.1	-1.4*
	Healthy LE	8.4	7.6	9.0	-0.8	1.3*	0.6	8.8	9.9	10.6	1.1*	0.7	1.8*
70	Total LE	8.6	8.4	8.7	-0.3	0.3	0.1	11.9	11.6	11.9	-0.3	0.4	0.0
	Unhealthy LE	3.8	3.5	3.4	-0.3	-0.1	-0.4	6.5	6.1	5.2	-0.4	-0.9	-1.3*
	Healthy LE	4.9	4.9	5.3	0.0	0.4	0.4	5.4	5.5	6.8	0.0	1.3*	1.3*
80	Total LE	5.5	5.2	5.5	-0.3	0.2	-0.1	7.5	7.0	7.3	-0.4	0.2	-0.2
	Unhealthy LE	3.5	3.1	2.1	-0.4	-1.0*	-1.4*	5.0	4.0	3.5	-1.0	-0.5	-1.5*
	Healthy LE	2.0	2.1	3.4	0.1	1.2*	1.3*	2.4	3.0	3.7	0.6	0.8	1.3*

Note: LE – Life Expectancy
Level of significance for a two-tailed test
Test for statistical significance done for Healthy LE and Unhealthy LE
*significantly different at 5% level from previous time period
The sum of LE in health states might not add up to Total LE because of rounding

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Table 4.3 Proportion of expected lifetime in self-rated good health and bad health for men and women at ages 50, 60, 70 and 80 in South Africa in 2005, 2008 and 2012

		Men			Women		
Age	**Life years**	**2005**	**2008**	**2012**	**2005**	**2008**	**2012**
50	Total LE	100.0	100.0	100.0	100.0	100.0	100.0
	Unhealthy LE	31.8	33.2	31.3	46.7	38.8	37.8
	Healthy LE	68.2	66.8	68.7	53.3	61.2	62.2
	SE	2.1	2.2	1.4	1.6	1.9	1.3
60	Total LE	100.0	100.0	100.0	100.0	100.0	100.0
	Unhealthy LE	35.8	40.7	32.8	49.6	42.7	40.9
	Healthy LE	64.2	59.3	67.2	50.4	57.3	59.1
	SE	3.3	3.3	1.9	2.1	2.6	1.7
70	Total LE	100.0	100.0	100.0	100.0	100.0	100.0
	Unhealthy LE	43.6	41.9	39.2	54.5	52.9	43.4
	Healthy LE	56.4	58.1	60.8	45.5	47.1	56.6
	SE	5.3	5.2	3.2	3.2	4.5	2.7
80	Total LE	100.0	100.0	100.0	100.0	100.0	100.0
	Unhealthy LE	63.2	59.3	38.5	67.7	57.6	48.6
	Healthy LE	36.8	40.7	61.5	32.3	42.4	51.4
	SE	10.0	9.3	7.1	6.3	7.3	5.5

Note: LE – Life Expectancy
The sum of LE in health states might not add up to 100 per cent because of rounding
SE – Standard error for proportion Healthy LE/Total LE

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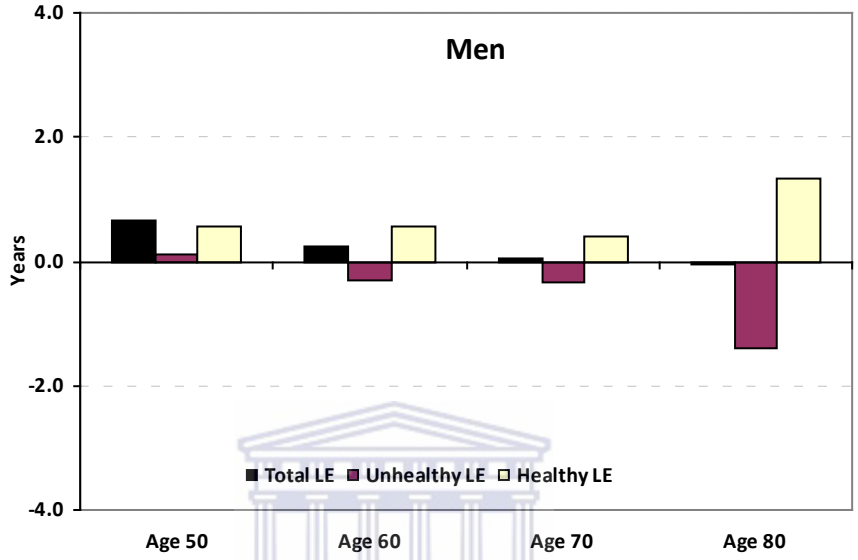
Figure 4.1 Change in total life expectancy (TLE), life expectancy in good health and bad health at ages 50, 60, 70 and 80 for a) men and b) women, South Africa, 2005-2012

a)



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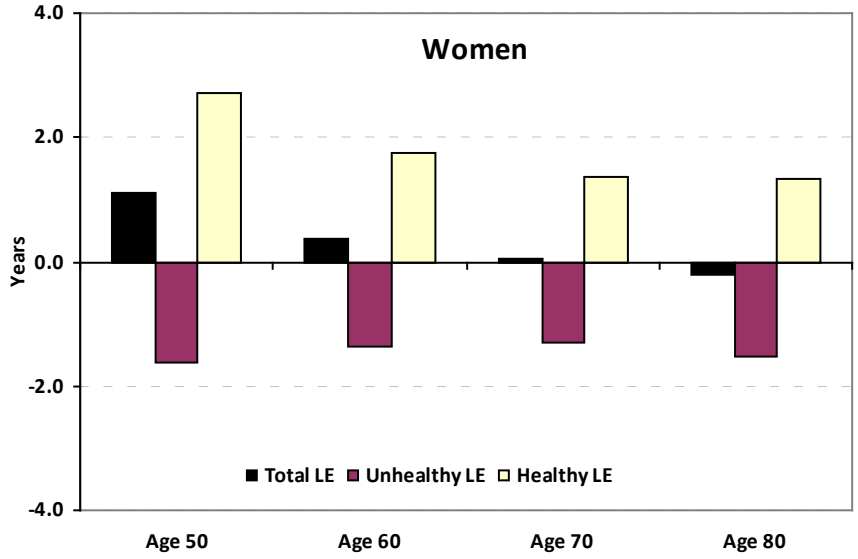
b)



Chapter 5

Gender Differences in Happiness among Older Adults in South Africa

5.1 Abstract

The objective of this paper is to examine factors associated with happiness and to estimate happy life expectancies for older people in South Africa. The study uses data from the first wave of the Study on Ageing and Adult Health (SAGE) data, which is a nationally representative population-based survey with a sample of 3,840 individuals aged 50 years and above. The Sullivan method was used to calculate happy life expectancy, whilst multiple logistic regression was used to examine factors associated with happiness. Similar factors were found to predict happiness in men and women. The strongest predictor of happiness was wealth status for both men (AOR 2.70; 95% CI 1.72-4.24; $p<0.001$) and women (AOR 2.84; 95% CI 1.81-4.47; $p<0.001$). Across all ages, men spent a greater proportion of their remaining lifetime in happiness compared to women. We find a peak at age 70 for both genders, however the rapid decline especially in men could require further investigation. It is important to understand the factors that promote happiness in older people as this may point to areas that need intervention for improving overall quality of life. Happiness is a sensitive measure which can be used to monitor the wellbeing of a nation over time.

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5.2 Introduction

Happiness is the most important global measure of quality of life (QoL), which evaluates the degree to which people are satisfied with life as a whole (Easterlin 2001; Yang 2008; Veenhoven 1984). Many philosophers such as Aristotle have all been fascinated about the subject of happiness, and came to the conclusion that it is the ultimate goal of human existence (Frey 2008). Politicians mainly from developed countries and other settings have started looking at how they can elevate happiness and wellbeing to official government's policy (Bok 2010; Steptoe, Deaton *et al.* 2014). Although happiness has mainly been an area of study in the field of positive psychology, intense interest has spread to other fields. For example economists have recently advocated for 'economics of happiness' as a new area of study (Layard 2005; De Vos 2012; Graham 2005). Demographers and epidemiologists too, wonder if happiness; changes along the life course, differs by socio-demographics e.g. gender, race and income.

Historically, there was a presumption that the quality of life of a nation can largely be measured based on economic indicators such as Gross Domestic Product (GDP) (Veenhoven 1996; Conceição & Bandura 2008). However, as economic growth limits were reached with time, it became apparent that the economic based conceptualization of QoL was inadequate. This led to the movement towards broader 'social indicator' based conception of QoL (Veenhoven 1996). One such indicator is happiness. This is 'positive' measure of overall health and well-being which can be contrasted from other 'negative' measures such as the absence of diseases or functional limitations (Yang 2008). The happiness of a population can be assessed either directly or indirectly (Veenhoven 2005). Indirect measurement involves making inference on the extent of happiness from behavioural manifestations consistent with discontentment and despair. This is the method which has traditionally been used by social scientists/researchers. Such behaviours may include suicides, social uprisings and public protests. However, measuring happiness based on these behaviours has its own shortcomings (Veenhoven 2005). For example people may protest for specific issues, which does not necessarily amount to unhappiness. Similarly, people might commit suicide for circumstantial reasons not totally indicative of unhappiness on the bigger scale. Lately, researchers have shown

preference to using direct way of measuring happiness(Veenhoven 2005). This is typically done in a survey using a question commonly worded as "*Taking all together, how satisfied or dissatisfied are you currently with your life as a whole*?"(Veenhoven 2005). Of course, questions can be raised if subjective measures, in this case self-reported happiness, can adequately capture and summarize quality of life. Critics also argue that most happiness surveys only give one-off snapshots which are susceptible to temporal fluctuations (De Vos 2012). However, in spite of its simplicity, extensive research has shown that the happiness measure has both adequate reliability and validity (Yang 2008; Senik 2014; Sabatini 2014), and psychometric adequacy (Yang 2008). Further, the measure has been found to be correlated to other physiological, psychological and neurological measures (Senik 2014).

Within the context of global ageing phenomena, questions have been raised if increasing life expectancy is being accompanied by increases in health, happiness and quality of life at the older ages (Yang 2008). In other words – are people living longer and happier lives? Similar questions have been asked with respect to health. These questions arise from the realization that increasing longevity does not always equal to improvements in health, happiness and quality of life. In fact, gains in life expectancy at old ages can actually be attained at a penalty of disability, frailty and high dependency (Karcharnubarn *et al.* 2013; Kunst, Okma-VanKeulen 1994), which require costly care. Therefore, mortality based indicators such as life expectancy cannot be a sufficient measure of good quality of life. Health expectancy is an appropriate measure since it combines both morbidity and mortality information. This is defined as the average number of remaining years of life one can expect to live in good health given the prevailing age-specific mortality and morbidity rates. Several health expectancies can be calculated depending on the definition of 'healthy' used (Robine 2002). In this paper we focus on happiness, and hence, the aim is to estimate happy life expectancies (HapLE) for elderly men and women in South Africa. Whilst few similar studies have been done elsewhere (Yang 2008; Veenhoven 1996; Yang & Waliji 2010; Kunst, Okma-VanKeulen 1994), to our knowledge, this is the first study to calculate happy life expectancies for South Africa. The study also investigates factors associated with happiness in older people.

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5.3 Methods

5.3.1 Data sources

The study is based on secondary analysis of the Study on Ageing and Adult Health (SAGE) wave I survey which was conducted in South Africa by the Human Sciences Research Council (HSRC), the World Health Organization (WHO), and the National Department of Health (NDOH). The SAGE is designed to compile comprehensive longitudinal information on the health, well-being, health-related outcomes and their determinants in adult populations. The survey instruments consist of different modules collecting information on self-reported health, disability or functional limitations and well-being. Our analysis is based on wave I data which was collected between 2007 and 2008. The core SAGE collects data on adults aged 18+ years, with an emphasis on populations aged 50+ years, from nationally representative samples in six low-medium income countries (LMIC) namely: China, Ghana, India, Mexico, Russian Federation and South Africa. The survey employs a multistage cluster sampling design, which results in nationally representative cohorts. Further details about the sampling strategy are previously described (Phaswana-Mafuya, Peltzer *et al.* 2012). Household/person-level analysis weights and post stratification are developed to increase representativeness. The overall response rate for those aged 50 and older in the South African survey was 75% (Kowal *et al.* 2012). Ethical approval for the survey was granted by the HSRC Research Ethics Committee (REC 5/13/04/06) and the National Department of Health (J1/14/45).

5.3.2 Measures

Happiness

In the SAGE survey, the question on overall happiness is: *"Taking all things together, how would you say you are these days? Are you…? Very happy, happy, neither happy nor unhappy, unhappy, and very unhappy?"* The first two categories were recoded 1 "happy" whilst the last three were recoded 0 "unhappy".

Self-rated health

This was measured from the question *"In general, would you say that your health is excellent, good, fair or poor?"* A binary variable was created by categorising response categories as; excellent and good as 1 'good health' and fair and poor as 0 'poor health'.

Socio-demographics

The SAGE survey also collected information on; age, sex, educational level, marital status and race. The wealth status of a household was derived from ownership of assets, retirement and retirement benefits, dwelling characteristics and access to services such as sanitation, clean water and cooking fuel. A multi-process was involved which involved converting the assets ownership into an asset ladder, through the application of a random-effects probit model (Chatterji *et al.* 2008). Eventually wealth quintiles created which in this study was latter collapsed to wealth tertiles (1st and 2nd quintiles: low; 3rd quintile: medium; and 4th and 5th quintiles: high).

QoL and Subjective well-being

This measure captures an individual's overall appraisal of their life, and hence it is an important aspect of older people's health. QoL and subjective well-being was measured using the eight-item World Health Organization Quality of Life (WHOQoL) instruments (Schmidt *et al.* 2006; Kowal *et al.* 2010), which is cross-culturally valid tool. The instrument uses questions on overall life satisfaction and questions in each of the four broad domains: physical, psychological, social, and environmental domains. An overall WHOQoL score was then obtained by summing up the eight items, which was then transformed to a 0 to 100 scale. The WHOQoL was dichotomized at the mean such that people with lower scores were considered to be in poor quality of life and vice versa (Porto *et al.* 2012; Van Minh *et al.* 2010).

Limitation of activities

This was measured based on commonly asked activities of daily living (ADLs) (Katz, Ford *et al.* 1963) and instrumental activities of daily living (IADLs) (Lawton & Brody 1969) questions. The questions were asked about difficulties the respondents had in the last 30 days due to health conditions, phrased as "*In the last 30 days, how much difficulty did you have* … (list of activities)". The response categories provide the degree

of severity of disability for each limitation through asking about the level of difficulty i.e. from 'none' to 'extreme difficulty/cannot do'. ADLs are basic daily self-care activities that support survival, including eating, bathing, toileting, bathing, and dressing. A person's functional status is typically assessed from their ability to perform ADLs with an inability to perform ADLs suggesting disability. IADLs are indicators of functional well-being that measure the ability to perform more complex tasks, such as household responsibilities, getting around outside, daily work, managing money, and going out.

5.3.3 Analysis

Multiple logistic regression was used to assess the association between happiness and self-rated health. Covariates included; age, wealth status and race. Education and marital status were excluded since they were not significant in both univariate and multivariate analysis. Multicollinearity was checked to ensure the exposure variables were not highly correlated. This was assessed using the variance inflation factor (VIF), condition index and tolerance values, and none of the variables came close to the threshold. The data were analysed using STATA 12 (StataCorp 2011), incorporating the complex sampling design of the two surveys by using the '*svy*' commands in obtaining all estimates. Only people aged 50 years and over were included in the analysis, and in regression analysis the models were stratified by gender. Odds ratios (ORs) and 95% confidence intervals (95% CI) were used to determine the association between the outcome and exposure variables. The strength of associations based on the ORs was ranked as follows; 0.9–1.1 (no effect), 1.2–1.6 (weak association), 1.7–2.5 (moderately strong association), 2.6 and more (strong association). In the case of negative association the ranking was; 0.6–0.8 (weak), 0.4–0.5 (moderately strong), and 0–0.3 (strong association) (Sahai & Khurshid 1996).

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The Sullivan method (Sullivan 1971) was used to calculate the happy life expectancy. This is the commonly used method when calculating 'healthy life expectancies' using cross sectional data. This method utilises age-specific prevalence of happiness to partition the number of person-years into happy and unhappy years. The other method also used to calculate healthy life expectancies is the multistate method

which utilises incidence data to estimate multistate life tables (Rogers *et al.* 1990). The data required for this method usually comes from longitudinal studies, which are not usually available because of the costs involved. As a result, the prevalence based method is most commonly used. In summary, the Sullivan method works as follows: a period life table is created to obtain age and sex specific life expectancy estimates. These are based on person years lived assuming that future cohorts will experience observed age-specific mortality rates. The following step is to divide the person years lived by the corresponding age-specific prevalence rates of a health state (which is happiness in this case). Hence, happy life expectancy will be obtained which can be interpreted as the number of remaining years a person can be expected to live in happiness assuming that they experience the prevailing mortality and happiness rates. The Sullivan method is regarded to produce unbiased and consistent estimates (Imai & Soneji 2007), and simulations have shown the Sullivan method to produce results similar to the multistate method, except in cases where there are sudden fluctuations in transition rates (Mathers & Robine 1997). The ages-specific prevalence data on happiness were obtained from the SAGE surveys mentioned above. The life expectancy estimates were obtained from life tables published by the UN (United Nations Population Division 2013) for the period 2005-2010 i.e. corresponding with the year of the SAGE survey. Standard errors and 95%CIs were calculated following the guidelines suggested by the International Network on Health Expectancy (Jagger, Cox *et al.* 2006).

5.4 Results

5.4.1 Sample characteristics

Table 5.1 presents the age-specific prevalence rates (%) of 'happiness' and 'unhappiness' for older men and women. At the youngest of the age groups (50-59) the prevalence of happiness is actually the same for men and women. However, the prevalence of happiness is higher in men than women and the gap gets wider with increasing age. For both gender, the highest prevalence rates of happiness are in the 70-79 year age group i.e. 72 and 62 per cent for men and women, respectively.

5.4.2 Factors associated with happiness

Multivariable logistic regression analysis was used to investigate the association between happiness and predictor variables identified from literature (Table 5.2). In the adjusted models, we find a moderately strong positive association between self-rated health and happiness for both genders – men (OR 2.5; 95% CI, 1.33-4.80) and women (OR 2.4; 95% CI, 1.55-3.68). A moderately strong association was found between age and happiness. Men aged 70-79 years were 2.2 times (95%CI, 1.29-3.62) more likely to be happier than men i.e. 50-59 years old. Women aged 70-79 and 80 years and above were 1.8 times (95%CI, 1.09-2.91) and 1.6 times (95%CI, 1.23-5.42) more likely to more happy than those aged 50-59 years, respectively. In men, race also had a modest but significant association with happiness in that whites and coloureds were 2.2 times (95%CI, 1.01-4.71) and 2.3 times (95%CI, 1.35-3.96) respectively more likely to be happier than African Black men. In women, the effect of race disappeared after adjusting for other predictor variables. ADL limitations had the same moderately strong negative effect for both men (OR 0.5; 95% CI, 0.31-0.79) and women (OR 0.5; 95% CI, 0.35-0.83). IADL limitations had the same negative effect as ADL limitations in women (OR 0.5; 95% CI, 0.29-0.86). The strongest predictor of happiness in both men and women was wealth status. Men in high wealth tertile were 2.7 times (95%CI, 1.72-4.24) more likely to be happier than men in low wealth tertile. On the other hand, women in medium and high wealth tertile were 1.9 times (95%CI, 1.13-3.07) and 2.8 times (95%CI, 1.81-4.47) respectively more likely to be happier than poorer women.

5.4.3 Happy life expectancy

Table 5.3 presents the estimates of total life expectancy (TLE), happy life expectancy (HapLE) and 95% confidence intervals, unhappy life expectancy (unHapLE) and percentage of HapLE to TLE by sex for ages 50, 60, 70 and 80. The results show that at all ages women have higher life expectancy and HapLE compared to men. A 50 year old woman can still expect to live on average 23 years, of which 13 years will be lived in happiness. On the hand, a man of the same age will can expect to live 18 years more, and of these 11 years will be spent in happiness. However, women also have greater unhappy life expectancy across all the ages. For example at age 50, the unhappy life expectancy for women is 10 years whilst for men it is 7 years. This is further illustrated in Figure 5.1a & b for men and women, respectively. Further,

when examining the life expectancies proportionally, it can be seen clearly that the proportions of life spent in happiness is greater for men than women. A 70 year old man can expect to live more than two thirds (70 per cent) of his remaining life in happiness, whilst a woman of the same age would expect to live 60 per cent of her remaining live in happiness. These findings imply that older women live longer than men but spent a greater proportion of their lifetime in unhappiness. This is shown clearly in Figure 5.2. On the same figure, the proportions of life spent in good quality of life are also shown. It is interesting to see that the trajectories for happiness and quality of life were similar for both genders, and that the proportion of remaining life in happiness was higher than the proportion of remaining quality of life. This can be attributed to the fact that quality of life is a broader measure which is composed of economic, physical, psychological, and environmental dimensions.

5.5 Discussions

The purpose of this study was twofold. The first purpose was to investigate factors associated with happiness, and the second was to estimate happy life expectancy for older people in South Africa. Similar to other studies(Easterlin 2003; Diener & Chan 2011), we found that good health was associated with happiness. As discussed later, caution needs to be exercised in interpreting associations from cross-sectional designs as causal. Notwithstanding, this is an important finding which calls for pursuit of both goals i.e. happiness and health in policies and programmes, targeting older people. Similarly, although temporal precedents cannot be established based on our data, this association is consistent with the theoretical conception about health and happiness (Diener & Chan 2011; Sabatini 2014; Frey 2011; Cowell 2008).

The relationship between wealth status and happiness has been found to be puzzling (Easterlin 2001). There would appear to be a dose-response relation between wealth and happiness, such that poorer people are less happier compared to the wealthier ones. However, there is a ceiling effect of wealth beyond which further accumulation does not add more happiness, a scenario called the 'happiness-income paradox' or the 'Easterlin paradox' (Easterlin *et al.* 2010; Senik 2014). This was observed at an aggregate level in developed countries where GDP and material status was initially used as a measure of nation's happiness and quality of life (Veenhoven 1996). However, 'saturation' levels were reached which led economists and other

researchers to abandon this materialistic approach to QoL and started using other social indicators (Veenhoven 1996). Japan is a typical example that confirms that a country's level of happiness does not increases as a nation transitions from being a low income to high income country (Easterlin 1995; Conceição & Bandura 2008). In the South African context, our results seem to suggest that the threshold effect of wealth status has not yet been attained, and as such, wealth is still the strongest predictor of happiness. Surprisingly, the famous Brickman study (Brickman *et al.* 1978) from the USA found no significant difference in happiness levels between lottery winners and the controls who were living in the same neighbourhood. Even more surprisingly, they found that paraplegics were marginally less happy than the lottery winners, and both groups reported almost similar levels of anticipated future happiness. However, critics (Powdthavee 2010) have questioned the results of the Bricks study because of its cross-sectional design, from which no causality can be deduced, and its small sample sizes.

As expected, our results show that disability is negatively associated with happiness. Functional limitations, especially ADL was found to have a moderately strong association with happiness for both genders. The effect of disability on happiness has also been established in previous studies (Boyce & Wood 2011). Our results show that self-rated health is a stronger predictor of happiness compared to disability, which is in line with other studies (George 2010). Although the ADL is a composite measure of disability, it could be important in future studies to examine the associations with each specific dimension, since they have been found to be of a hierarchical nature (Willis 1996). In women, the variables self-rated health and IADLs were predictive of happiness in multivariable but not in univariate models. This apparent inconsistency between the univariate and multivariable analysis is not unusual, and can be due to accumulation of evidence from several variables incorporated in the adjusted model (Manly 2005). This goes on to confirm that unadjusted or raw results from univariate analysis can often be biased due to confounding factors or interrelationships between other extraneous factors, not accounted for. In this case, age, wealth status and race come in the relationship between self-rated health, IADLs and happiness.

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Racial inequalities in happiness were also shown in that White and Coloured men were more likely to be happier than Black men. Studies from other settings have also reported substantial racial gaps in happiness between Whites and Blacks (Yang 2008; George 2010). In South Africa, this finding can be situated within the historic context of the country. The sample in this study is of older people who lived much of their lives under the apartheid system, and therefore this can be reflective of the socioeconomic inequalities along racial lines brought by apartheid systems. Similar cohort effects have been observed in social disparities in health and happiness (Yang 2008). It would be interesting to continue and monitor these racial gaps in happiness and quality of life in future years for younger cohorts who might have later benefitted from the Broad-Based Black Economic Empowerment (B-BEEE) initiatives implemented to reverse these inequalities. Also, it would be important in future studies to estimate happy life expectancy by race, which was not done in this study because the life tables used were not disaggregated by race.

A USA study (Yang 2008) reported; total life expectancy (16.2 in men; 19.1 in women), happy life expectancy (14.7 in men; 16.5 in women) and proportion of life in happiness (90.6 for men; 86.5 for women), at age 65 years in 2000. These estimates are much higher compared to the ones from this study, taking age 60 for rough comparison (see Table 5.3). It is clear that older Americans spent higher proportion of their remaining life in happiness compared to their South African counterparts. This difference can be attributed to differentials in distribution of underlying determinants of happiness between the two countries. In line with this, according to the World Database of Happiness, USA ranks much higher than South Africa in terms of average happiness (Veenhoven 2014).

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The proportion of life spent in happiness increased from age 50, crested at age 70 and plummeted thereafter. This result lends support to a previous longitudinal study of healthy veterans which also found that happiness changes along the life course. In that study, they found a peak in men at age 65 which started declining at age 75 (Mroczek & Spiro 2005). Along the life course, it has been found that the relationship between age and happiness is actually U-shaped (Conceição & Bandura 2008; Powdthavee 2005; Steptoe, Deaton *et al.* 2014), with minimum point around the 30s and 40s, which is synonymous with 'midlife crisis'. Although we only have

data for 50 years and above, our results lend partial support to the suggested shape in that we observe a rise after the middle ages through the 60s. An important contribution we make in this regard is that our findings suggest a peak in the old ages at age 70, which somewhat transforms the U-shape into an S-shape. The graphs for quality of life follow the same pattern with the ones for happiness but at lower levels, because quality of life is a composite measure that includes many other dimensions from economic, physical, social and environmental. It can be speculated that the increase coincides with the age ranges when people will be entering retirement phase. Studies have also found retirement to be good predictor happiness (Easterlin 2003). During these years older people are happy as they start enjoying their long waited retirement period and pension funds. The mere fact of reaching retirement age, and being called a "senior citizens" comes with some sense of pride, achievement and happiness. The plummeting of the graphs beyond age 70 can also be the effect of hedonic treadmill or hedonic adaption. This is whereby individuals quickly return to their normal levels of happiness and satisfaction following a major positive event or occurrence in life that had triggered the initial sudden rise in happiness (Brickman & Cambell 1971). In this case it can speculated that soon after reaching the sixties and seventies, the euphoria of entering retirement age dies out as people start adjusting to living on pension and retirement savings, which in most cases are not enough. Another possible contributory factor within the South African context could be HIV and AIDS. The impact of AIDS on older people in South Africa is that they have been left to look after their children and grandchildren who are either sick or orphaned. This caregiving responsibilities brings additional physical and psychosocial strain upon old people, who themselves actually need to be looked after (Joubert & Bradshaw 2004). Further realities that come with old age include increased burden of age-related chronic conditions e.g. diabetes, hypertension, arthritis and other conditions prevalent at these ages. Ironically, although most of the risk factors for these conditions are accrued over the life course, they might be worsened at these ages e.g. lack of physical activity, since most elderly people would spend most of their time seated at home, which they were not used to. Access to health at the older ages could be another factor. The majority of South Africans in general (Mayosi & Benatar 2014), and older people in particular (Joubert & Bradshaw 2004), rely on the public sector for health services, which is offered free of charge to senior citizens.

However, high levels of dissatisfaction with the public sector among older people have been reported (Joubert & Bradshaw 2004; Ferreira, M & Charlton 1996). The grievances cited include; shortages of drugs, inefficient systems and lack of assistive technology needed by older people with functional limitations(Joubert & Bradshaw 2004). Only a small proportion of older people have access to medical aid, especially among Black Africans (Statistics South Africa 2013; Joubert & Bradshaw 2004). Medical cover becomes expensive postretirement where more frequent visits to healthcare facilities are required due to chronic conditions.

The gender gap is also reflected, which shows that men are at an economic advantage. In general, more men are in employment, have higher levels of income and hence have more money to retire on compared to women. On the other hand, women suffer more from negative effects of widowhood and marital disruptions (Easterlin 2003). Women as a result, become financially dependent on men at the old ages. This is evidenced in Figure 5.2 where the graph of women has the same shape and peak with that of men, although it is much flatter. Gender differentials in happiness have been reported to change along the life course (George 2010; Easterlin 2003). Young women are happier than young men prior to middle age, and the reverse is true thereafter (Yang 2008). Our results seem to partially substantiate this finding, although we cannot establish the pattern in the young ages from our data. The evidence is shown in Figure 5.2, where the graphs for men and women converge at age 50, although we cannot tell if this is the point of crossover. Thereafter, the gender gap increases with age and increases even more at the peak (age 70). The point of crossover implied by our results is much lower compared to the one reported by Easterlin (Easterlin 2003), which was between ages 58-67. This further highlight that South African women's relative advantage in happiness is shorter compared to other settings. Another possible explanation for the higher proportions in happiness in older men could be selective survival i.e. happier and healthier men are more likely to be the ones reaching these ages. However, this effect can only be tested in the next follow-up wave of SAGE. The other potential explanation given the high mortality among men is a comparison effect. This is whereby older adults cherish life and are happy because they compare themselves to their peers who might be in a worse state or have died (Conceição & Bandura 2008; Jagger *et al.* 2010).

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The limitation of this study is that it did not take into account institutionalized persons because such data were not available from the survey. If persons residing in institutions are less happy and have poor quality of life compared to those in the community, then excluding them might overestimate HapLE, especially at the oldest ages. Our assumption here is that institutionalised persons have generally the same characteristics and happiness levels as those in the community, and that number is negligible.

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Table 5.1 Age-specific prevalence rates of 'Happy' and 'Unhappy' status for older South Africans by sex, SAGE data

	Happy			Unhappy		
	%	95% CI Lower	95% CI Upper	%	95% CI Lower	95% CI Upper
Men (N=1460)						
50-59	55.5	48.8	62.1	44.5	37.9	51.2
60-69	60.8	53.5	68.0	39.2	32.0	46.5
70-79	71.6	62.0	81.2	28.4	18.8	38.0
80+	62.5	43.4	81.6	37.5	18.4	56.6
Women (N=1998)						
50-59	55.4	49.2	61.7	44.6	38.3	50.8
60-69	58.7	51.5	65.9	41.3	34.1	48.5
70-79	62.4	53.5	71.3	37.6	28.7	46.5
80+	55.6	41.5	69.7	44.4	30.3	58.5

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Table 5.2 Factors associated with happiness among old men and women: South Africa, SAGE data

	Males		Females	
	UOR (95% CI)	**AOR (95% CI)**	**UOR (95% CI)**	**AOR (95% CI)**
Self-rated health				
Poor	1	1	1	1
Good	3.53 (1.71-7.27)***	2.52 (1.33-4.80)**	2.74 (0.92-8.15)	2.39 (1.55-3.68)***
ADL limitations				
None	1	1	1	1
One or more	0.16 (0.07-0.33)***	0.50 (0.31-0.79)**	0.27 (0.12-0.61)**	0.54 (0.35-0.83)**
IADL limitations				
None	1	1	1	1
One or more	0.23 (0.12-0.46)***	1.09 (0.57-2.09)	0.40 (0.15-1.05)	0.50 (0.29-0.86)**
Age (years)				
50-59	1	1	1	1
60-69	1.24 (0.83-1.86)	1.46 (0.97-2.21)	1.14 (0.81-1.61)	1.27 (0.87-1.85)
70-79	2.02 (1.15-3.56)*	2.16 (1.29-3.62)**	1.34 (0.86-2.08)	1.78 (1.09-2.91)*
80 +	1.34 (0.57-3.14)	2.01 (0.83-4.88)	1.00 (0.57-1.79)	1.58 (1.23-5.42)*
Wealth status				
Low	1	1	1	1
Medium	1.36 (0.44-4.19)	1.16 (0.68-2.00)	2.32 (0.70-7.87)	1.86 (1.13-3.07)*
High	3.89 (1.53-9.88)**	2.70 (1.72-4.24)***	4.55 (1.88-11.0)***	2.84 (1.81-4.47)***
Race				
African	1	1	1	1
White	6.05 (1.53-23.1)*	2.18 (1.01-4.71)*	4.73 (1.12-19.9)*	2.66 (0.95-7.44)
Coloured	1.00 (0.33-3.09)	2.31 (1.35-3.96)**	1.11 (0.26-4.80)	1.70 (0.98-2.95)
Indian	2.00 (0.53-7.49)	1.10 (0.55-2.19)	2.11 (0.52-8.45)	1.32 (0.47-3.70)

UOR – Unadjusted Odds Ratio;
AOR – Adjusted Odds Ratio;
CI – Confidence Interval;
****P<.001; **P<.01;*P<0.5*

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Table 5.3 Total LE, Happy LE, Unhappy LE and Proportion of life spent in happiness by age and sex, South Africa

Sex, Age	Total LE	HapLE	95% CI	UnHapLE	Proportion of life in Happiness	Difference in TLE ¥ (Women -Men)
Men						
50	18.4	11.0	(10.2; 11.8)	7.3	60.0	4.6
60	12.9	8.3	(7.5; 9.0)	4.6	64.1	4.3
70	8.4	5.8	(5.1; 6.5)	2.5	69.6	3.1
80	5.3	3.3	(2.3; 4.3)	2.0	62.5	1.6
Sex, Age	Total LE	HapLE	95% CI	UnHapLE	Proportion of life in Happiness	Difference in HapLE (Women -Men)
Women						
50	22.9	13.3	(12.3; 14.2)	9.7	57.8	2.2 †
60	17.2	10.2	(9.3; 11.1)	7.0	59.4	2.0 *
70	11.5	6.9	(6.1; 7.8)	4.6	60.2	1.1 †
80	6.9	3.8	(2.8; 4.8)	3.0	55.6	0.5 ns

Note: LE- Life Expectancy; 95%CI – 95% Confidence Interval;
The sum of LE in happiness states might not add up to Total LE because of rounding;
Differences in TLE = Differences in Total life expectancy from women to men;
Differences in HapLE = differences in Happy Life Expectancy from women to men
Level of significance for a two-tailed test
ns = not statistically significant
¥ Differences are not tested for statistical significance
†P<0.01; *P<0.001.

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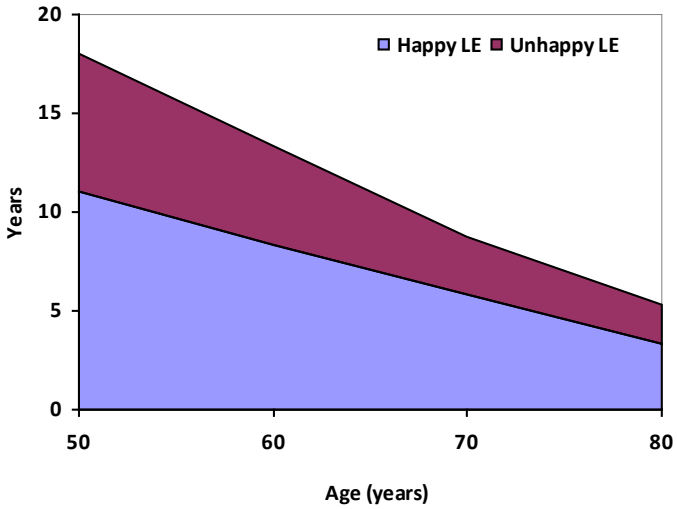
Figure 5.1 Expected years in happiness and unhappiness for a) men and b) women, South Africa

a) Men



b) Women

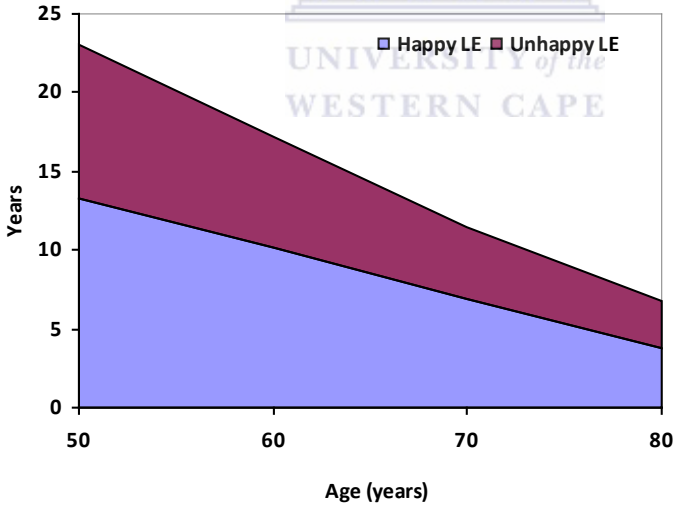


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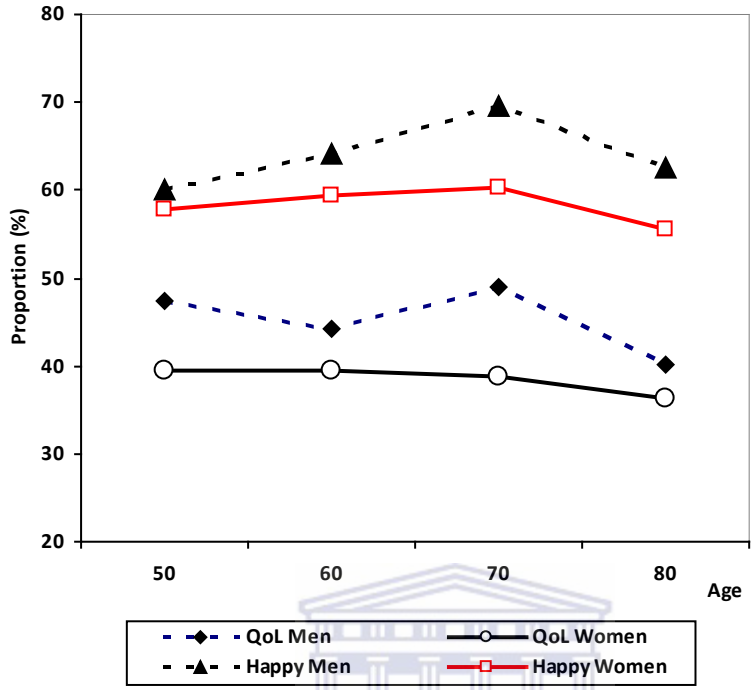
Figure 5.2 Proportion of remaining life spent in happiness and good quality of life for men and women, South Africa



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Chapter 6

Estimation of Healthy Life Expectancies: a novel approach to studying population health in South Africa

6.1 Abstract

The objective of this study is to estimate healthy expectancies in the following domains: self-rated health, functional limitations and quality of life. To our knowledge, this is the first study to report healthy expectancies in multidimensional health domains for South Africa. The data used was from the WHO-Study on Ageing and Adult Health (SAGE) survey, which was conducted in 2008 in South Africa. The SAGE survey is a nationally representative study of elderly people with a sample of 3,840 people aged 50 years and older. Health expectancies were calculated using the Sullivan method, whilst the association between self-rated health, functional limitations and quality of life were assessed using multiple logistic regression. The study found that healthy life expectancies were highest when measured by self-rated health and lowest by quality of life for both genders. Independent life expectancy was higher in instrumental activities of daily living (IADLs) than in activities of daily living (ADLs). Gender differentials were evident in that women live longer but in poorer health and quality of life compared to men. The mean duration with functional limitations in ADLs and IADLs was longer for women than men. Interventions are required to prevent, delay onset and improve quality of life of older people with disabilities.

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6.2 Introduction

Globally, populations are growing older at a faster pace than ever before (WHO 2011). In fact, population aging is thought to be one of the main drivers of social, demographic and epidemiological transformations of societies across the globe in the future (World Economic Forum 2014). There is evidence suggesting that in decades to come population aging will be actually more speedy and extensive in developing regions than it has been elsewhere (United Nations 2007; Kinsella & He 2009; Olshansky *et al.* 2011). For example in the case of South Africa, the United Nations projects that the proportion of older people aged 60 years and older would more than double form seven (7) per cent in 2005 to 16 per cent in 2050 (Anon 2013). Life expectancy at birth in South Africa has also increased from; 54.6 to 58.5 (men) and 59.7 to 64.0 (women) between 2009 and 2012 (Dorrington, Bradshaw *et al.* 2014), and this is projected to further increase in the future (Actuarial Society of South Africa (ASSA) 2011). Whilst population aging is a success story, it also comes along with challenges such as increased health and long-term social care costs for the elderly, who are more vulnerable to chronic diseases and disability (Kinsella & Phillips 2005; UNFPA & HelpAge International 2012). As a result, there is a shift of late from narrowly focusing on aging in terms of mortality based indicators such as increasing life expectancy, towards a broader view that encompasses health and wellbeing (Crimmins 2004). The question of interest among demographers, epidemiologists and other health planners is whether the long lives are being spent in good health and quality of life.

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The underlying factor is that mortality and morbidity should no longer be studied separately, in order to answer the question above. There is therefore need to obtain a summary measure that combines both mortality and morbidity information into a single index. The idea of generating a summary measure of health was first suggested about half a century ago by Sanders (Sanders 1964).Years later, Sullivan (Sullivan 1971) developed the computational technique for healthy life expectancy. Since then, there has been an increase in the number of studies reporting healthy life expectancies for various countries (Robine & Jagger 2003). Healthy life expectancy is an umbrella term for all population based measures that calculate expected life time (in years) in various health states, by combining information on morbidity and

mortality. As such, different healthy life expectancies can be estimated depending on the definition of 'healthy' used (Christensen, Doblhammer *et al.* 2009; Molla *et al.* 2001). Commonly used measures include; disability-based (Disability Free Life Expectancy), disease-based (e.g. Dementia-Free Life Expectancy) and healthy life expectancy based on self-rated health, among others. The use of different measures to describe health is necessitated by the fact that health is complex and multidimensional concept that can be effectively captured by use of several indicators (Christensen, Doblhammer *et al.* 2009; Crimmins 2004). Unfortunately, this also creates a problem in that it makes comparisons difficult since different definitions are used. Further, even if the same measures are used, variations in wording of questions, cultural interpretations, and study designs still make it difficult to compare results from different settings. Researchers from different organizations and networks (e.g. REVES[1], WHO, and Eurostat) have been working on promoting the use of healthy expectancies in policy decisions, and harmonizing methods and measures to make estimates comparable across countries (Murray *et al.* 2002; Crimmins 2004).

Little is known about the health states spend in by older people in developing countries, including South Africa. One study used the Sullivan method to calculate DFLE in South Africa using the 1996 census (Phillips & Noumbissi 2004). There are no studies which have calculated healthy life expectancies in multidimensional domains in South Africa. The aim of this paper is to give the first comprehensive investigation of health expectancies for South Africa, based on several measures of health. The paper also intends to contribute to the existing body of international literature on health and aging by bringing on board the perspective from high mortality settings.

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6.3 Methods

6.3.1 Data sources

The prevalence data used in this study were obtained from the WHO-SAGE survey. SAGE is also conducted in five other low-medium income countries which are; China, Ghana, India, Mexico and Russian Federation. The SAGE used in the study

1 Reseau Esp´erance de Vie en Sant´e (the international network on health expectancies and the disablement process)

was conducted by the WHO in collaboration with the Human Sciences Research Council (HSRC) and the National Department of Health (NDOH). The SAGE survey is designed to be a prospective longitudinal follow-up survey, and in this study we use the baseline (wave I) data collected between March 2007 and September 2008. The targeted sample consists of 5000 old people aged 50 and older, and for age comparisons, a smaller cohort of 1000 people aged 18-49 is also included. The HRSC's master sample designed from the 2001 census Enumerator Areas (EAs) from Statistics South Africa was used as the sampling frame. A total of 600 EAs were sampled from the master sample stratified by Province; Geotype; and Race in urban EAs. This constituted the primary sampling unit (PSU). From each of the 600 EAs, a circular systematic unit was used by fieldworkers to select 15 households which made up the secondary sampling units (SSU). In order to reach the sample size targets, oversampling of households with older people was done. Sampling weights were calculated for each stage in the sampling process. These were applied in deriving the age-specific prevalence rates of the health states, using the *'svy'* commands in statistical software package STATA12 (StataCorp 2011). For those aged 50 and older, the response rate was 75 per cent (Kowal *et al.* 2012). Age heaping is considered to be an indicator of data quality and consistency. Age-misreporting is a common problem especially with older people, and the educationally disadvantaged. In SAGE, the interviewers verified the respondent's date of birth with their birth certificates during the interviews. The Myers's Blended Index is usually used to evaluate accuracy of age reporting, and this Index also indicates if there is any age heaping on an end digit. The theoretical range of the Index is from 0 to 99, where 0 represents no heaping and 90 represents heaping at all reported ages (Myers 1940; Shryock & Siegel 1976). For SAGE, the Myer's Index for the SAGE Wave 1sample was 3.3 (Phaswana-Mafuya, Peltzer *et al.* 2012), which shows that there was no evidence of age heaping. The SAGE survey is a nationally representative population based survey involving multi-stage stratified probabilistic sampling techniques. Further detailed description of the sampling methods are previously described (Phaswana-Mafuya, Peltzer *et al.* 2012). The instruments and design of the SAGE survey are largely adapted from the World Health Survey (WHS) and other similar surveys on ageing such as Health and Retirement Survey (HRS) from the USA and the English Longitudinal Study of Ageing (ELSA). The surveys consist of multiple modules used to collect information

on socio-demographics, overall health and well-being, functional status, chronic conditions and their risk factors. Other information collected include: anthropometric measures including; height and weight, hip and waist circumference; biomarkers; blood pressure, heart rate, and dry blood spot; and performance tests; walking speed, grip strength, spirometry, cognitive battery, near and distance vision. Ethics approval for the SAGE survey was granted by the HSRC Research Ethics Committee and WHO's Ethical Review Committee.

6.3.2 Measures[2]

Self-rated health status

This is a subjective measure of one's health which captures both disability and sub-clinical conditions, hence giving a holistic approach to health (Robine & Jagger 2003). Self-rated health status (SRH) was assessed by the question "*In general, how would you rate your health today*?" The responses were rated on a 5 point scale; 1 'very good', 2 'good', 3 'moderate', 4 'bad', and 5 'very bad'. In the analysis, this was recoded as 1/3=0 'good health' and 4/5=1 'poor health'. Self-rated health is normally used as an overall indicator of global health (Van Oyen, Cox *et al.* 2008), and it gives a complete, rather than partial measure of health (Robine & Jagger 2003). It is also a proxy measure for other composite measures such as dementia and Health-related Quality of Life (HRQoL), which is usually measured by asking several questions (Karcharnubarn *et al.* 2013; Robine & Jagger 2003). Studies have also shown self-rated health to be associated with other health measures, and to be a good predictor of mortality in South Africa (Ardington & Gasealahwe 2014). Self-rated health can be used to calculate self-rated health life expectancy (SRHLE), which is health expectancy free of poor self-rated health.

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Activity limitations

Functional health was assessed at two levels namely; basic level - Activities of Daily Living (ADLs) and advanced level - Instrumental Activities of Daily Living (IADLs). The ADLs - a set of daily self-care activities that assess the need for help with personal care activities such as eating, bathing, and dressing. The IADLs – include

[2] See Table 6.1 for a complete description of the selected questions from the SAGE survey

carrying out household responsibilities, daily work, higher-level functioning considered necessary to live independently (see Table 6.1). Older people who reported being able to perform ADL and IADL activities without any difficulties were categorized as independent, whilst those who reported a difficulty in at least one activity were categorized as dependent. Both ADL and IADL measures are important because they indicate the need for social and health care services (Cambois *et al.* 2008; Jitapunkul & Chayovan 2000).

Quality of life

The quality of life measure, together with self-rated health described above, are complex latent constructs of global health and life as a whole (Robine & Jagger 2003; Hirve, Oud *et al.* 2014). The eight-item WHO Quality of Life and Well-being (WHOQoL) instrument was measured from responses to questions on overall life satisfaction and specific aspects of life in four broad domains: physical, psychological, social and environmental (Schmidt *et al.* 2006; Kowal *et al.* 2010). The eight items were summed to get an overall WHOQoL score, which was later transformed to a 0 to 100 scale. For the purposes of this study, a binary variable was created by dichotomizing the WHOQoL variable at the mean such that scores below the mean would mean poor quality of life and vice versa (Porto *et al.* 2012; Van Minh *et al.* 2010).

6.3.3 Analysis approach

The prevalence-based Sullivan (Sullivan 1971) method was used in the calculations of the different healthy expectancies. This method uses the age-specific prevalence rates of health states to divide the person years lived within the same age category into expected years in healthy and unhealthy states. The age-specific prevalence rates for each health state were obtained from the SAGE survey, as described above. The mortality data were abridged life tables published by the United Nations (Anon n.d.). In this study the life tables for 2005-2010 were used i.e. corresponding to the year of the survey - 2008. The healthy life expectancy at age x (HLE_x) is calculated using the following method;

$$HLE_x = \frac{1}{l_x}\sum_{x}^{\omega}(1-{}_n\pi_x)\,{}_nL_x$$

Where l_x is the number of survivors at age x; $(1-{}_n\pi_x)$ is age-specific rate of being in good health; ${}_nL_x$ is the total number of years lived in the interval (x, $x+n$), and ω is the oldest age group. The above formulae therefore combine morbidity $(1-{}_n\pi_x)$ and mortality (l_x and ${}_nL_x$) components. Random variation was assumed to arise from the SAGE survey only. The HLE_x is the average number of remaining years that an individual is expected to live in good health state, depending on definition of health used. In the case of Independent life expectancy (ILE) in ADL, this would mean the average number of years a person is expected to live free of ADL dependence. Otherwise stated, it is the number of years one can expect to live independently, without any functional limitation (ADL) requiring assistance or a complex assistive device. The same meaning applies to Independent life expectancy (ILE) in IADL. The two - ILE and its complement, LED (expectation of life with dependent disability), add up to TLE (total life expectancy) i.e. TLE = ILE + LED. The advantage of using the Sullivan method is that it combines morbidity data (based on the different health states) and mortality data obtained from separate sources to create a single measure of population health. The limitations of the methods are that it does not take into account mortality by health states and transitions between different health states and death (Jagger, Cox *et al.* 2006). This study does not attempt to derive trends over time, due to unavailability of such data. Rather, the intention is to produce for the first time, period healthy life expectancies based on several health measures in order to give a comprehensive description of the health of older South Africans. In this study, the estimation of health life expectancies is stratified by gender since this has been shown to be an important differential especially at the older ages (Jagger 1997).

Multiple logistic regression was used to assess the association between self-rated health, functional limitations and quality of life, controlling for other socio-demographic factors namely; age, sex, income and race. Adjusted Odds Rations (AOR) and the corresponding p-values and 95% confidence intervals (CIs) are reported.

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6.4 Results

6.4.1 Age-specific health prevalence rates

Four health indicators were used in this study, namely; self-rated health, ADL, IADL and QoL. The age-specific prevalence rates for the health indicators are shown in Table 6.2. From this table, the SAGE survey shows that the prevalence of poor self-rated health generally increases with age for both men and women. The gender differences in prevalence of poor self-rated health are not too clear below age 70. However, it appears men report poorer health than women at the oldest ages i.e. 80 and above (29 vs. 25 per cent), though at these ages the estimates are rendered unreliable due to age misreporting and likely small numbers. The SAGE survey also shows that functional disability (ADL and IADL) also tend to increase with age for both gender. The proportion of older people reporting one or more ADL limitation is higher among women than men across all age groups. Similarly, the proportion reporting one or more IADL limitations is also higher among older women except for the age group 70-79. The other indicator assessed is QoL and well-being. According to the results, older women also reported poor quality of life than men across all age group. In women, there is little variation with age in poor quality of life, whilst in men – those aged 70-79 years report better quality of life compared to those in adjacent age categories (i.e. 60-69 and 80+). The confidence interval (95% CI) across all the health indicators gets wider with increasing age due to smaller sample sizes at the oldest ages.

6.4.2 Self-rated Healthy Life Expectancies

Table 6.3 and Figure 6.1 show the healthy life expectancy based on the indicator-self-rated health. According to the results, a woman aged 50 years could expect to live a further 23 years, of which 19 years (82 per cent) would be in good self-rated health. A man of the same age group would expect to live 18 years more, of which 15 years (83 per cent) would be in good health self-rated health. Whilst the total LE and Self-rated Healthy Life Expectancies (SRHLE) is higher for women than men across all age groups, the proportion spent in good self-rated health is generally higher for men than women until the last age group (80+) (see Table 6.3 and Figure 6.1). It is

also important to note that the number of years in poor self-rated health is also higher for women than men across all ages (Table 6.3).

6.4.3 Independent Life Expectancy in ADLs and IADLs

The same pattern described above is also observed with ADLs and IADLs (see Table 6.4 & Table 6.5 and Figure 6.2 & Figure 6.3, respectively). Women have higher absolute years free of ADL and IADL limitations than men. However, when examined proportionally, it is evident from Figure 6.2 & Figure 6.3 that men spend a greater proportion of their remaining life independent in ADLs and IADLs, respectively. For example the proportion at age 50 are 68.9 and 57.7 for men and women respectively. The only exception to this is in IADLs at the oldest ages (80+), where the proportion for women is slightly greater than that for men by two percentage points (60 vs. 58). It is interesting to note the similarities in proportions between SRHLE described above and IADLs. In both graphs, the proportions are greater for men than women below age 70, and thereafter the reverse is true. Figure 6.4 shows the mean duration when one is expected to be dependent in ADLs and IADLs. According to this figure, the gender gap between the ADLs graphs is by far wider than that of IADLs. This means women spend longer durations with functional limitations compared to men. For example at the 'younger ages' (50-59) women approximately spend twice as much time with functional difficulties compared to men (i.e. 9.6 vs. 5.7 years). Another way of looking at the results is to calculate the durations only with ADL limitations but free from IADL limitations. This is obtained by getting the difference between the durations with ADL limitations (Table 6.4) and IADL limitations (Table 6.5). At ages 50 and 80, the durations with only ADL limitations is 3.3 and 1.1 years and 5.2 and 2.0 years for men and women, respectively.

6.4.4 Life Expectancy in good Quality of Life

The life expectancy in good QoL is shown in Table 6.6 and Figure 6.5. Women have higher absolute life expectancy in good QoL; however, the opposite is true when examining this proportionally. This is the general trend with the other measures described above. It can be observed in Figure 6.5 that the life expectancy in good quality of life is the lowest compared to other measures. This is the case for both

men and women. This is somehow expected since QoL is a broader measure which in a way summarizes all the other health measures, and additionally includes other domains which include economic and environmental (see Table 6.1). This can be contrasted from SRH which is based on a single question. Therefore, it can be expected that the life expectancy in SRH will be greater than life expectancy in good QoL.

6.4.5 All four health indicators together

Figure 6.6 & Figure 6.7 put all the four health indicators together namely: SRH, IADL, ADL and QoL. Figure 6.6 presents the healthy life expectancies whilst Figure 6.7 presents the proportion of life in the health states relative to total life expectancy. The results show that life expectancy is higher when using SRH and IADL, and least when using ADL and QoL as health measures. The proportions of life expectancy in good health are more stable when measured by in SRH and QoL, and fall rapidly when measured by ADLs, and less rapidly when measured by IADLs. In women, the proportions in SRH and QoL show little variation with age; whilst in men the same show a rapid decline after age 70. It is interesting to note that the shapes of the graphs for SRH are similar to QoL, whilst IADL are similar to ADL, although the levels are different.

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6.4.6 Associations between SRH, functionality and QoL

Multivariate logistic regression was used to assess the associations between self-rated health, functionality (ADL and IADL) and quality of life, adjusting for socio-economic variables namely; age, sex, race, and income (Table 6.7). The results showed that ADL was strongly associated with SRH in both men (Adjusted Odds Ratio (AOR) 2.55; 95% CI, 1.71-3.82) and women (AOR 2.83; 95% CI, 1.79-4.46). Similarly, IADL had the same strong effect on SRH in men (AOR 2.23; 95% CI, 1.49-3.63) and women (AOR 2.16; 95% CI, 1.23-3.79). The association between QoL and SRH was weak for both genders ($AOR<1.1$; $p<0.001$).

6.4.7 Creating index of ADLs in relation to SRH

An attempt was made to create an index of ADLs by increasing the number of limitations from one (1) up to three (3). The results are shown in Figure 6.8 & Figure

6.9 for men and women, respectively. Increasing the number of ADLs approaches SRH, and an index of 3 ADLs comes close to SRHLE. This pattern is much clearer for women than men. The purpose of this exercise was to draw a parallel between the subjective and objective measures of population health used in this study.

6.5 Discussions

The purpose of this study was to characterize older people in South Africa based on different measures of health. This is in line with the paradigm shift from the traditional chronological based approach to studying population aging towards the characteristic based approach (Sanderson & Scherbov 2008; Sanderson & Scherbov 2007; Sanderson, W.C. and Scherbov 2010). This is the first study to report healthy life expectances based on different measures for the country. These measures varied from subjective measures (self-rated health and quality of life) to 'objective' measures (ADL and IADL). Similar to previous studies done in other settings (Christensen, Doblhammer *et al.* 2009; Robine 2002), the results differ by the health measure used. The results from this study show that subjective measures give a more positive outlook of health status of older South Africans compared to the objective measures. Irrespective, there were differences even within these broad categories e.g. the estimates based on self-rated health were more positive compared to quality of life. The reason is that quality of life is a much broader concept which includes economic, physical, environmental and physical domains, hence, the expected lifetime in good quality of life is shorter. This is contrasted to self-rated health, which is based on one question on a single domain. It is interesting to note that the graphs for the proportions in good self-rated health and quality of life have the same shape although the levels are different for both genders. This means that the way people perceive their health is to a larger extend influenced by their quality of life. In fact, the health domain is also captured in the quality of life measure (see Table 6.1).

The prevalence of ADLs was higher than IADLs in this study. This is the same finding across all the other five countries (China, Ghana, India, Mexico and Russian Federation) which participated in the SAGE survey(He, Muenchrath *et al.* 2012). This is contradictory to previous studies (Konno *et al.* 2004; Sauvaget *et al.* 1999; Koyano *et al.* 1988), which reported that the prevalence of IADLs was higher than ADLs. This inconsistence might require further investigation. Most people with ADL

dependency also have IADL dependency, although the reverse is not always the case (Figas 2008). There is a hierarchical relationship between the two measures of functional limitation i.e. ADL and IADL (Wolinsky *et al.* 1992). The former refer to basic day-to-day simple tasks, whilst the later are advanced and are more cognitively complex (Willis 1996). As such, the prevalence of difficulties in IADL is expected to be lower than ADL performance, and similarly the duration with disabilities in the former is expected to be lower than in the later. Generally, people would be inclined to (over) report basic physical limitations than they would with advanced cognitive limitations. For example one might report that they have difficulties with standing up, but would less so report that they have difficulties in taking care of household responsibilities, especially if they are men. The results from this study seem to confirm this hypothesis, however, this is in contradiction with other studies (Konno *et al.* 2004). A possible explanation for this discrepancy is the difference in the items to measure ADLs and IADLs between the two studies. When looking at ADLs and self-rated health, it is evident from the results that self-rated health can mask existing functional limitations, if taken in isolation. Hence, it is important to use both measures. Similar discrepancies between the two measures have been reported (Karcharnubarn *et al.* 2013; Spiers *et al.* 1996; Robine & Michel 2004; Crimmins 1996). Data on independent life expectancy is important in predicting future needs of long-term care, planning healthcare and social services and evaluating interventions.

The gender gap in health status is also evident from the results of this study. Women were found to have longer life expectancy and Independent life expectancy in ADL and IADL in absolute numbers. However, they had smaller proportions of independent life expectancy compared to men. This is in agreement with some studies (Camargos *et al.* 2007; Jitapunkul *et al.* 2003; Christensen, Doblhammer *et al.* 2009), but at variance with others (Tareque *et al.* 2013). This result implies that women outlive men but spent a greater proportion of their life with functional limitations, because disability progresses at a slower pace in women compared to men (Sauvaget *et al.* 1999). A possible explanation for this could be in the etiology of disablement process which is different by gender (Cambois *et al.* 2001). In this regard, men succumb more to fatal conditions such as cerebrovascular diseases, whilst women suffer more from non-fatal conditions such as osteoporosis (Cambois *et al.* 2001; Konno *et al.* 2004).

An important finding from this study is that older persons perceive their health to be good even with high burden of disability, at population level. This can be seen by the graphs for self-rated health life expectancy (SRHLE) which are higher than ILE in ADL. What this means is that, generally, old people are more optimistic about their health. One way of explaining this could be that, with time old people adjust and learn to live with functional limitations and as a result they no longer see them as a problem or hindrance to day-to-day life. This is better explained as 'disability paradox' (Albrecht & Devlieger 1999), a scenario whereby individuals are positive about their healthy and are happy despite having some levels of disability and functional limitations (Kutner, Nowels *et al.* 2003; Bowling *et al.* 2007). This form of resilience would be important to understand further through qualitative approaches, as it could be a learning source of coping mechanisms that could be applicable across other ages. This finding is in line with another study (Mutafova *et al.* 1997) that also compared SRHLE and DFLE. The only difference is in that they found a cross over at age 70 (i.e. below this age people were less optimistic), which is not seen in this study. A policy recommendation linked to this finding could be to ensure provision and access to assistive devices and technology which can enable old people to cope with functional limitations.

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We created an index of ADLs i.e. increasing the number from one to three as shown in Figure 7. The results show that an index of three ADLs comes closer to SRHLE. This is similar to other studies (Mutafova *et al.* 1997), although they did not follow the approach of increasing number of ADLs as done in this study. This means that the single question on self-rated health can give a sensible impression about duration spent with functional limitations. Information on ADL limitations is typically collected by a battery of questions asking difficulties in at least five domains (see Table 6.1). Collection of such detailed information is expensive, and therefore using a single question on self-rated health would be meaningful where there are limited resources to administer the full questionnaires on ADLs.

The limitation of this study is that institutionalized populations were not included in our analysis since they were excluded from the SAGE survey. The exclusion of the institutionalized populations could potentially bias the estimates upwards, resulting in an overestimate of healthy life expectancies. Chances for this bias are greater if the

institutionalized populations have significantly poorer health status compared to their counterparts sampled in the survey i.e. those dwelling in the community. Unfortunately, no information is available on the health status of this population segment in South Africa. In the 1996 census (Statistics South Africa 1998) and the recent 2011 census (Statistics South Africa 2014a), the question on overall health and function status was asked in households only, and not among institutionalized persons. In the 1996 census, individuals residing in institutions constituted three (3) per cent of the population (Phillips & Noumbissi 2004). Another limitation is that the SAGE survey is not sufficiently powered statistically to allow for analysis and decomposition of healthy life expectancies by sociodemographic characteristics. This is important as it would enable the identification of specific subgroups in need of special care. An attempt was made to stratify the analysis by race in this study; however, the estimates were less stable as shown by wider confidence intervals, due to prevalence data which became very scant once disaggregated by race. In South Africa, analysis of racial inequalities in healthy life expectancies is paramount given the political history of the country i.e. the apartheid system which brought disparities in health along racial lines. If data permitted, other differentials that can be assessed include education and socio-economic status (SES). Another challenge in applying the Sullivan method using other differentials other than gender is that, virtually there are no full life tables disaggregated by these variables in South Africa (Dorrington, Moultrie *et al.* 2004). Statistics South Africa (the official agency of statistics) published life tables for two periods after the 1996 census; 1985-1994 and 1996. The 1985-1994 life tables were constructed through applying indirect demographic estimation techniques on "survivorship of kin" as reported in the 1996 census (Statistics South Africa. 2000). The 1996 life tables were produced by provinces based on registered deaths (adjusted for under-registration and the 1996 census), but not by race. The other potential sources of current life tables are the UN (United Nations Population Division 2013) and the Actuarial Society of South Africa (ASSA) ASSA2008 models (Actuarial Society of South Africa (ASSA) 2011). However, the former are disaggregated by age and sex, whilst the later can be obtained by age, sex and race disaggregation. Further, it is important to note that these are models which are just as good as their assumptions.

Notwithstanding, the study has come up with important findings on health and wellbeing of older people, which has potential value in informing national health and social policies. Based on the findings from this study, some policy recommendations can be made. Foremost, based on the evidence from the literature, it is important to recognize aging as a reality rapidly occurring in low to middle income countries including South Africa. Along with aging, the number of older people in poor health and with functional disabilities, and hence in need of care will also increase. There is need to design appropriate preventive measures to delay onset of disability in both men and women. Further, there is also need to provide appropriate care for people with functional disabilities and ensure they have better quality of life, particularly women. One way is to provide assistive devices and technologies to older people in need, to enable them to live normal functional lives, as discussed earlier. It might also be important to consider ways of engaging older people in meaningful economic activities, especially post retirement. Studies have demonstrated that continued active engagement of older people significantly averts problems associated with isolation and loneliness which include rapid cognitive decline and depression (Minagawa & Saito 2014). This seems reasonable since the results are showing that older people are expected to live for longer durations in self-rated good health. This can be recommended to older people in general, and also those with functional limitations. This study lays the foundation for future studies aimed at assessing the health of older people in South Africa. The present study could only give a cross sectional or snap-shot perspective since it is based on the first cross-sectional wave data available. There are several opportunities of expanding the work in this study. Moving forward, the next important analytical step would be to monitor the health measures, and assess trends in health status over time. This will answer the important question – if there is a compression or expansion of morbidity in older people. This will be possible in the next waves of SAGE. Since SAGE is a prospective longitudinal study, it could be feasible to analyse transitions between health states, and estimate recovery rates by using multistate methods. Another possibility is to examine healthy life expectancies based on other measures such as dementia and cognitive functioning which were not included in this study. Studies from other developing countries found life expectancy with cognitive impairments to be relatively higher compared to developed countries (Andrade *et al.* 2014).

6.6 Acknowledgements

I would like to thank the following for organizing the 2013-14 South African Young Scientists Summer Programme (SA-YSSP); The International Institute for Applied Systems Analysis (IIASA), the National Research Foundation (NRF), Department for Science and Technology (DST) and the University of the Free State. I am grateful to my SA-YSSP Supervisors: - Profs: Warren Sanderson (IIASA), Sergei Scherbov (IIASA) and Nancy Phaswana-Mafuya (HSRC), for their support and guidance during the programme which culminated in this report. I also thank fellow young scientists for their constructive feedback in the SA-YSSP programme. This paper was also presented at the 2014 REVES meeting in Edinburgh - Scotland (Chirinda 2014), where it also benefited from comments received from participants.

Table 6.1 Questions and response categories used in the 2007/8 SAGE survey

Measure	Question	Responses
SRH	In general, how would you rate your health today?	*1 Very good* *2 Good* *3 Moderate* *4 Bad* *5 Very bad*
ADL	In the last 30 days, how much difficulty did you have …	
	… *in sitting for long periods?*	*1 None* *2 Mild* *3 Moderate* *4 Severe* *5 Extreme/ cannot do*
	… *in walking 100 meters?*	
	… *in standing up from sitting down?*	
	… *in standing for long periods?*	
	… *with climbing one flight of stairs without resting?*	
	… *with stooping, kneeling or crouching?*	
	… *picking up things with your fingers (such as picking up a coin from a table)?*	
	… *in extending your arms above shoulder level?*	
	… *concentrating on doing something for 10 minutes?*	
	… *in walking a long distance such as a kilometer?*	
	… *in bathing/washing your whole body?*	
	… *in getting dressed?*	
	… *with carrying things?*	
	… *with moving around inside your home (such as walking across a room)?*	
	… *with eating (including cutting up your food)?*	
	… *with getting up from lying down?*	
	… *with getting to and using the toilet?*	
IADL	In the last 30 days, how much difficulty did you have …	
	… *in taking care of your household responsibilities?*	*1 None* *2 Mild* *3 Moderate* *4 Severe* *5 Extreme/ cannot do*
	… *in joining in community activities (for example, festivities, religious or other activities) in the same way as anyone else can?*	
	… *in your day to day work?*	
	… *with getting where you want to go, using private or public transport if needed?*	
	… *getting out of your home?*	
QoL	Do you have enough energy for everyday life?	*1 Completely* *2 Mostly* *3 Moderately* *4 A little* *5 None at all*
	Do you have enough money to meet your needs?	
	How satisfied are you with…	
	… *your health?*	*1 Very Satisfied* *2 Satisfied* *3 Neither Satisfied Nor Dissatisfied* *4 Dissatisfied* *5 Very Dissatisfied*
	… *yourself?*	
	… *your ability to perform your daily living activities?*	
	… *your personal relationships?*	
	… *the conditions of your living place?*	

Source: (World Health Organization 2014b)

Table 6.2 Age specific prevalence rates and 95% CI by gender and health indicator, South Africa 2008

Age, Sex	Poor Self-rated health		ADL limitations (1+)		IADL limitations (1+)		Poor Quality of Life	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI
Men								
50	15.2	(10.9; 19.6)	19.1	(14.8; 23.4)	5.4	(3.2; 7.6)	49.3	(43.1; 55.5)
60	19.0	(13.2; 24.7)	35.3	(27.8; 42.8)	13.5	(8.2; 18.7)	58.7	(52.0; 65.4)
70	15.2	(6.9; 23.4)	49.1	(39.0; 59.2)	27.6	(17.0; 38.2)	48.7	(37.4; 59.9)
80	29.4	(13.7; 45.1)	61.9	(47.9; 76.0)	42.1	(24.3; 59.9)	59.9	(42.3; 77.6)
Women								
50	15.6	(11.9; 19.3)	30.0	(24.6; 35.3)	10.4	(7.0; 13.9)	60.7	(55.5; 65.9)
60	18.7	(13.7; 23.7)	42.7	(36.3; 49.2)	20.2	(15.6; 24.8)	59.8	(53.6; 66.0)
70	19.7	(13.1; 26.2)	50.7	(42.9; 58.5)	24.0	(16.6; 31.3)	60.0	(52.6; 67.4)
80	25.3	(15.2; 35.4)	70.3	(60.3; 80.2)	40.2	(27.5; 52.8)	63.6	(51.1; 76.1)

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Table 6.3 Total Life Expectancy, Self-rated Healthy Life Expectancy - SRHLE and Proportion of remaining life in good self-rated health

Age, Sex	Total LE	Good SRHLE	95% CI	Poor SRHLE	Proportion in SRHLE	Difference in TLE (Women - Men) ¥
Men						
50	18.4	15.2	[14.7; 15.8]	3.1	82.9	4.6
60	12.9	10.5	[9.9; 11]	2.4	81.3	4.3
70	8.4	6.8	[6.2; 7.5]	1.5	81.7	3.1
80	5.3	3.7	[2.9; 4.5]	1.5	70.6	1.6
Age, Sex	Total LE	Good SRHLE	95% CI	Poor SRHLE	Proportion in SRHLE	Difference in SRHLE (Women - Men)
Women						
50	22.9	18.7	[18.1; 19.3]	4.2	81.7	3.5 *
60	17.2	13.7	[13.1; 14.4]	3.5	79.9	3.3 *
70	11.5	9.0	[8.4; 9.6]	2.5	78.5	2.2 *
80	6.9	5.1	[4.4; 5.8]	1.7	74.7	1.4 †

Note: LE- Life Expectancy; 95%CI – 95% Confidence Interval;
The sum of LE in health states might not add up to Total LE because of rounding;
Level of significance for a two-tailed test
¥ Differences are not tested for statistical significance
†P<0.01; *P<0.001.

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Table 6.4 Total Life Expectancy, Independent Life Expectancy and Proportion of remaining life Independent in ADL

Age, Sex	Total LE	ILE in ADL	95% CI	Dependent LE in ADL	Proportion in Active LE	Difference in TLE (Women - Men) ¥
Men						
50	18.4	12.7	[12.0; 13.3]	5.7	69.1	4.6
60	12.9	7.5	[6.8; 8.2]	5.4	58.4	4.3
70	8.4	4.0	[3.3; 4.7]	4.4	48.1	3.1
80	5.3	2.0	[1.3; 2.7]	3.3	38.1	1.6
Age, Sex	Total LE	ILE in ADL	95% CI	Dependent LE in ADL	Proportion in Active LE	Difference in ILE (Women - Men)
Women						
50	22.9	13.3	[12.5; 14.1]	9.6	58.0	0.6 ns
60	17.2	8.6	[7.9; 9.4]	8.6	50.3	1.1 †
70	11.5	4.9	[4.2; 5.6]	6.5	43.0	0.9 ns
80	6.9	2.0	[1.4; 2.7]	4.8	29.7	0.0 ns

Note: LE- Life Expectancy; ILE- Independent Life Expectancy; 95%CI – 95% Confidence Interval;
The sum of LE in health states might not add up to Total LE because of rounding;
Level of significance for a two-tailed test
ns = not statistically significant
¥ Differences are not tested for statistical significance
†P<0.01

Table 6.5 Total Life Expectancy, Independent Life Expectancy and Proportion of remaining life Independent in IADL

Age, Sex	Total LE	ILE in IADL	95% CI	Dependent LE in IADL	Proportion in Active LE	Difference in TLE (Women - Men) ¥
Men						
50	18.4	16.0	[15.5; 16.5]	2.4	86.9	4.6
60	12.9	10.3	[9.7; 10.9]	2.6	79.9	4.3
70	8.4	5.8	[5.0; 6.6]	2.6	69.2	3.1
80	5.3	3.1	[2.1; 4.0]	2.2	57.9	1.6
Age, Sex	Total LE	ILE in IADL	95% CI	Dependent LE in IADL	Proportion in Active LE	Difference in ILE (Women - Men)
Women						
50	22.9	18.6	[17.9; 19.2]	4.4	81.0	2.6 *
60	17.2	13.0	[12.3; 13.6]	4.2	75.4	2.7 *
70	11.5	8.1	[7.4; 8.9]	3.4	70.8	2.3 *
80	6.9	4.1	[3.2; 5.0]	2.8	59.8	1.0 ns

Note: LE- Life Expectancy; ILE- Independent Life Expectancy; 95%CI – 95% Confidence Interval;
The sum of LE in health states might not add up to Total LE because of rounding;
Level of significance for a two-tailed test
ns = not statistically significant
¥ Differences are not tested for statistical significance
*P<0.001.

Table 6.6 Total Life Expectancy, Life Expectancy in good QoL and Proportion of remaining life in good QoL, South Africa

Age, Sex	Total LE	LE in good QoL	95% CI	LE in Poor QoL	Proportion of LE in good QoL	Difference in TLE (Women-Men) ¥
Men						
50	18.4	8.7	[7.9; 9.4]	9.7	47.3	4.6
60	12.9	5.7	[5.0; 6.4]	7.2	44.2	4.3
70	8.4	4.1	[3.3; 4.9]	4.3	48.9	3.1
80	5.3	2.1	[1.2; 3.0]	3.2	40.1	1.6
Age, Sex	Total LE	LE in good QoL	95% CI	LE in Poor QoL	Proportion of LE in good QoL	Difference in QoL (Women-Men)
Women						
50	22.9	9.0	[8.3; 9.8]	13.9	39.4	0.4 ns
60	17.2	6.8	[6.0; 7.6]	10.4	39.5	1.1 †
70	11.5	4.5	[3.7; 5.2]	7.0	38.8	0.4 ns
80	6.9	2.5	[1.6; 3.3]	4.4	36.4	0.4 ns

Note: LE- Life Expectancy; 95%CI – 95% Confidence Interval;
The sum of LE in health states might not add up to Total LE because of rounding;
Level of significance for a two-tailed test
ns = not statistically significant
¥ Differences are not tested for statistical significance
†P<0.01

Table 6.7 Association between Self-rated health, Activity limitations and Quality of life

	Men		Women	
	UOR (95%CI)	**AOR[¥] (95%CI)**	**UOR (95%CI)**	**AOR[¥] (95%CI)**
ADL limitation				
None	ref	ref	ref	ref
One or more	6.19 (4.87-7.86) ***	2.55 (1.71-3.82) ***	7.91 (5.96-10.50) ***	2.83 (1.79-4.46) ***
IADL limitation				
None	ref	ref	ref	ref
One or more	8.4 (6.51-10.85) ***	2.32 (1.49-3.63) ***	8.65 (6.23-12.03) ***	2.16 (1.23-3.79) ***
Quality of life				
Poor	ref	ref	ref	ref
Good	1.09 (1.07-1.10) ***	1.07 (1.05-1.08) ***	1.09 (1.08-1.11) ***	1.08 (1.06-1.10) ***

UOR – Unadjusted Odds Ratio
AOR – Adjusted Odds Ratio
CI – Confidence Interval
****P<.001; **P<.01; *P<0.5*
Ref – reference category.
[¥] *Models adjusted for socio-demographic variables*

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Figure 6.1 Self-rated Healthy Life Expectancy - SRHLE (left) and proportion of life spent in good self-rated health (right) by gender and age[3], South Africa

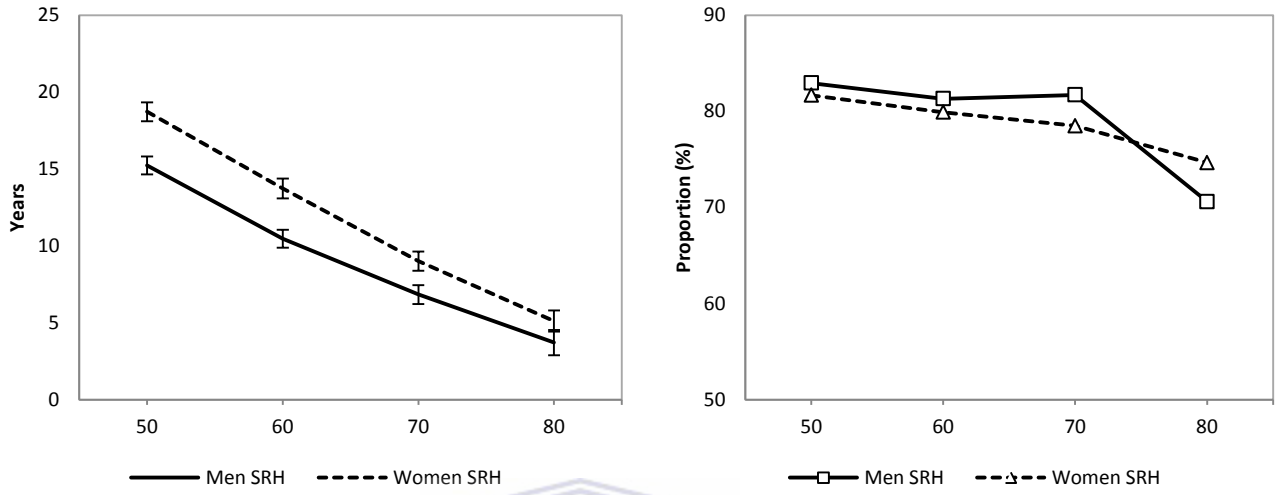
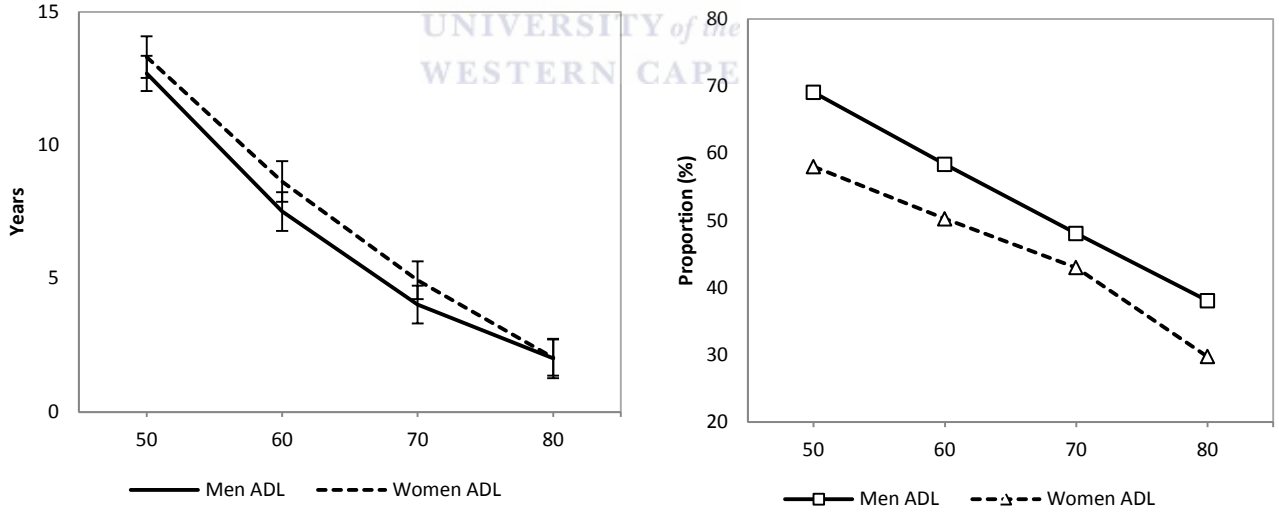


Figure 6.2 Independent Life Expectancy (left) and Proportion of remaining life Independent in ADL (right) by gender and age, South Africa



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[3] Age in years is shown on the x-axis on all graphs (Figures 1-9)

Figure 6.3 Independent Life Expectancy (left) and Proportion of remaining life Independent in IADL (right) by gender and age, South Africa

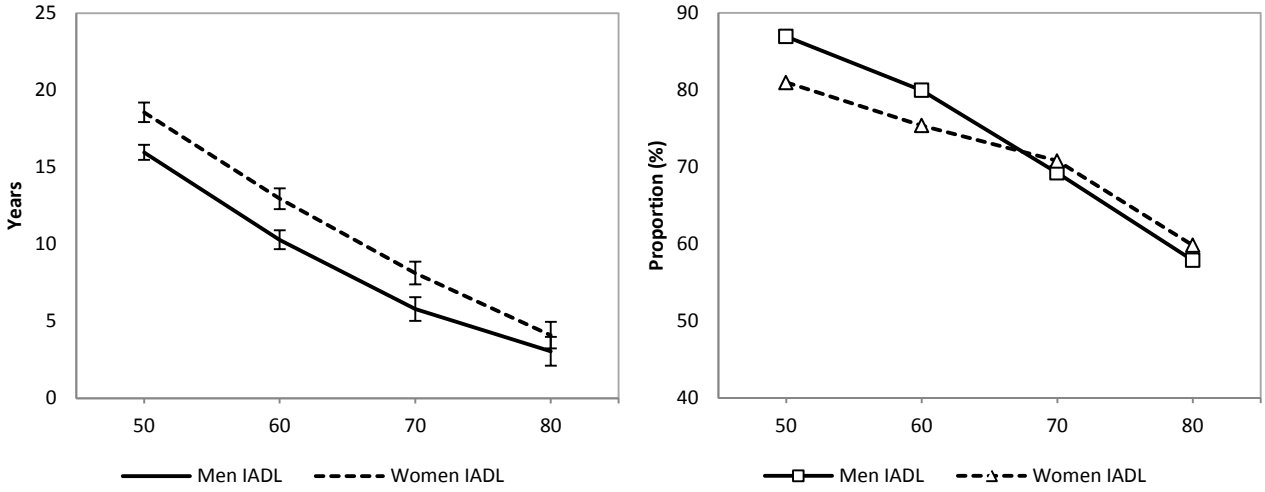

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Figure 6.4 Mean duration with functional disability in ADL and IADL by gender and age, South Africa

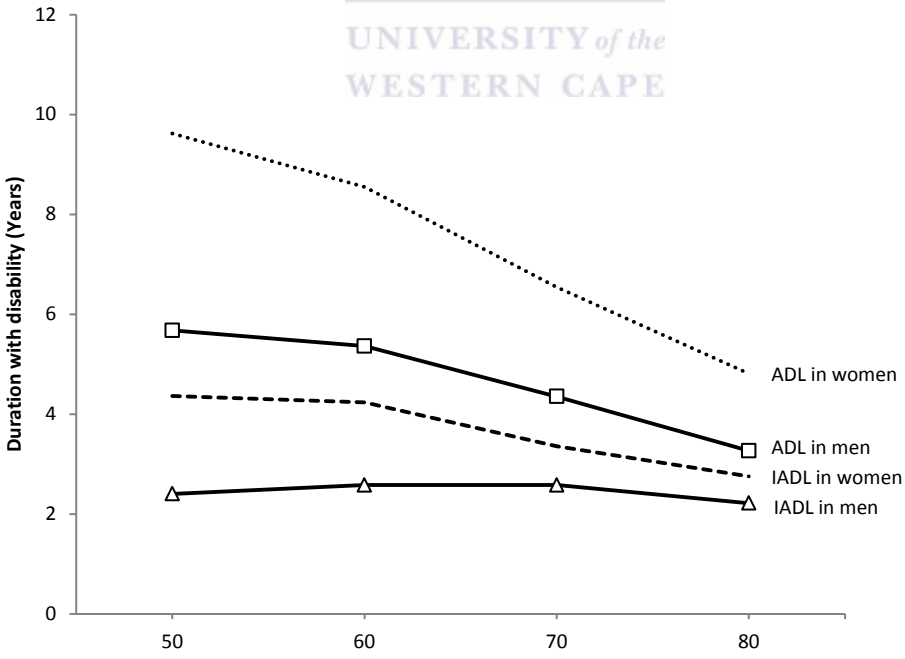

Figure 6.5 Life Expectancy in good QoL (left) and Proportion of remaining life in good QoL (right) by gender and age, South Africa

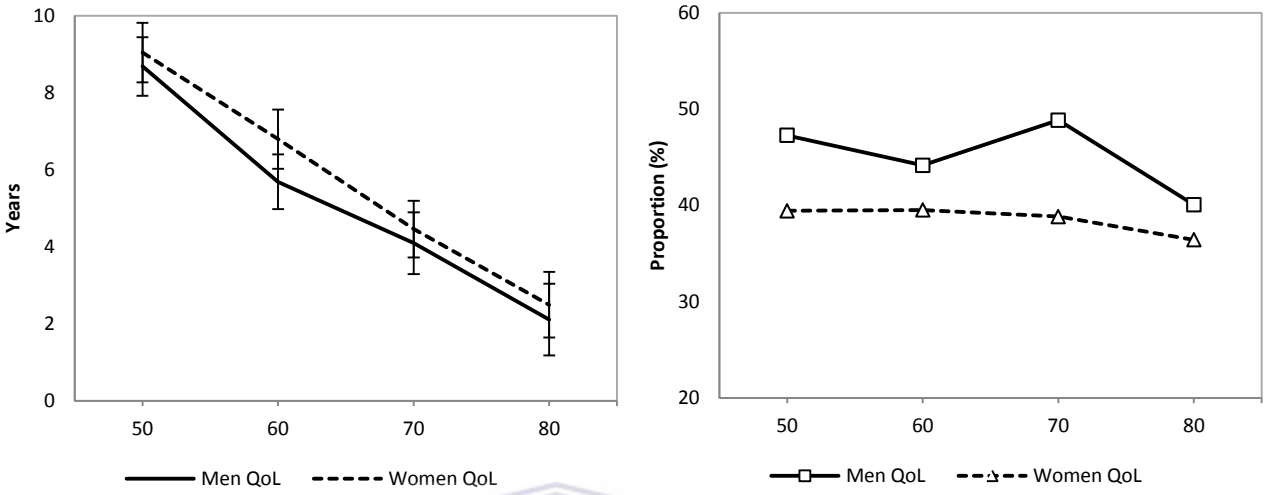

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Figure 6.6 Self-rated Health Life Expectancy, Independent Life Expectancy in ADL and IADL, and Life Expectancy in good QoL for Men (left) and Women (right), South Africa

a) Men b) Women

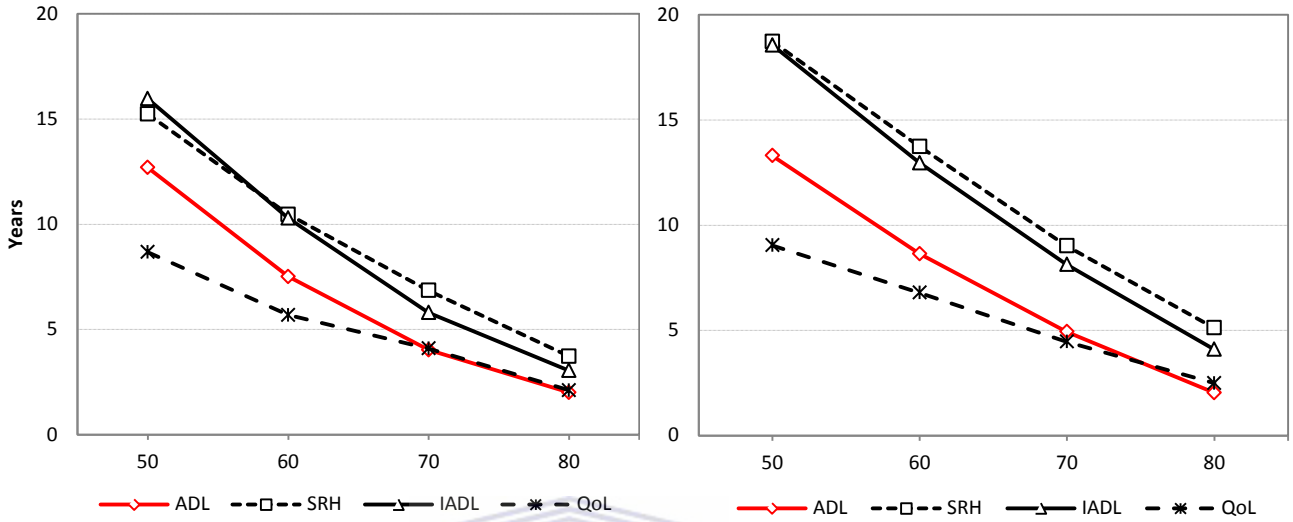

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Figure 6.7 Proportion of remaining life; in good self-rated health and quality of life, Independent in ADL and IADL for Men (left) and Women (right), South Africa

a) Men b) Women

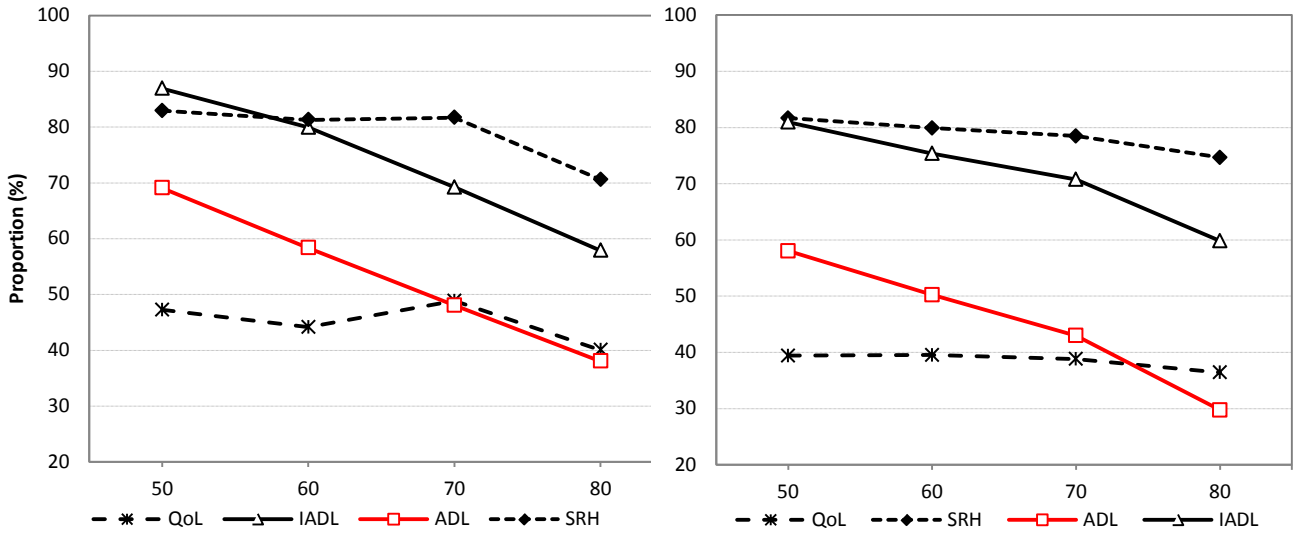

Figure 6.8 Comparison of self-rated health and increasing number of ADL Limitations (index from 1-3) for Men: expressed in years (Left) and proportions (Right)

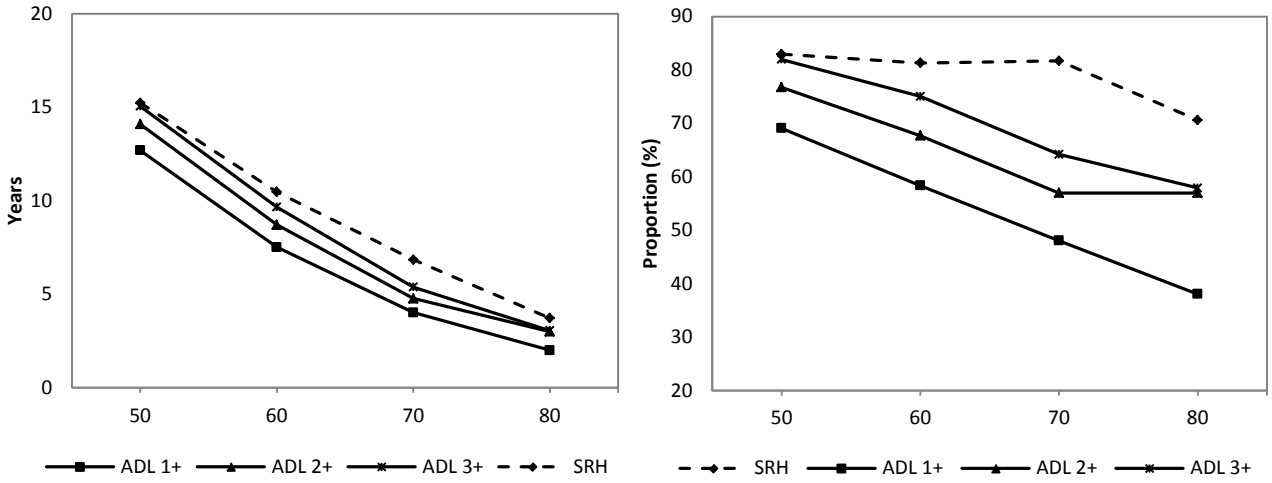

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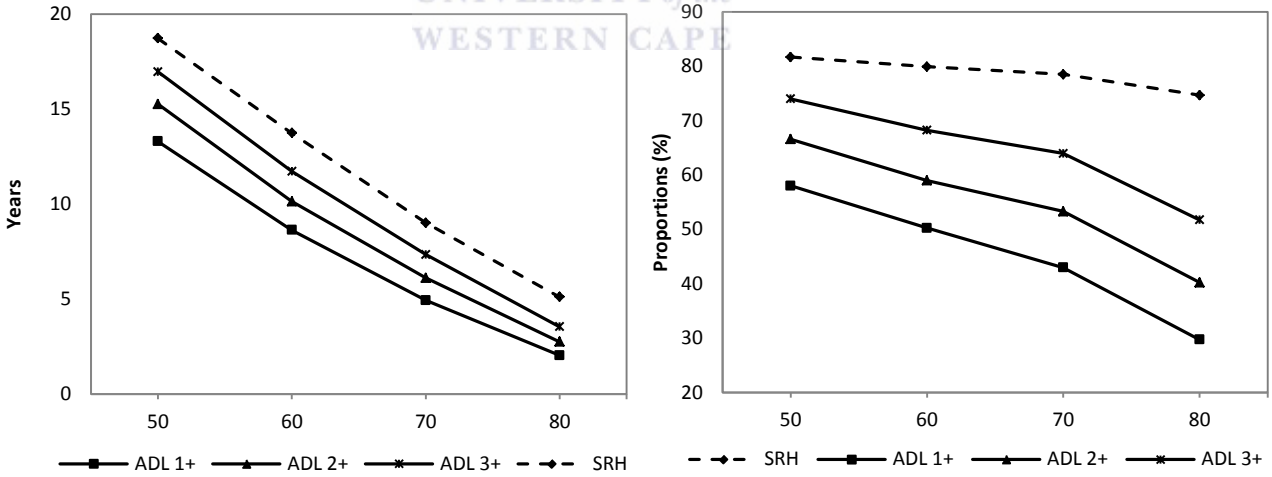
Figure 6.9 Comparison of self-rated health and increasing number of ADL Limitations (index from 1-3) for Women: expressed in years (Left) and proportions (Right)



Chapter 7

Contribution of specific chronic diseases to disability among Older Adults in South Africa

7.1 Abstract

Introduction: The rapid population aging being experienced across the globe is expected to result in an increase in the proportion of older people with disabilities. One of the first critical steps towards reducing disability burden is to identify the specific diseases contributing to disability. Consequently, the objective of this study is to assess the contributions of specific diseases to disability burden among older people in South Africa.

Methods: The study utilised data from the first wave of WHO- Study on Ageing and Adult Health (SAGE) survey conducted in South Africa between 2007 and 2008. The attribution technique based on multivariate additive regression model was used to obtain disabling impacts and disability prevalence by disease.

Results: musculoskeletal diseases (arthritis) and cardiovascular diseases (stroke, hypertension) and diabetes were the leading causes of disability burden in both men and women. Cataracts also had a high contribution particularly in men aged 80 years and above.

Conclusions: The chronic conditions identified in this study namely; musculoskeletal and cardiovascular diseases should be targeted prioritised in alleviating disability in older people.

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7.2 Introduction

The 'greying' of the human population has been acknowledged as a universal phenomenon happening across the globe (United Nations Population Division 2013). The rapid increase in older people is expected to result in in an increase in burden of disability (Klijs *et al.* 2011). Consequently, this means the demand for long-term care is going to increase dramatically. One way of averting this burden of disability is to delay the onset of and improve the quality of life of people with disabilities. A crucial step towards this is to identify the specific diseases that contribute to disability. This will enable the formulation and design of effective interventions targeting specific contributory factors to disability(European Health Expectancy Monitoring Unit 2010).

There are limited studies focusing on the contribution of disease to disability burden (Klijs *et al.* 2011). Most of these studies are in the developed countries (Jagger *et al.* 2003; Klijs *et al.* 2011; Laditka & Laditka 2006; Spiers, Matthews, *et al.* 2005). Elsewhere, a recent study was done to assess the contribution of chronic conditions to burden of disability in China (Chen *et al.* 2014). Several conditions have been identified to have significant disabling impacts. These include; arthritis (Klijs *et al.* 2011; Picavet & Van Den Bos 1997; Boult *et al.* 1994), depression (Peres, Jagger *et al.* 2008), diabetes (Laditka & Laditka 2006), cardiovascular diseases (CVDs) (Boult *et al.* 1994) and musculoskeletal diseases (Mathers 1999; Nusselder & Looman 2004; Klijs *et al.* 2011). The approach used in this study is substantially different from the one used by the WHO Global Burden of Disease (World Health Organization 2008) and the South African Burden of Disease (Bradshaw *et al.* 2003). In these studies, disability weights are used to quantify disease burden and Disability Adjusted Life Years (DALYs), based on a wider spectrum of health loss which include years of life lost from premature death (YLL) and years of life lived in less than full health (World Health Organization 2008; Klijs *et al.* 2011; Chen *et al.* 2014). This is not specific to physical or mental disabilities (World Health Organization 2008). Other studies done in South Africa have mainly been focused on estimating the contribution of risk factors to burden of disease e.g.; high blood pressure (Norman, Gaziano, *et al.* 2007), high cholesterol (Norman, Bradshaw *et al.* 2007), urban outdoor air pollution (Norman, Cairncross *et al.* 2007), indoor air pollution (Norman, Barnes *et al.* 2007),

lead exposure (Norman, Mathee *et al.* 2007), interpersonal violence (Norman, Bradshaw, Schneider *et al.* 2007), excess body weight (Joubert *et al.* 2007), and diabetes (Bradshaw *et al.* 2007). These studies too, are different in approach from this present study. Hence, there still exists a fundamental gap to explore the contribution of diseases to disability. The purpose of this study, therefore, is to estimate the contribution of specific diseases to burden of disability in older people in South Africa.

One of the key challenges in evaluating impact of diseases on burden of diseases in older people is the fact that more than one diseases might be present i.e. comorbidity (Nusselder, Looman *et al.* 2005). Previous methods used the elimination technique which attributed disability to a single major cause, and the assumption was that disability would be reduced if this cause is eliminated (Colvez & Blanchet 1983). The limitation of this approach is that it overestimates the impact of main causes and underestimates that of other causes (Mathers 2003). Subsequent methods attempted to deal with the issue of comorbidity (Nusselder *et al.* 1996; Reynolds *et al.* 2008; Jagger *et al.* 2003), albeit with some pitfalls. Recently, an attribution technique was developed by Nusselder and colleagues (Nusselder & Looman 2004) which is based on additive regression model, and is able to partition the disability burden into additive contributions of causes (diseases) taking into account comorbidity (Nusselder & Looman 2004). This study uses this attribution technique to investigate the role of disabling impact and prevalence of specific diseases to the burden of disability among older South Africans.

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7.3 Methods

7.3.1 Data sources

The study is based on secondary analysis of the SAGE survey which was conducted in South Africa by the Human Sciences Research Council (HSRC), the World Health Organization (WHO), and the National Department of Health (NDOH) between 2007 and 2008. The SAGE is designed to compile comprehensive longitudinal information on the health, well-being, health-related outcomes and their determinants in adult populations. The core SAGE collects data on adults aged 18+ years, with an emphasis on populations aged 50+ years, from nationally

representative samples in six low-medium income countries (LMIC) namely: China, Ghana, India, Mexico, Russian Federation and South Africa. The survey employs a multistage cluster sampling design, which results in nationally representative cohorts. Household/person-level analysis weights and post stratification are developed to increase representativeness. The overall response rate for those aged 50 and older was 75% (Kowal *et al.* 2012). Ethical approval for the survey was granted by the HSRC Research Ethics Committee (REC 5/13/04/06) and the National Department of Health (J1/14/45).

7.3.2 Measurements

Disability

Disability was measured by Activities of Daily Living (ADLs). The ADLs - a set of daily self-care activities that assess the need for help with personal care activities such as eating, bathing, and dressing. Older people who reported being able to perform ADL activities without any difficulties were categorized as independent, whilst those who reported a difficulty in at least one activity were categorized as dependent (Klijs *et al.* 2011). ADL measures are important because they indicate the need for social and health care services (Cambois *et al.* 2008; Jitapunkul & Chayovan 2000).

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Diseases

The SAGE questionnaire collected information on a range of diseases. The presence of diseases was self-reported. The respondents were asked if they had been diagnosed or been told by a health professional that they had a particular diseases. The diseases asked were; arthritis, stroke, angina, diabetes, chronic lung disease, asthma, depression, and hypertension. For example in the case of arthritis the questions was asked as "*Have you ever been diagnosed/told you have arthritis (a diseases of joints, or by other names rheumatism or osteoarthritis)*, and for diabetes - '*Have you ever been diagnosed with diabetes (high blood sugar)*?'

7.3.4 Analysis

Disability prevalence by disease was estimated from individual level data on the presence or absence of specified diseases, age and gender. An attribution tool

developed by Nusselder and colleagues (European Health Expectancy Monitoring Unit 2010; Nusselder & Looman 2004) was used to attribute disability to diseases.

Assumptions: The assumptions made when estimating cause-specific disability prevalence by cause using cross-sectional data are: first, the distribution of disability by causes (diseases) is explained entirely by diseases identified during the survey and the background risk; second, this distribution is proportional to the distribution of risk of becoming disabled in the time-period preceding the survey; third, all individuals of a particular age are exposed to the same background disability risk; fourth, the causes of disability and background risk act as independently competing factors.

Additive hazard regression model

The attribution tool is based on multivariate additive regression model which allows for the estimation of disability prevalence by cause. The model takes into account comorbidity and the fact that individuals who do not report any diseases may have disability (referred to as 'background risk'). More details about the attribution tool are previously explained (European Health Expectancy Monitoring Unit 2010; Nusselder & Looman 2004).

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The regression model is specified as follows:

$$\hat{y} = 1 - e^{-\eta}$$

$$\eta = \alpha_a + \sum_d \beta_d X_d$$

Where $\hat{y}$ is the estimated probability that the person is disabled, and the observed disability (y) follows a binomial distribution, e is the base of the natural logarithm and η the linear predictor. The latter is defined as the sum of the background hazard by age (α_a) and the cause-specific hazards of disability β_d (also called the 'disabling impact' or 'disease effects') for the diseases (d) that are present in the respondent (given by the dummy variables X_d). A single model was fitted for both genders since the log-likelihood ratio test for gender differences in background and disease risks

was not statistically significant. Further, reduced rank regression (RRR) was done to test if disabling impact (β_d) varied with age (Yee & Hastie 2003; Nusselder & Looman 2004). From the result, adding one rank did not improve the fit of the model, and hence, the above equations were used in further analysis. Model fitting was programmed in statistical package *R* version 2.7.1 (European Health Expectancy Monitoring Unit 2010; Nusselder & Looman 2004).

Disability prevalence by diseases

Disability prevalence by cause depends on both the prevalence of diseases - X_d and disabling impact - β_d (discussed above). The attribution of disease (d) is: $(\beta_d X_d/\eta).\hat{y}$ and of background is $(\alpha_a/\eta).\hat{y}$. The total number of disabled individuals by cause or background would be obtained by adding the diseases specific or background attribution of all the individuals. The prevalence of disability by disease is obtained by dividing the total number of diseases-specific disabled persons by the total number of individuals.

7.4 Results

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Table 7.1 and Figure 7.1 show that disability increases with age. At age 50, a fifth of men (21 per cent) and a quarter of women (26 per cent) have activity limitations, and at age 80 more than half (55 per cent – women and 53 per cent men). It is also evident from Figure 1 that the prevalence of disability is only slightly higher in women than men, and there are no strong gender differences across the age groups.

The contribution of disease to disability prevalence depends on both disabling impacts and prevalence of diseases. Table 7.2 shows the disabling impacts of diseases for men and women. In men, stroke, arthritis and cataracts had the highest significant disabling impacts. Depression also had a high disabling impact (0.3), though not significant. In women, stroke, arthritis, angina, diabetes and lung disease had the highest disabling impacts. Figure 7.2 shows that background risk increases with age and there are no major gender differences except at the oldest ages where it is higher in women than men.

Table 7.3 & Table 7.4 are reporting the same results. The difference is that Table 7.3 presents results as 'fraction of disabled' whilst in Table 7.4, it is 'fraction of total population'. Overall, similar diseases namely; arthritis, stroke, hypertension and diabetes were the most important contributors to the prevalence of disability in both men and women. In men and women aged 60 to 69, arthritis accounted for 19 and 22 per cent respectively, which is more than double that of cardiovascular diseases combined. Cataracts also had a huge contributed among the oldest men. The disabling impacts and contributions of diseases to disability prevalence are further illustrated in Figure 7.3 & Figure 7.4, respectively.

7.5 Discussions

This is the first study to investigate the contribution of specific diseases to the burden of disability in South Africa. The results show that across all ages musculoskeletal and cardiovascular diseases are the main contributors to disability for both men and women. The important musculoskeletal disease was arthritis, whilst cardiovascular diseases included hypertension, stroke and angina. For both genders, arthritis was the leading contributor because of its high prevalence and disabling impact. On the other hand, hypertension contributed mostly by its high prevalence in both men and women.

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The results from this study are in line with previous studies which also found that musculoskeletal and cardiovascular to be important contributors to disability (Nusselder, Looman *et al.* 2005; Klijs *et al.* 2011; Picavet & Van Den Bos 1997; Jagger, Matthews *et al.* 2007; Nusselder, van der Velden *et al.* 1996). Diabetes also had significant disabling effect in women and high prevalence in both genders. This has also been found in previous studies (Jagger *et al.* 2003; Klijs *et al.* 2011; Jagger, Matthews *et al.* 2007). In South Africa, the burden of diseases due to diabetes has been found to be unacceptably high (Bradshaw *et al.* 2007). The results from this study further suggest that diabetes also contributes much to disability, especially in older women. Cataracts in oldest men also had a significant disabling impact and high prevalence. Previous studies had also found that sensory diseases, and in particular eye problems contributed significantly to the burden of disability(Chen *et al.* 2014).

With regards to background risk, the results are in contrast to a recent from China (Chen *et al.* 2014) which also used the attribution technique. In that study, they found a minimal contribution of background factors. The reason was that the causes of disability were directly assigned by health professionals (doctors) in the China Disability Survey used by that study. Consequently, much lesser disability was attributed to background in that study (Chen *et al.* 2014), since much of it could be attributed to specific conditions. In this study, the high background risk suggests that other conditions and/or frailty (Fried *et al.* 2001; Campbell & Buchner 1997)are also important contributors to disability at the old ages. The method of directly assignment is different from self-reports used in the SAGE survey (Kowal *et al.* 2012).The former is more accurate than the latter. The use of self-reports in the SAGE survey which is used in this study might lead to an overestimation or underestimation of disability and disease. This has also been found in previous studies, particularly with reference to arthritis (Kriegsman, Penninx *et al.* 1996). Considering the high prevalence, it is possible that arthritis was over reported in the SAGE survey. Notwithstanding, this probable bias in diseases estimate may be cancelled off by the resultant bias in disability impact which operates in the opposite direction (Klijs *et al.* 2011). In this study there were no significant gender differences in the causes of disability i.e. the same diseases were causing disability in both genders. Consequently, the same regression model was fitted for both men and women. Other studies (Chen *et al.* 2014) also found no variation in attribution of disability to disease by gender.

The results from this study might not be generalized to the institutionalised populations in South Africa, since the SAGE survey excluded this population segment from its sample. It is possible that the contribution of diseases to disability among institutionalized populations might be different from the results presented in the study (Klijs *et al.* 2011). Further, although we do not have data on burden of disability inside institutions, it is likely to be higher than the prevalence from this study. According to the 1996 census (Phillips & Noumbissi 2004), only three per cent of population were dwelling in institutions. It is unlikely that this percentage might have changed drastically over the past years. Hence, the exclusion of institutionalized populations is unlikely to cause a significant bias on the results of this study. Another limitation is that the list of diseases considered might not be

exhaustive. In other words, other diseases not accounted for in this study might be having a considerable contribution to disability. Mental health conditions such as dementia have been found to be strongly associated with disability onset (van Gool Kempen *et al.* 2005; World Health Organization 2008; Klijs *et al.* 2011). According to the WHO (World Health Organization & Alzheimer's Disease International 2012), dementia is the leading cause of years of life lost due to disability in less developed countries, and the second greatest globally. Due to aging, it is projected that the prevalence and numbers of people with dementia will further increase especially among the 'oldest old', in countries undergoing demographic transition (WHO & Alzheimer's Disease International 2012; UNFPA & HelpAge International 2012). It is recommended that this be included in among the causes of disability in future studies.

This study is important in that it identifies causes of disability which can become immediate possible entry points for policy and programmatic interventions aimed at reducing the onset and burden of disability in the population. Further, addressing the primary cause of disability is the most effective way of achieving the largest population level reductions in disability burden (Klijs *et al.* 2011). Specifically, the results indicate that the causes of disability to be targeted are musculoskeletal and cardiovascular diseases. Since these conditions have their antecedents in the younger ages, it is important to design and implement prevention programmes in younger and middle aged people targeting the risk factors for these particular diseases. The WHO (World Health Organization 2011) has come up with the 'best buys' interventions which are highly cost-effective and feasible to implement within the resource constraints of low to medium income countries (LMIC). These interventions are aimed at lowering the risk of common chronic conditions. One straightforward example is reduction of salt intake as a prevention measure for hypertension (World Health Organization 2011). A reduction in hypertension, in turn, reduces the risk of other cardiovascular conditions such as stroke and ischaemic heart disease. Another important entry point of intervention is to reduce the degree to which diseases cause disability i.e. disabling impacts (Klijs *et al.* 2011). This can be achieved through interventions such as lifestyle interventions e.g. exercise programmes (Rejeski, Marsh *et al.* 2009; Klijs *et al.* 2011) and home visits (Stuck, Egger *et al.* 2002). All these

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interventions are urgently needed given the rapid aging process underway in low to medium countries including South Africa.

7.6 Acknowledgements

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Table 7.1 Characteristics of the sample by age-group and sex (%)

Variable	Men				Women			
	50-59	60-69	70-79	≥ 80	50-59	60-69	70-79	≥ 80
Disabled ®	21.3	31.1	42.0	52.9	25.9	33.0	44.4	53.8
No schooling	32.7	31.9	25.6	43.3	29.3	38.5	30.6	59.8
Primary	24.2	34.4	25.6	40.5	30.4	32.7	29.8	20.5
Secondary	31.1	21.6	41.9	7.4	35.7	22.6	36.5	16.0
Tertiary	12.1	12.1	6.9	8.9	4.5	6.2	3.1	3.6

® 1+ Activity of Daily Living (ADL) limitations

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Table 7.2 Disabling impact of disease by sex for South Africa

	β	SE	95% CI	p-value
Men				
Arthritis	0.38	0.06	(0.26; 0.51)	<0.001
Stroke	0.50	0.15	(0.21; 0.80)	0.001
Angina	0.07	0.09	(-0.10; 0.24)	0.397
Diabetes	0.05	0.07	(-0.08; 0.18)	0.426
Lung disease	0.23	0.17	(-0.10; 0.56)	0.177
Asthma	0.18	0.10	(-0.01; 0.37)	0.061
Depression	0.30	0.15	(-0.01; 0.60)	0.054
Hypertension	0.01	0.04	(-0.06; 0.08)	0.793
Cataracts	0.23	0.11	(0.00; 0.45)	0.047
Women				
Arthritis	0.33	0.04	(0.24; 0.41)	<0.001
Stroke	0.26	0.13	(0.01; 0.50)	0.044
Angina	0.19	0.09	(0.02; 0.36)	0.030
Diabetes	0.18	0.07	(0.05; 0.31)	0.007
Lung disease	0.32	0.16	(0.02; 0.63)	0.038
Asthma	0.07	0.09	(-0.10; 0.24)	0.400
Depression	0.16	0.10	(-0.04; 0.36)	0.124
Hypertension	0.06	0.03	(0.00; 0.13)	0.069
Cataracts	0.05	0.08	(-0.11; 0.21)	0.528

β – beta coefficient (Hazard); SE – Standard Errors; CI – Confidence Intervals

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Table 7.3 Contribution of disease to prevalence of disability – fraction of disabled (in % points), by sex and age, South Africa

	50-59	60-69	70-79	≥ 80
Men				
Arthritis	**16.90**	**18.91**	**9.91**	**9.64**
Stroke	**3.51**	**4.23**	**2.66**	**3.33**
Angina	2.29	1.62	0.73	0.62
Diabetes	**2.93**	**3.12**	**2.35**	**1.68**
Lung disease	1.82	1.85	1.12	0.48
Asthma	2.31	1.15	0.46	0.74
Depression	2.01	1.19	0.80	0.34
Hypertension	**4.09**	**3.12**	**2.30**	**1.34**
Cataracts	1.01	1.05	1.26	**1.61**
Women				
Arthritis	**25.97**	**22.08**	**13.59**	**8.69**
Stroke	**3.86**	1.56	**2.47**	**1.65**
Angina	2.04	**1.82**	1.23	0.61
Diabetes	**3.18**	**3.10**	**3.08**	**0.84**
Lung disease	1.90	1.39	0.95	0.50
Asthma	1.36	1.34	0.60	0.20
Depression	2.55	1.15	0.41	0.35
Hypertension	**3.76**	**4.03**	**2.75**	**1.50**
Cataracts	0.75	1.16	1.41	0.73

NB: diseases with highest contribution in each age group are put in **bold**

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Table 7.4 Contribution of disease to prevalence of disability – fraction of total population (in % points), by sex and age, South Africa

	50-59	60-69	70-79	≥ 80
Men				
Arthritis	**3.36**	**5.53**	**4.19**	**3.91**
Stroke	**0.70**	**1.24**	**1.13**	**1.35**
Angina	0.47	0.49	0.32	0.26
Diabetes	**0.59**	**0.92**	**1.00**	**0.69**
Lung disease	0.36	0.54	0.47	0.20
Asthma	0.43	0.31	0.18	0.28
Depression	0.41	0.36	0.35	0.14
Hypertension	**0.93**	**1.04**	**1.11**	**0.62**
Cataracts	0.19	0.29	0.51	**0.62**
Women				
Arthritis	**7.12**	**7.64**	**6.11**	**5.52**
Stroke	**1.06**	0.54	**1.11**	**1.05**
Angina	0.58	0.65	0.57	0.40
Diabetes	**0.88**	**1.08**	**1.39**	0.54
Lung disease	0.52	0.48	0.43	0.31
Asthma	0.35	0.43	0.25	0.12
Depression	0.72	0.41	0.19	0.23
Hypertension	**1.18**	**1.60**	**1.42**	**1.10**
Cataracts	0.20	0.38	0.61	0.44

NB: diseases with highest contribution in each age group are put in **bold**

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Figure 7.1 Prevalence of disability by age and sex, South Africa

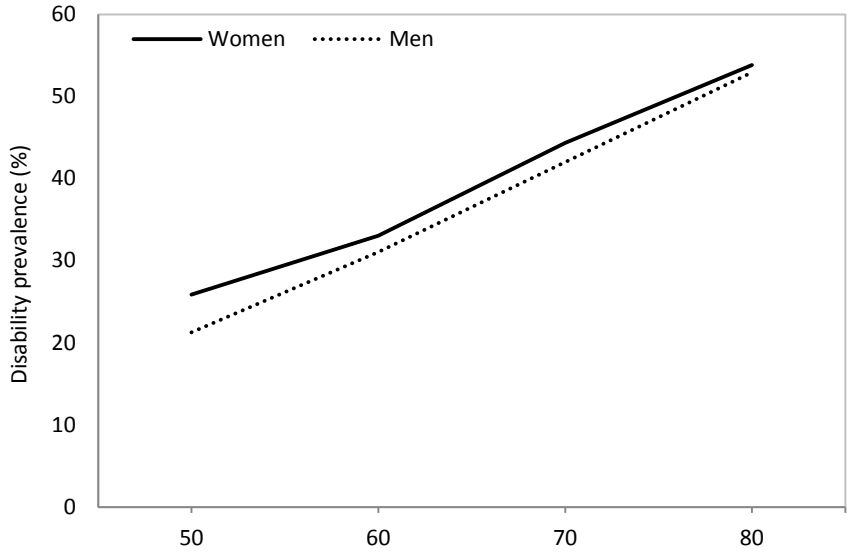

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Figure 7.2 Background hazards for men and women, South Africa

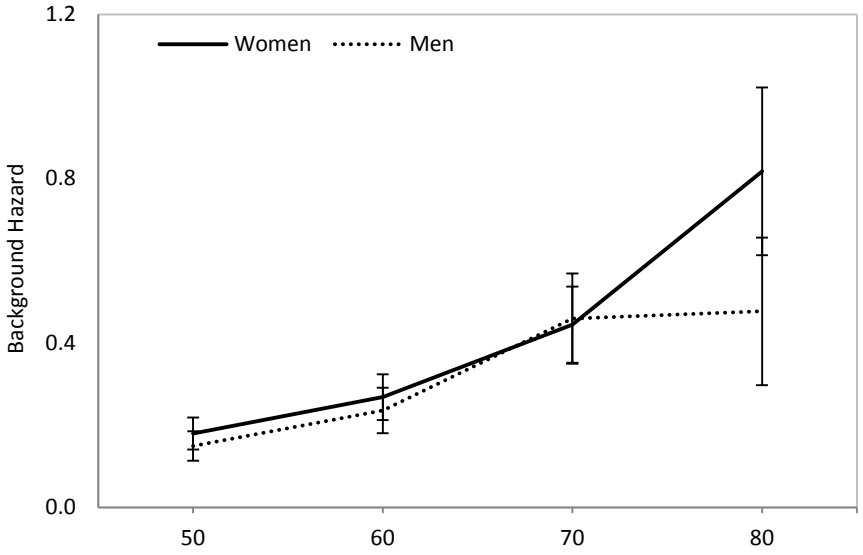

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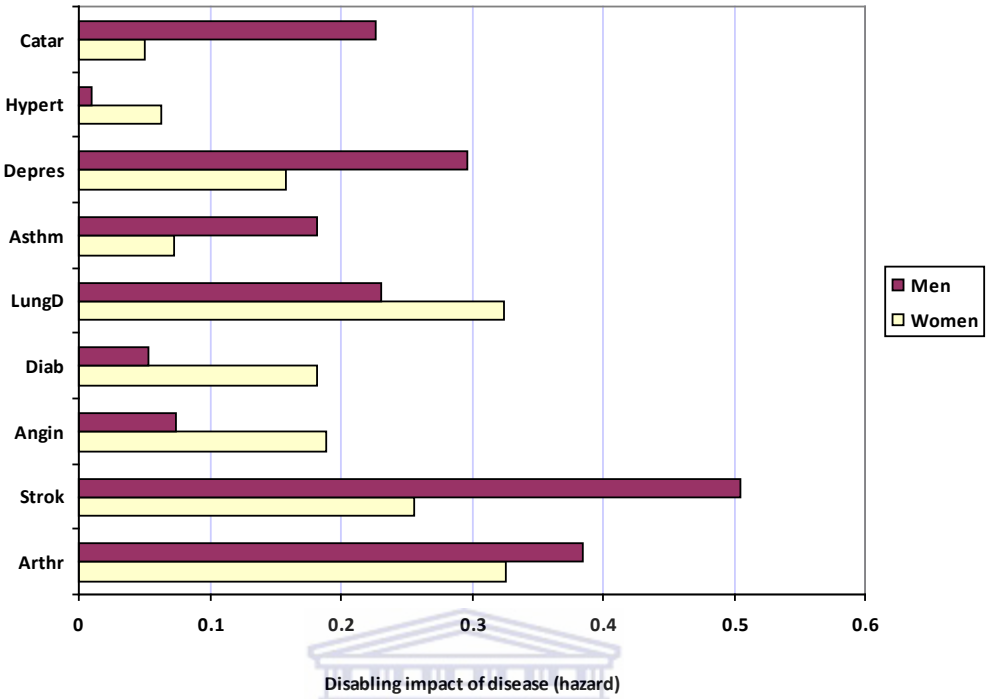
Figure 7.3 Disabling impacts of diseases[4] by sex, South Africa



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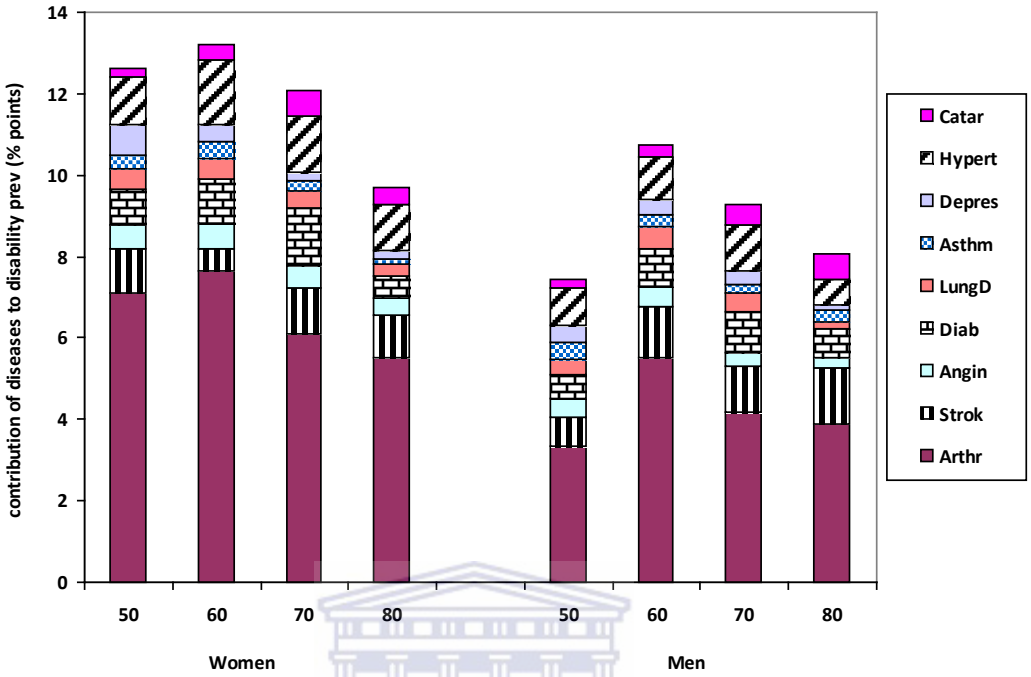
[4] Catar - Cataracts, Hypert - Hypertension, Depres - Depression, Asthm - Asthma, Strok - Stroke, LungD - Lung disease, Athr - Arthritis, Agnin - Angina, Diab - Diabetes

Figure 7.4 Contribution of disease[5] to prevalence of disability (in % points)[6], by age and sex, South Africa



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[5] Catar - Cataracts, Hypert - Hypertension, Depres - Depression, Asthm - Asthma, Strok - Stroke, LungD - Lung disease, Athr - Arthritis, Agnin - Angina, Diab – Diabetes

[6] Fraction of total population

Chapter 8 Concluding Remarks

This thesis sought to describe the health status and wellbeing of older people in South Africa. This was achieved through estimating health expectancies based on various measures of health. This is the first study to estimate healthy expectancies using different health measures in South Africa. The results of this study shed light on the health status of older people. The purpose of this chapter is to sum up the findings of this study and suggest some policy recommendations.

8.1 Summary of findings

The first paper focused on sexual health which was assessed using sexual activity as a measure. Sexual health is a crucial yet neglected area of elderly people's overall health and quality of life. The results show that sexually active life expectancy has increased over the period 2005-2012 for both genders and across all age categories. This means that old people remain sexually active and sex must be de-stigmatized and not treated as a taboo among old people. Traditionally, there is a misconception that only young people are sexually active. As a result, sexual health programmes are mainly targeted at 'young' people i.e. those within the 'reproductive age group' (15-49). The results from this study challenge this myth and demonstrate the need to target older people with sexual health programmes and interventions. This is important especially given that people are aging with HIV, and hence the need to broaden the targeted age spectrum to include the older ages.

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The present findings show that during the period from 2005 to 2012, there was 'compression of morbidity' in older South Africans. This is a positive finding which implies that older people are actually spending more of their remaining years of life in self-perceived good health. The policy implication of this important finding is that older people should continue to be engaged in all social and economic activities e.g. labour participation as this would capitalize on this 'wealth dividend' associated with healthy aging. Older people can continue to contribute to society in various forms since they are living for extended periods in good health. Although aging is naturally associated with decline in health and function, many older people are still able to live an active, healthy, and productive live even up to the oldest ages (Olshansky *et al.*

2011; Christensen, McGue *et al.* 2008; Perls, Silver *et al.* 1999). The findings from this study confirm these observations, and give an optimistic view of aging. In the pursuit of healthy aging, it is recommended that health promotion and disease prevention programmes be implemented targeting chronic conditions, and with the aim of compressing morbidity and disability into a shorter duration of lifetime towards the end of lifespan. There is need to emphasise a life course approach since most of the chronic conditions have their antecedents in the younger ages. Overall, there is internal consistency between the two measures i.e. sexual health and self-rated health from SABSSM data, in that the trends for both measures are in the same positive direction.

From SAGE data, objective (functional limitations – ADL and IADL) and subjective (self-rated heath, happiness and quality of life) measures, were used to estimate health expectancies (Papers 3 & 4). Overall, the results show that health expectancies measured by subjective measures were greater than those measured by objective measures, although there is an exception in the case of quality of life. The reason is that quality of life is a broader measure which in fact encompasses or summarises all the other measures. The study could not show trends in the health expectancies since data only come from a single time point (i.e. SAGE wave I). Nonetheless, the variations in the results from these measures confirms the need for using multiple measures in measuring health since health is a complex multidimensional concept (World Health Organization 1946). Each of these measures is important as it refers to a different phase of disease and disablement process, and as a result, different trends can be observed (Christensen, Doblhammer *et al.* 2009). Therefore, it is important to monitor each of these measures across time, and to evaluate if there is an improvement or decline in the health status of older people. The study went on a crucial step further to look at the contribution of specific disease to disability (Paper 5). This piece of analysis is important in identifying specific disease to target in ameliorating disability. According to the results, musculoskeletal and cardiovascular diseases should be prioritised as they were the most contributors to disability in both men and women.

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8.2 Strengths and limitations

The study utilized two datasets i.e. SAGE and SABSSM. The two datasets were complimentary in strengthening the methodological basis of the study. SAGE is the first comprehensive nationally representative study to be conducted in South Africa specifically targeting older people. The survey collected detailed information covering a wide range of health measures. Unfortunately, although SAGE is designed to be prospective longitudinal study, only baseline data collected between 2007 and 2008 were used in this study since the next wave (II) is still to be conducted. Thus, essentially the data available is cross-sectional, and as a result no time trends could be derived. This limitation was to an extent mitigated by SABSSM survey data which brings a trend dimension to the analysis. This is a repeated cross-sectional survey, and the data used in this study were for the period 2005 – 2012. It was therefore possible to examine trends in health outcomes based on this data. Further, in SABSSM the same wording of questions, research design, sampling procedures and methodology is used in each survey round. This makes it possible to make comparisons across surveys. The downside of SABSSM was that the surveys are primarily focused on HIV surveillance in the general population, and as such, data collected mainly pertain to behavioural factors and HIV related outcomes. Only two measures were appropriate to be used in this study for the calculating health expectancies, namely; sexual health – measured by sexual activity, and self-rated health. It was therefore possible to examine trends in these two measures. More importantly, it was feasible to test the hypothesis of compression or expansion of morbidity based on self-rated health measure (Paper 2). It would be of great interest to do the same i.e. test these hypotheses based on 'objective measures' e.g. disability (ADLs) collected in SAGE. This will only be possible in the next waves of SAGE. It is also reasonable to recommend that questions on sexual health be included in SAGE questionnaire. This is important as it will be an important addition to the conceptual framework used for this research. In this case, it will be possible to establish the relationships between sexual health, quality of life, functionality and diseases. The results from Paper 1 suggested that presence of chronic conditions significantly reduced sexual activity in men.

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The other strength of this study is that it applied a broader conceptualization of health, based on WHO framework (World Health Organization 1946). In this line, several health measures were used which included; sexuality health, self-rated health, functional limitations, happiness and quality of life. This is a key strength in that it was possible to give a comprehensive analysis of health, and cross-validation of results based on the various measures. Methodologically, this thesis adds value in that it uses several approaches which include the Sullivan method, attribution technique and logistic regression models, in order to produce robust results.

The study also had some limitations. The one which has been mentioned in almost all the five papers is the exclusion of institutionalized populations from the two surveys which are both household based, and consequently from the analysis in this study. It can generally be suspected that the health status and wellbeing of the people living in institutions will be different from those in the population. Therefore, it is important to include them in analysing health expectancies to avoid getting biased estimates. Unfortunately, there is no information on the health status of institutionalized population in South Africa. However, the effect of excluding institutionalized populations in the study is negligible because the proportion is small.

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Another limitation of this study is that it does not drill down to specific subsystem components. In other words it does not decompose health expectancies for provinces, race groups, socio-economic status (SES) and other differentials apart from sex. The reason for this is that there are no life tables disaggregated by these variables in South Africa. Health expectancies are used as a policy tool to analyse inequalities across subgroups. Hence, it would be of interest to policy makers to get estimates stratified by these sub-categories.

8.3 Future research

A recommendation made in in Paper 2 to add a disability question to the next round of SABSSM surveys is currently being considered by the survey technical team at the HSRC. This means it would be possible to analyse trends in health expectancies based on objective measures in the future. It is hoped that the results of this study can stimulate debate and interest among researchers to further study aging and health issues in Africa and South Africa. More studies are needed to provide evidence for

policymakers on possible interventions that can be made to advance the health of elderly people. There is an urgent need for concerted effort from all sectors to start thinking and planning for an aging society, given the future projections of the aging process in developing countries. Future research can also expand on the measures used in this study. An important extension is to look at mental health aspect – and hence derive Mental Health Free Life Expectancies (MHFLE). This is because mental health and cognitive decline is an important challenge among older people in developing countries. There is also need to use longitudinal data in the estimation of health expectancies and for monitoring trends over time. In this study though, an attempt in monitoring trends over time was attempted using the SABSSM repeated cross-sectional surveys. However, the ideal data to use for this purpose will be from a longitudinal design. Based on such data, it would be possible to estimate transition between health states and recovery rates from e.g. disability. This form of analysis will further validate the findings from this study.

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Appendices

Appendix 1: Supplementary results from attribution (paper 5)

Additional Model Results

Further results from the attribution tool are shown below

```
[1] "> > > OUTPUT PART 1: DATA INSPECTION AND DOCUMENTATION < < <"
[1] "selection:" function(){Crossdat[  ,]}
[1] "number of cases and variables after selection:"
[1] 3622   13
[1] "first five records:"
           1:age10m 2:ADL 3:Female 4:Arthr 5:Strok 6:Angin 7:Diab 8:LungD 9:Asthm
10:Depres
1558009001     50    1      1      1      0      0      0      0      0       0
1558018401     60    0      2      1      0      0      0      0      0       0
1558018402     50    0      1      1      1      0      0      0      0       1
1558018501     50    0      1      0      0      0      0      0      0       0
1558018502     70    0      1      0      0      0      0      0      0       0
           11:Hypert 12:Catar 13:OralH
1558009001         0       0        0
1558018401         0       0        0
1558018402         0       0        0
1558018501         0       0        0
1558018502         0       0        0

[1] "ageclasses are in column number:"
[1] 1
[1] "original name:"
[1] "age10m"
[1] "disability is in column number:"
[1] 2
[1] "original name:"
[1] "ADL"
[1] "population is in column number:"
[1] 3
[1] "original name:"
[1] "Female"
[1] "column numbers for diseases:"
 [1]  4  5  6  7  8  9 10 11 12 13
[1] "list of names:"
 [1] "Arthr"  "Strok"  "Angin"  "Diab"   "LungD"  "Asthm"  "Depres" "Hypert" "Catar"
"OralH"
  optimization method is Nelder-Mead
[1] "attributions based on fitted values"
```

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[1] "machine readable copy of the result"

[1] "> > > OUTPUT PART 2: DESCRIPTIVE CALCULATIONS < < <"
[1] "Start of calculations"

[1] "prevalence of disability per age class:"
   50   60   70   80
0.2351 0.3242 0.4373 0.5356

[1] "numbers by disability and age class:"
      50 60 70 80
 0 1220 788 350 111
 1 375 378 272 128

[1] "numbers of diseases:"
 Arthr Strok Angin   Diab LungD Asthm Depres Hypert Catar OralH
  841   138   218   356   87   163   113   1110   166   366

" > OUTPUT PART 3: RESULTS FROM THE SIMPLE ADDITIVE REGRESSION MODEL (SL) <"

[1] "deviance at initial values:"
[1] 4214
[1] "run 2 (NM) 4131.51613676089"
[1] "Mon Oct 20 06:24:38 2014"

[1] " XXXXX output for simple linear model: XXXXX "

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Call:
[1] "disab~age5+Diseases,family=adhaz,data=Crossdat,weight=wgt"

Coefficients:

	beta	stderrs	CIlow	CIhigh	p-value
age550	0.16078	0.01326	0.1347912	0.18677	NA
age560	0.25073	0.02001	0.2115155	0.28995	NA
age570	0.43869	0.03533	0.3694376	0.50795	NA
age580	0.64894	0.06862	0.5144351	0.78344	NA
DiseasesArthr	0.35027	0.03604	0.2796322	0.42090	0.0000
DiseasesStrok	0.36573	0.09483	0.1798510	0.55160	0.0001
DiseasesAngin	0.11927	0.05975	0.0021549	0.23639	0.0459
DiseasesDiab	0.12487	0.04773	0.0313240	0.21842	0.0089
DiseasesLungD	0.27600	0.11260	0.0553004	0.49670	0.0142
DiseasesAsthm	0.09885	0.05999	-0.0187409	0.21644	0.0994
DiseasesDepres	0.19540	0.08270	0.0332983	0.35750	0.0181
DiseasesHypert	0.04967	0.02520	0.0002769	0.09906	0.0487
DiseasesCatar	0.09761	0.06254	-0.0249697	0.22020	0.1186
DiseasesOralH	-0.07870	0.02967	-0.1368579	-0.02053	0.0080

Residual degrees of freedom: 3608
Residual deviance: 4131.51

[1] "> > > OUTPUT PART 3b: POPULATION SPECIFIC LINEAR MODELS[7] < < <"

[1] " XXXXX model A: background hazards different: XXXXX"

[1] "deviance at initial values:"

[1] 4208

[1] "run 2 (NM) 4122.6024449716"

[1] "run 3 (NM) 4122.52776492205"

[1] "disab~age5+Diseases,family=adhaz,data=Crossdat,weight=wgt"

[1] " parameters:"

	beta	stderrs	CIlow	CIhigh	p-value
age51.50	0.17968	0.01882	0.142785	0.21656	NA
age51.60	0.27050	0.02711	0.217365	0.32364	NA
age51.70	0.44614	0.04581	0.356361	0.53592	NA
age51.80	0.78871	0.09943	0.593830	0.98359	NA
age52.50	0.14523	0.01708	0.111761	0.17870	NA
age52.60	0.22909	0.02716	0.175865	0.28232	NA
age52.70	0.44195	0.05404	0.336025	0.54787	NA
age52.80	0.46670	0.08893	0.292402	0.64100	NA
DiseasesArthr	0.34712	0.03616	0.276249	0.41799	0.0000
DiseasesStrok	0.36163	0.09343	0.178507	0.54474	0.0001
DiseasesAngin	0.11368	0.05924	-0.002431	0.22979	0.0550
DiseasesDiab	0.12270	0.04776	0.029084	0.21632	0.0102
DiseasesLungD	0.27324	0.11272	0.052306	0.49418	0.0153
DiseasesAsthm	0.10635	0.06038	-0.011984	0.22469	0.0782
DiseasesDepres	0.18795	0.08148	0.028245	0.34765	0.0211
DiseasesHypert	0.04292	0.02524	-0.006556	0.09239	0.0891
DiseasesCatar	0.10111	0.06219	-0.020790	0.22301	0.1040
DiseasesOralH	-0.08149	0.02988	-0.140052	-0.02293	0.0064

[1] " deviance and df:"

[1] 4122.26

[1] 3604

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[1] " XXXXX model D: disease effects different: XXXXX"

[1] "deviance at initial values:"

[1] 4205

[1] "run 2 (NM) 4121.79769415582"

[1] "run 3 (NM) 4120.04157217676"

[1] "run 4 (NM) 4119.91599837619"

[1] "disab~age5+Diseases,family=adhaz,data=Crossdat,weight=wgt"

[1] " parameters:"

	beta	stderrs	CIlow	CIhigh	p-value
age550	0.160848	0.01326	0.134857	0.18684	NA
age560	0.250349	0.01996	0.211233	0.28947	NA
age570	0.439610	0.03534	0.370339	0.50888	NA
age580	0.644463	0.06888	0.509454	0.77947	NA
DiseasesArthr.1	0.336084	0.04376	0.250308	0.42186	0.0000
DiseasesStrok.1	0.251344	0.12372	0.008844	0.49384	0.0422
DiseasesAngin.1	0.184334	0.08432	0.019075	0.34959	0.0288
DiseasesDiab.1	0.181178	0.06656	0.050728	0.31163	0.0065
DiseasesLungD.1	0.333498	0.15436	0.030950	0.63605	0.0307
DiseasesAsthm.1	0.064381	0.08189	-0.096129	0.22489	0.4318
DiseasesDepres.1	0.160260	0.09913	-0.034039	0.35456	0.1060

[7] Coded as; 1 – Females 2 – Males

```
DiseasesHypert.1  0.076775 0.03252  0.013038  0.14051  0.0182
DiseasesCatar.1   0.043163 0.07564 -0.105090  0.19142  0.5682
DiseasesOralH.1  -0.063558 0.03996 -0.141877  0.01476  0.1117
DiseasesArthr.2   0.361710 0.06192  0.240350  0.48307  0.0000
DiseasesStrok.2   0.498751 0.15185  0.201124  0.79638  0.0010
DiseasesAngin.2   0.052885 0.08294 -0.109671  0.21544  0.5237
DiseasesDiab.2    0.038238 0.06350 -0.086231  0.16271  0.5471
DiseasesLungD.2   0.210750 0.16348 -0.109679  0.53118  0.1974
DiseasesAsthm.2   0.149358 0.08995 -0.026947  0.32566  0.0968
DiseasesDepres.2  0.299346 0.15504 -0.004526  0.60322  0.0535
DiseasesHypert.2  0.002683 0.03546 -0.066821  0.07219  0.9397
DiseasesCatar.2   0.207222 0.11026 -0.008894  0.42334  0.0602
DiseasesOralH.2  -0.094397 0.04239 -0.177488 -0.01131  0.0260
[1] "    deviance and df:"
[1] 4119.88
[1] 3598

[1] "summary comparisons:"
[1] "p-value for differences in disease effects:"
[1] 0.311
[1] "p-value for differences in background hazards:"
[1] 0.055
[1] "p-value for differences in background hazards given difference in disease effects:"
[1] 0.162
[1] "p-value for differences in disease effects given difference in background hazards:"
[1] 0.54
```

[1] "> > > OUTPUT PART 5: ATTRIBUTION OF DISABILITY BY DISEASE < < <"

```
$`differences in background hazards`
$`differences in background hazards`$`1`
              50       60        70       80
nn       883.000 667.000 386.0000 147.0000
disab    238.746 227.404 171.9738  87.7485
backgrnd 135.609 147.022 129.7078  75.9192
Arthr     62.007  50.214  23.3638   7.6227
Strok      9.210   3.543   4.2436   1.4440
Angin      4.862   4.135   2.1141   0.5362
Diab       7.590   7.059   5.2905   0.7330
LungD      4.531   3.157   1.6351   0.4354
Asthm      3.251   3.035   1.0343   0.1763
Depres     6.090   2.618   0.6997   0.3044
Hypert     8.982   9.158   4.7280   1.3178
Catar      1.787   2.633   2.4312   0.6405
OralH     -5.172  -5.171  -3.2743  -1.3808

$`differences in background hazards`$`2`
              50       60        70       80
nn       712.000 499.000 236.0000 92.0000
disab    141.715 146.513  99.1744 39.9561
backgrnd  92.545  96.251  80.2112 32.6414
Arthr     23.953  27.711   9.8243  3.8507
Strok      4.973   6.201   2.6375  1.3314
Angin      3.243   2.366   0.7228  0.2485
Diab       4.150   4.566   2.3339  0.6728
LungD      2.580   2.706   1.1092  0.1931
Asthm      3.276   1.688   0.4570  0.2962
```

```
Depres     2.851   1.744   0.7914  0.1353
Hypert     5.793   4.566   2.2763  0.5350
Catar      1.427   1.540   1.2504  0.6423
OralH     -3.074  -2.826  -2.4395 -0.5906
```

[1] "as fraction of disabled:"

```
[1] "no differences in parameters"
[1] "1"
                50       60        70        80
backgrnd  0.534973  0.62299  0.746144  0.837447
Arthr     0.275259  0.23117  0.137683  0.102652
Strok     0.040885  0.01630  0.025064  0.019450
Angin     0.022379  0.01976  0.012934  0.007487
Diab      0.033954  0.03274  0.031439  0.009951
LungD     0.020137  0.01456  0.009657  0.005849
Asthm     0.013348  0.01292  0.005635  0.002189
Depres    0.027759  0.01238  0.004238  0.004192
Hypert    0.045682  0.04834  0.031941  0.020371
Catar     0.007597  0.01162  0.013734  0.008248
OralH    -0.021973 -0.02277 -0.018469 -0.017837
[1] "2"
                50        60        70        80
backgrnd  0.670033  0.671879  0.802995  0.858480
Arthr     0.157780  0.178139  0.099836  0.073785
Strok     0.032812  0.039928  0.026852  0.025585
Angin     0.022168  0.015785  0.007620  0.004923
Diab      0.027563  0.029582  0.023892  0.012977
LungD     0.017021  0.017417  0.011281  0.003697
Asthm     0.019965  0.010024  0.004293  0.005236
Depres    0.019304  0.011524  0.008275  0.002652
Hypert    0.043716  0.033620  0.026505  0.011697
Catar     0.009009  0.009479  0.012175  0.011762
OralH    -0.019371 -0.017377 -0.023723 -0.010794
[1] "differences in background hazards"
[1] "1"
                50       60        70        80
backgrnd  0.568007  0.64652  0.754230  0.865191
Arthr     0.259721  0.22081  0.135857  0.086869
Strok     0.038576  0.01558  0.024676  0.016456
Angin     0.020364  0.01818  0.012293  0.006110
Diab      0.031791  0.03104  0.030763  0.008354
LungD     0.018978  0.01388  0.009508  0.004961
Asthm     0.013615  0.01335  0.006014  0.002009
Depres    0.025507  0.01151  0.004069  0.003469
Hypert    0.037620  0.04027  0.027492  0.015018
Catar     0.007486  0.01158  0.014137  0.007299
OralH    -0.021665 -0.02274 -0.019039 -0.015736
[1] "2"
                50       60        70        80
backgrnd  0.65303  0.65695  0.808789  0.816933
Arthr     0.16902  0.18913  0.099061  0.096374
Strok     0.03509  0.04233  0.026595  0.033321
Angin     0.02289  0.01615  0.007288  0.006219
Diab      0.02928  0.03116  0.023533  0.016838
LungD     0.01820  0.01847  0.011184  0.004832
Asthm     0.02312  0.01152  0.004608  0.007413
Depres    0.02012  0.01191  0.007980  0.003386
Hypert    0.04087  0.03117  0.022952  0.013390
Catar     0.01007  0.01051  0.012608  0.016075
```

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```
OralH    -0.02169 -0.01929 -0.024599 -0.014781
```

[1] "as fraction of total population:"

```
[1] "no differences in parameters"
[1] "1"
                50        60        70        80
backgrnd  0.138444  0.205812  0.330929  0.450592
Arthr     0.071234  0.076369  0.061065  0.055232
Strok     0.010580  0.005385  0.011116  0.010465
Angin     0.005791  0.006528  0.005737  0.004028
Diab      0.008787  0.010817  0.013944  0.005354
LungD     0.005211  0.004810  0.004283  0.003147
Asthm     0.003454  0.004267  0.002499  0.001178
Depres    0.007184  0.004091  0.001880  0.002256
Hypert    0.011822  0.015971  0.014166  0.010960
Catar     0.001966  0.003838  0.006091  0.004438
OralH    -0.005686 -0.007523 -0.008191 -0.009597
[1] "2"
                50        60        70        80
backgrnd  0.142678  0.208687  0.337376  0.454496
Arthr     0.033598  0.055330  0.041946  0.039063
Strok     0.006987  0.012402  0.011282  0.013545
Angin     0.004720  0.004903  0.003201  0.002606
Diab      0.005869  0.009188  0.010038  0.006870
LungD     0.003625  0.005410  0.004740  0.001957
Asthm     0.004251  0.003113  0.001804  0.002772
Depres    0.004111  0.003580  0.003477  0.001404
Hypert    0.009309  0.010442  0.011136  0.006193
Catar     0.001918  0.002944  0.005115  0.006227
OralH    -0.004125 -0.005397 -0.009967 -0.005715
[1] "differences in background hazards"
[1] "1"
                50        60        70        80
backgrnd  0.153578  0.220422  0.336030  0.516457
Arthr     0.070223  0.075283  0.060528  0.051855
Strok     0.010430  0.005312  0.010994  0.009823
Angin     0.005506  0.006200  0.005477  0.003647
Diab      0.008596  0.010584  0.013706  0.004987
LungD     0.005131  0.004733  0.004236  0.002962
Asthm     0.003681  0.004550  0.002679  0.001200
Depres    0.006896  0.003925  0.001813  0.002071
Hypert    0.010172  0.013731  0.012249  0.008964
Catar     0.002024  0.003948  0.006298  0.004357
OralH    -0.005858 -0.007752 -0.008483 -0.009393
[1] "2"
                50        60        70        80
backgrnd  0.129979  0.192888  0.339878  0.354798
Arthr     0.033641  0.055532  0.041628  0.041856
Strok     0.006984  0.012428  0.011176  0.014471
Angin     0.004555  0.004742  0.003063  0.002701
Diab      0.005828  0.009150  0.009889  0.007313
LungD     0.003623  0.005424  0.004700  0.002099
Asthm     0.004601  0.003382  0.001936  0.003219
Depres    0.004005  0.003496  0.003354  0.001471
Hypert    0.008136  0.009151  0.009645  0.005815
Catar     0.002004  0.003085  0.005298  0.006981
OralH    -0.004318 -0.005664 -0.010337 -0.006419
```

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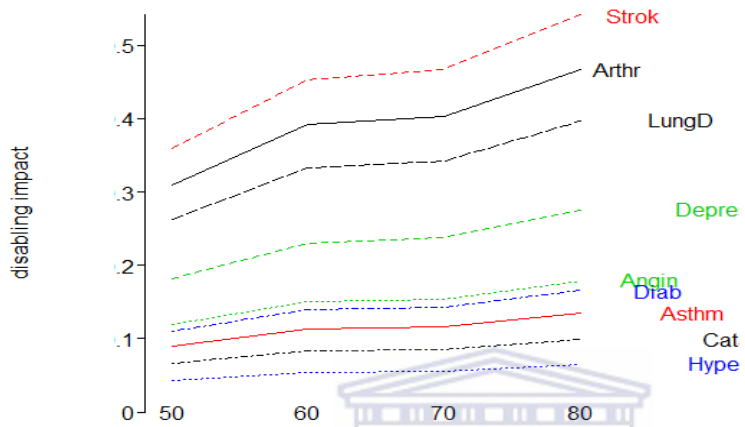
Reduced rank regression (RRR)

Reduced rank regression (RRR) was conducted to test whether disabling impacts (βd) vary by age. The output below shows that reduced rank regression - RRR 1 and RR2 were not necessary.

RRR =1



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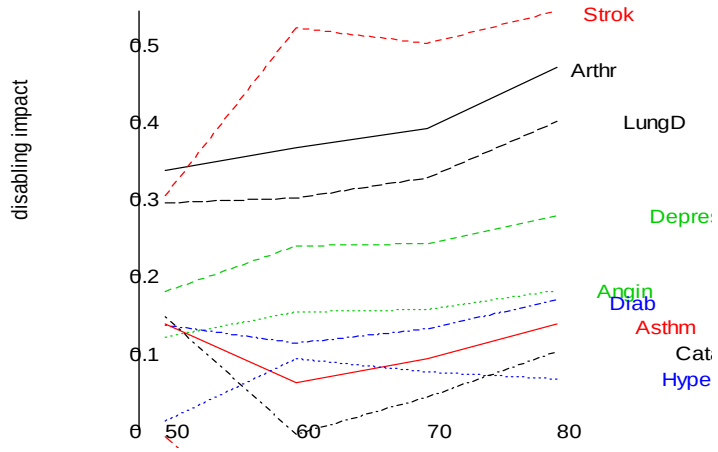
RRR=2



Appendix 2: Supplementary research on Aging co-authored by candidate

The candidate took part in supplementary work on Aging in South Africa which is related to the PhD project. This is presented in the form of four published articles in this section:

1. Phaswana-Mafuya, N., Peltzer, K., **Chirinda, W.**, Kose, Z., Hoosain, E., Ramlagan, S., Tabane, C. & Davids, A. (2013) Self-rated health and associated factors among older South Africans: evidence from the study on global ageing and adult health. *Glob Health Action* 2013, 6: 20936 - http://dx.doi.org/10.3402/gha.v6i0.20936
2. Nancy Phaswana-Mafuya, Karl Peltzer, **Witness Chirinda**, Zamakayise Kose, Ebrahim Hoosain, Adlai Davids & Shandir Ramlagan (2013). Self-reported prevalence of chronic non-communicable diseases and associated factors among older adults in South Africa. *Glob Health Action* 2013, 6: 20936 - http://dx.doi.org/10.3402/gha.v6i0.20936
3. Phaswana-Mafuya, N., Peltzer, K., Ramlagan, S., **Chirinda, W.** & Kose, Z. (2013), 'Social and health determinants of gender differences in disability amongst older adults in South Africa', *Health SA Gesondheid* 18(1), Art. #728, 9 pages. http://dx.doi.org/10.4102/hsag.v18i1.728
4. Phaswana-Mafuya, N., Peltzer, K., **Chirinda, W.** & Kose, Z. (2013). Clustering of Chronic Non-communicable Disease Risk Factors among older Adults in South Africa. *Glob Health Action* 2013, 6: 20680 - http://dx.doi.org/10.3402/gha.v6i0.20680

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COACTION

Self-rated health and associated factors among older South Africans: evidence from the study on global ageing and adult health

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Background: Population ageing has become significant in South African society, increasing the need to improve understandings of health and well-being among the aged.
Objective: To describe the self-reported ratings of overall health and functioning, and to identify factors associated with self-rated health among older South Africans.
Design: A national population-based cross-sectional survey, with a sample of 3,840 individuals aged 50 years and older, was completed in South Africa in 2008. Self-reported ratings of overall health and functioning were measured using a single self-reported health state covering nine health domains (used to generate the Study on Global Ageing and Adult Health (SAGE) composite health state score). Disability was measured using the World Health Organization Disability Assessment Schedule II (WHODAS-II) activities of daily living (ADLs), instrumental activities of daily living (IADLs), perceptions of well-being, and the World Health Organization Quality of Life index/metric (WHOQoL).
Results: Overall, more than three quarters (76.8%) of adults rated their health as moderate or good. On balance, men reported very good or good health more often than women ($p < 0.001$). Older people (aged 70 years and above) reported significantly poorer health status than those aged 50–59 (adjusted odds ratio (AOR) 1.52; 95% confidence interval (CI) 1.00–2.30). Indians and Blacks were significantly more likely to report poorer health status at (AOR =4.01; 95% CI 1.27–12.70) and (AOR =0.42; 95% CI 0.18–0.98; $p = 0.045$), respectively, compared to Whites. Respondents with primary education (AOR =1.83; 95% CI 1.19–2.80) and less than primary education (AOR =1.94; 95% CI 1.37–2.76) were more likely to report poorer health compared to those with secondary education. In terms of wealth status, those in low wealth quintile (AOR =2.02; 95% CI 1.14–3.57) and medium wealth quintile (AOR =1.47; 95% CI 1.01–2.13) were more likely to report poorer health status than those in high wealth quintile. Overall, the mean WHODAS-II score was 20%, suggesting a low level of disability. The mean WHOQoL score for females (Mean =51.5; SD =12.2) was comparable to that of males (Mean =49.1; SD =12.6).
Conclusion: The depreciation in health and daily functioning with increasing age is likely to increase demand for health care and other services as people grow older. There is a need for regular monitoring of the health status of older people to provide public health agencies with the data they need to assess, protect, and promote the health and well-being of older people.

Keywords: *adult health*; *ageing*; *self-reported health*; *disability*; *quality of life*; *SAGE*; *South Africa*; *WHODAS-II*; *WHOQoL*; *ADLs*; *IADLs*

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(page number not for citation purpose)

It is crucial to understand the health of older people given the fact that the world's population is rapidly ageing, and estimates show that this increase will continue (1, 2). Similar trends have been observed in South Africa which has the continent's highest percentage of older inhabitants −6.7% of the population was estimated to be 60 years or older in 2005 (3). In South Africa, the older population currently constitutes 7.7% (4). The growth in the numbers of older persons, combined with the exigencies of growing old, puts pressure on governments to respond and to provide for the needs of this population. In this regard, the United Nations Madrid International Plan of Action on Ageing (5) and the 2003 African Union Policy Framework and Plan of Action on Ageing (6) were developed to urge governments to take account of ageing and older populations.

Earlier studies have shown that self-rated health of older people typically deteriorates with increasing age (7–9). Despite women having higher life expectancy than men, older men have consistently reported better health than their female counterparts (10) even after adjustments for differences in demographic and socioeconomic factors. Older people without formal education, without a spouse, and with low socioeconomic status (SES) are significantly more likely to self-rate their health status as poor compared to their more educated, married, younger, and higher SES counterparts (10, 11).

Earlier studies have also shown that quality of life (QoL) deteriorates with age, and higher proportions of women reported poor QoL compared to their male counterparts (12, 13). These studies showed that older age group, lack of formal education, being single, and currently not working were significantly associated with lower QoL (10, 11, 13). Lower QoL was also associated with poorer self-rated health (14).

Further, previous studies found that the incidence of disability and impairment increases with age (11, 15, 16). Women generally reported poorer functionality than men (11). Functional problems were compounded, if the older person had no spouse, had lower education, was unemployed, and was economically unstable (13, 16). Disability and impairment were also associated with poorer self-rated health (17). These findings need to be further explored among elderly people in South Africa, where health research has historically been more heavily focused on younger age populations.

A number of smaller scale studies (18–20) were conducted. National level studies such as the 2003 World Health Survey and the 1998/2003 South African Demographic and Health Surveys (SADHS) had limited samples of individuals aged 50 years and above, and, thus, the data were inadequate to inform policy formulation and program implementation. As the South African population ages, there is an increasing need for valid and comparable data on the health and well-being of older adults. There is a need to build an evidence base that can be used in formulating policies and monitoring their impact. Against this background, the Study on Global Ageing and Adult Health (SAGE) was conducted in 2008 as the first nationally representative population-based study among older South Africans. This study highlights the health needs of elderly South Africans upon which strategies to enhance health service provision for Africa's older persons can be built (5). The study provides high quality baseline data, which improve the understanding of health and well-being of older adults and ageing in South Africa, needed to inform policy and program debates.

Methods

Sample and procedure

The Human Sciences Research Council (HSRC), the World Health Organization (WHO), and the National Department of Health (NDOH) conducted a national population-based cross-sectional study, namely SAGE. Data for SAGE were collected between March 2007 and September 2008 in South Africa among individuals aged 50 years and above. The SAGE sample design entailed a two-stage probability sample that yielded national and sub-national estimates to an acceptable precision at provincial level, by locality type (urban and rural) and race (including Black, Colored, Indian or Asian, and White). The target sample size for SAGE was 5,000 individuals aged 50 years and above. A total of 3,840 individuals aged 50 years or older agreed to participate in SAGE. This gave an individual response rate of 77%. The study was approved by the HSRC Research Ethics Committee and the NDOH.

Measures

Sociodemographic characteristics

These included age, sex, education, race, religious affiliation, marital status, geolocality (divided into rural and urban), and wealth status.

Self-rated health

Overall, self-rated health status was based on respondents' assessment of their current health status on a 5-point scale in response to the question: 'In general, how would you rate your health today?' Response categories were: very good, good, moderate, bad, and very bad. The WHO's approach to measuring health states uses multiple domains of health that explain 80% of the variance in an individual's health (21). This approach provides scalable levels of health and the ability to decompose a single score into meaningful components. Respondents also rated their health on nine domains: affect, mobility, sleep and energy, cognition, interpersonal activities, vision,

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self-care, pain, and breathing (22). The SAGE composite health score was derived from 16 responses, two questions for each domain, using a Rasch partial credit model of Item Response Theory (23) that served to generate a composite health-state score (24, 25). A Chi-square goodness of fit statistics was calculated to determine how well each item contributed to a common global health measurement. The calibration for each of the health items was taken into account, and the raw scores were transformed into a continuous cardinal scale, where a score of 0 represents the worst health and a maximum score of 100 represents the best health.

Difficulty in carrying out work or household activities

The time period was specified as 'In the last 30 days', and the respondents were asked to provide an average of good and bad days. This indicator is intended to measure the impact of health on a person's functioning.

Disability

The 12-item version of WHO Disability Assessment Schedule (WHODAS-II) (www.who.int/icidh/whodas/) was used to measure health, functioning, and disability. WHODAS II evaluates six domains (two items per domain) of day-to-day functioning in the last 30 days – understanding and communicating, getting around, self-care, getting along with people, life activities, and participation in society (15). It contains many of the most commonly asked activities of daily living (ADLs) and instrumental activities of daily living (IADLs) questions, with response categories that provide an estimate of severity of disability through asking about the level of difficulty with each activity. Levels range from 'no difficulty at all' to 'extreme difficulty/cannot do'. ADLs are basic daily self-care activities that support survival, including eating, bathing, and toileting. They usually assess the need for help with personal care activities, such as eating, bathing, and dressing. An individual's ability to perform ADLs is typically considered normal functional status, with an inability to perform ADLs suggesting disability. IADLs are indicators of functional well-being that measure the ability to perform more complex tasks, such as heavy or light housework, laundry, preparing meals, shopping for groceries, getting around outside, travelling, managing money, and using a telephone. Results from the 12 items were summed to get an overall WHODAS-II score, which was then transformed to a 0 (no disability) to 100 (high disability) scale.

Subjective well-being and QoL

Subjective well-being includes a person's overall appraisal of his or her life (global well-being) and affective state (hedonic well-being), and it is an important aspect of older people's health (26). For this study, subjective well-being and QoL were measured using the eight-item World Health Organization Quality of Life (WHOQoL) instruments. The WHOQOL instrument contains a set of international, cross-cultural comparable tools used to assess QoL and provides a measure of the evaluative component of well-being (27). The instrument ranges from 0 to 100 and was evaluated by responses to questions on overall life satisfaction and specific aspects of life. It also used two questions in each of the four broad domains: physical, psychological, social, and

Table 1. Sociodemographic characteristics of adults aged 50 years or older, per cent distribution by sex

Sociodemographic characteristics	Men (*N* = 1,690)	Women (*N* = 2,146)	Total (*N* = 3,836) *n* (%)
Age group (years)			
50–59	52.2	48.1	1,914 (49.9)
60–69	30.5	30.7	1,174 (30.6)
70–79	11.4	16.0	536 (14.0)
80+	5.8	5.3	212 (5.5)
Ethnic background			
African/Black	73.7	74	2,337 (73.9)
White	10.7	8.3	293 (9.3)
Colored	11.8	13.5	406 (12.8)
Indian/Asian	3.7	3.9	121 (3.8)
Unknown	0	0.1	2 (0.1)
Other	0.1	0.1	3 (0.1)
Residence			
Urban	65.8	64.1	2,489 (64.9)
Rural	34.2	35.9	1,348 (35.1)
Marital status			
Never married	8.3	18.6	539 (14.1)
Currently married	71.9	31.9	1,901 (49.5)
Cohabiting	7.4	3.8	207 (5.4)
Separated or divorced	3.8	7.4	224 (5.8)
Widowed	7.6	35.9	900 (23.5)
Education			
No formal education	22.2	27.1	774 (25.2)
Less than primary education	25.2	23.2	738 (24.0)
Primary school completed	22.0	22.7	688 (22.4)
Secondary or more	30.7	27.0	875 (28.3)
Wealth quintile			
Lowest	20.3	21.0	791 (20.7)
Second	20.2	19.6	759 (19.9)
Middle	13.2	22.2	696 (18.2)
Fourth	20.1	19.6	757 (19.8)
Highest	26.1	17.6	815 (21.3)

Figures do not add up to 100% because of rounding off.

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environmental domains (28). Results from the eight items were summed up to get an overall WHOQOL score, which was then transformed to a 0–100 scale, with lower scores indicating a better QoL. Besides overall satisfaction, SAGE also asked whether an older person was satisfied with a wide range of life aspects – health, oneself, ability to perform ADLs, personal relationships, and conditions of living space.

Experience of happiness

SAGE used the Day Reconstruction Method (DRM) to measure the experienced happiness component (29, 30). The methodology of the DRM entails asking participants to think about the preceding day, break it down into episodes, and then describe each episode in terms of the activity engaged in, the accompanying positive and negative emotions, the amount of control the respondent had over the activity, and the context in which the activity was carried out.

Household wealth

It was measured from possession of assets, such as television, radio, and fridge, as well as access to amenities, such as electricity, water, and toilet facilities. Principal component analysis was used to derive household wealth scores, which were later categorized into quintiles.

Data analysis

Data were captured onto United States Census Bureau's Census and Survey Processing System (CSPro) version 3.0.1 and converted into STATA version 10 (Stata Corporation, College Station, Texas, USA) for statistical analyses. It was weighted using post-stratified individual probability weights based on the selection probability at

Table 2. Overall self-rated health status among adults aged 50 years or older, per cent distribution by Sociodemographic characteristics, South Africa, 2007–2008

		Self-rated overall general health				
	Number of respondents	Very good	Good	Moderate	Bad	Very bad	*p*
Sex							<0.001
Male	1,615	6.8	35.5	40.5	15.9	1.3	
Female	2,061	3.4	31.1	47.7	16.7	1.0	
Age group (years)							0.001
50–59	1,832	7.2	37.8	39.6	14.5	1.0	
60–69	1,126	3.1	30.7	47.4	17.6	1.3	
70–79	514	2.1	25.3	54.5	17.2	1.0	
80+	204	1.6	22.5	48.6	24.4	3.0	
Residence							0.036
Urban	2,382	5.3	36.1	43.7	13.8	1.1	
Rural	1,293	4.2	27.3	46.0	21.2	1.2	
Marital status							<0.001
Never married	512	2.1	30.9	45.2	20.7	1.1	
Currently married	1,819	6.7	36.5	42.9	13.2	0.7	
Cohabiting	193	5.4	41.0	34.4	17.8	1.5	
Separated or divorced	217	5.0	35.1	40.4	15.1	4.4	
Widowed	867	2.6	24.6	51.1	20.6	1.2	
Education							<0.001
No formal education	967	3.5	29.1	45.9	20.0	1.4	
Less than primary	787	2.2	25.7	49.7	20.2	1.9	
Primary school completed	914	3.4	31.3	47.5	16.3	1.3	
Secondary or more	1,047	9.1	43.1	37.4	9.9	0.2	
Wealth quintiles							<0.001
Lowest	755	2.6	24.4	45.2	25.4	2.5	
Second	735	3.4	32.5	45.9	16.7	1.5	
Middle	668	3.5	33.7	44.3	17.4	1.1	
Fourth	724	5.3	31.2	48.1	15.0	0.4	
Highest	778	9.5	42.8	39.6	7.9	0.3	

Figures do not add up to 100% because of rounding off.

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Table 3. Self-rated difficulty with work or household activities among adults aged 50 years or older, per cent distribution by sociodemographic characteristics, South Africa, 2007–2008

Characteristic	Number of respondents	Self-rated difficulty with work or household activities					*p*
		None	Mild	Moderate	Severe	Extreme	
Sex							<0.001
Male	1,607	42.6	17.3	31.8	7.5	0.8	
Female	2,046	34.9	16.3	36.2	11.2	1.4	
Age group (years)							<0.001
50–59	1,826	47.1	15.6	29.1	7.4	0.8	
60–69	1,116	35.1	18.4	34.6	10.5	1.5	
70+	511	21.8	17.9	46.1	13.2	0.9	
Residence							<0.001
Urban	2,365	41.5	18.3	32.7	6.2	1.3	
Rural	1,287	32.5	13.8	37.1	15.6	0.9	
Marital status							<0.001
Never married	508	39.7	14.5	35.3	9.4	1.1	
Currently married	1,812	43.2	17.4	31.7	6.8	0.9	
Cohabiting	190	46.3	19.6	26.0	7.4	0.7	
Separated or divorced	211	31.5	16.1	33.8	12.7	5.8	
Widowed	864	27.4	15.8	41.0	15.1	0.6	
Education							<0.001
No formal education	967	33.5	17.3	35.0	12.6	0.8	
Less than primary	787	28.5	17.1	36.6	14.4	2.8	
Primary school completed	914	31.4	18.6	39.8	9.1	0.4	
Secondary or more	1,047	54.1	14.4	26.7	3.1	0.5	
Wealth quintile							<0.001
Lowest	751	28.6	15.6	39.7	14.7	1.4	
Second	732	34.0	16.7	37.7	10.5	1.1	
Middle	664	37.0	19.1	31.9	9.2	2.8	
Fourth	722	39.8	16.5	33.1	10.1	0.5	
Highest	768	51.6	15.7	29.0	3.6	0.2	

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Figures do not add up to 100% because of rounding off.

each sampling stage. Individual weights were post-stratified by province, sex, and age-group, according to the 2009 Mid-Year population estimates from Statistics South Africa (31). Associations between key outcomes of self-reported health and sociodemographic, social, and health variables were assessed using odds ratios (OR). Unconditional multivariable logistic regression was used for evaluation of the association of explanatory variables, with a key outcome (poor self-rated health). A dichotomous measure was created for self-reported health, where responses 'very good', 'good', or 'moderate' were grouped into one category, that is, 0, and responses 'bad' or 'very bad' were grouped into a secondary category, that is, 1.

All variables statistically significant at the $p < 0.05$ level in univariate analyses were included in the multivariable models. In the analysis, weighted percentages have been reported. The reported sample size refers to the sample that was asked the target question. The two-sided 95% CIs have been reported to indicate significance levels and were adjusted for the multi-stage stratified cluster sample design of the study. Interaction between predictor variables was also examined, and it was found that none of the variables had a variance inflation factor (VIF) value above 2.5.

Results

Sample characteristics

Slightly more than half (55.9%) of the respondents were women. The dominant racial group was African Black (74%), and almost half (49.9%) were between 50 and 59 years. The educational level of most participants (71.6%) was lower than secondary school education, and almost two-thirds (64.9%) lived in an urban area. Overall, there were no major wealth differentials in this sample (Table 1).

Table 4. Mean health state, WHODAS II and WHOQoL scores among adults aged 50 years or older, by socio-demographic characteristics, South Africa, 2007–2008

	Health-state score	WHODAS II	WHOQoL
Characteristic	Mean (SE)	Mean (SD)	Mean (SD)
Sex			
Male	64.5 (0.9)	18.2 (19.4)	58.3 (12.2)
Female	60.0 (0.8)	22.9 (20.4)	46.2 (12.6)
Age group (years)			
50–59	64.6 (0.9)	16.2 (16.8)	47.4 (12.4)
60–69	61.5 (1.0)	22.2 (21.1)	47.0 (12.5)
70+	57.3 (1.3)	30.3 (22.6)	46.5 (12.6)
Residence			
Urban	62.5 (0.8)	19.9 (19.3)	44.4 (12.0)
Rural	60.9 (1.1)	22.5 (21.6)	48.6 (12.5)
Education			
No formal education	58.5 (1.1)	22.2 (20.8)	45.6 (12.3)
Less than primary	59.6 (1.1)	23.2 (20.7)	45.4 (12.3)
Primary school completed	60.4 (1.2)	23.0 (20.5)	45.2 (12.1)
Secondary or more	64.5 (1.6)	14.8 (16.8)	52.6 (11.8)
Marital status			
Never married	60.8 (1.4)	21.5 (18.6)	44.2 (12.6)
Currently married/ cohabiting	64.9 (0.8)	18.1 (19.0)	49.1 (12.1)
Separated or divorced	58.4 (2.3)	23.1 (22.6)	44.2 (13.7)
Widowed	57.2 (0.9)	26.4 (21.7)	45.0 (12.4)
Wealth quintile			
Low	60.2 (1.3)	23.0 (21.4)	42.2 (11.5)
Medium	61.0 (1.4)	21.7 (20.0)	46.7 (12.1)
High	65.5 (1.5)	18.3 (18.6)	52.0 (11.6)

Self-reported health and functioning

Overall, more than three-quarters (76.8%) of adults rated their health as moderate or good, while few reported very good or very bad health (Table 2). On balance, men reported very good or good health more often than women ($p < 0.001$). Poor self-rated health and work difficulties increased with age.

More adults in rural (14.9%) than urban (22.4%) areas reported their health status as bad or very bad. In relation to marital status, good health was comparatively low for widowed people ($p < 0.001$). There were more married people (6%) reporting very good health than those in other categories of marital status. Health status decreased with increasing age ($p < 0.001$).

Difficulty in carrying out work

Table 3 shows the self-rated difficulty in carrying out work or household activities. More than half of the men and women had at least some difficulty with work or household activities, with most (31.8% male and 36.2% female) within that group rating their difficulty as moderate. The proportion of adults with severe or extreme difficulty was generally low, although 11% of women reported having severe difficulty.

Health status, QoL, and satisfaction and disability

Table 4 presents the mean Health, WHOQoL and WHODAS II scores for adults aged 50 years and above.

On average, men (64.5) had better health scores than women (60.0), as shown in Table 4. Health scores also showed predictable patterns, with health declining with increasing age and increasing with increasing levels of education. Married or cohabiting respondents had better health than those who were widowed, divorced, separated, or never married. Those in the highest wealth quintile had better health than those in the lowest wealth quintile.

Women had slightly worse evaluative well-being than men, with rural worse than urban dwellers. The overall mean score was 50.5, which implied that QoL was moderate. The scores were relatively constant over the different age groups. Clearer patterns were evident by socioeconomic status, with worse well-being reported in lower levels of wealth (55.8) and education (53.9). Currently married respondents (47.9) reported better well-being than all other marital status groups.

Table 5 presents results related to difficulties in carrying out ADLs and IADLs among adults aged 50 years or older. About two-thirds (69.9% males and 60.7% females) of older adults had no difficulties in functioning. For respondents reporting some level of difficulty with functioning, women had higher rates than men (30.9% vs. 22.3%), particularly for those with difficulties with two or more ADLs. Examining patterns by age, the proportion of people with no difficulty decreased with age. With regards to education, the proportion reporting no difficulty was higher among those with secondary education and above (70.2%) compared to those with no education (59.2%). Trends by marital status showed that those who were widowed (37.3%) had the greatest difficulty (two or more ADLs), while those who were cohabiting (17.8%) had the least. However, these results are likely to be confounded by age. The patterns found in difficulty with ADLs did not differ significantly between urban and rural areas ($p = 0.687$). The mean WHODAS-II scores increased with increasing levels of ADLs deficiencies, and demonstrated good face validity. Overall, the mean disability score was 20 (out of 100), suggesting a low level of disability.

In terms of difficulties in carrying out IADLs, older adults had more difficulty (two or more IADLs) than younger adults (29.3% vs. 4.3%); those who were less educated had more difficulty than those with higher education (12.6% vs. 7.1%); those in households with

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Table 5. Difficulty in carrying out activities of daily living (ADLs) and instrumental activities of daily living (IADLs), overall mean WHODAS score among adults aged 50 years or older, per cent distribution by sociodemographic characteristics

	Number of activities of daily living deficiencies			Number of IADL deficiencies		
Characteristic	0	1	2 or more	0	1	2 or more
Sex						
Male	69.9	7.8	22.3	87.4	6.8	5.8
Female	60.7	8.4	30.9	82.8	6.1	11.1
Age group (years)						
50–59	75.0	7.2	17.8	91.9	3.9	4.3
60–69	60.5	8.3	31.2	82.8	8.0	9.3
70 or more	49.9	8.7	41.4	70.2	10.5	19.3
Residence						
Urban	65.1	8.5	26.5	86.4	5.0	8.6
Rural	64.2	7.5	28.3	82.0	9.0	9.0
Education						
No formal education	59.2	8.2	32.6	81.0	6.4	12.6
Less than primary education	63.3	9.6	27.0	85.3	6.4	8.3
Primary school completed	59.7	8.7	31.6	82.3	8.7	9.0
Secondary or more	70.2	7.0	22.8	85.6	7.3	7.1
Marital status						
Never married	69.9	6.2	23.9	86.6	6.5	6.9
Currently married	68.1	8.1	23.8	88.3	5.6	6.1
Cohabiting	72.1	10.2	17.8	89.3	0.8	9.9
Separated or divorced	61.9	6.4	31.8	77.6	4.6	17.8
Widowed	53.1	9.6	37.3	77.4	9.9	12.7
Wealth quintile						
Lowest	65.9	7.8	26.4	81.0	8.4	10.5
Second	63.9	6.2	29.9	84.4	6.6	9.0
Middle	63.1	9.6	27.2	86.7	4.4	8.8
Fourth	59.5	10.5	30.1	83.3	8.2	8.5
Highest	70.7	6.4	22.9	88.5	4.5	7.0

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lower wealth status had more difficulty than those in higher wealth households (10.5% vs. 7.0%), and those in rural areas had slightly more difficulty than those in urban areas (9.0% vs. 8.6%); women had slightly more difficulty than men (11.1% vs. 5.8%). Looking at marital status, those who were separated or divorced (23.4%) had the most difficulty (1 or more), while those cohabiting (10.7%) had the least.

Associations between sociodemographics, activity limitations, QoL, and poor health status

The association between poor self-rated health and the following sociodemographic factors was assessed: gender, age, marital status, race, educational level, geo-locality, and wealth status. More women reported poorer health status than their male counterparts, although this was not significant (AOR = 1.30; 95% CI 0.82–2.06). Individuals in older age group reported poorer health status than the younger age group, that is, the 70+ age group was 52% more likely to do so compared to the 50–59 age group (95% CI 1.00–2.30). In terms of race, Indians were more likely to report poorer health status than all other races (AOR = 4.01; 95% CI 1.27–12.70). In terms of education, those with primary education (AOR = 1.83; 95% CI 1.19–2.80) and less than primary education (AOR = 1.94; 95% CI 1.37–2.76) were more likely to report poorer health compared to those with secondary education. In terms of wealth status, those in low wealth quintile (AOR = 2.02; 95% CI 1.14–3.57) and medium wealth quintile (AOR = 1.47; 95% CI 1.01–2.13) were more likely to report poorer health status than those in the high wealth quintile. There were significant associations between marital status and locality type and self-reported poor health status (see Table 6). In terms of activity limitations, older people with moderate (AOR = 3.31; 95% CI 1.82–6.03) to severe (AOR = 6.67; 95% CI 2.74–16.24) IADL deficiencies were more likely to report ill health compared to those with mild IADL

Table 6. Multivariate analysis with poor health status

Sociodemographics	Unadjusted odds ratio (95% confidence interval = CI)	Adjusted odds ratio (95% CI) [with sociodemographics only]	Adjusted odds ratio (95% CI) [with sociodemographics, activity limitation, and quality of life]
Gender			
Female	1.00	1.00	1.00
Male	0.97 (0.77–1.22)	1.30 (0.82–2.06)	1.48 (0.85–2.57)
Age group (years)			
50–59	1.00	1.00	1.00
60–69	1.27 (0.93–1.72)	1.19 (0.91–1.55)	0.93 (0.58–1.50)
70 or more	1.42 (1.05–1.92)	1.52 (1.00–2.30)	0.93 (0.63–1.38)
Race			
White	1.00	1.00	1.00
African Black	5.90 (2.55–13.66)	2.76 (1.20–6.34)	1.52 (0.66–3.51)
Colored	2.70 (1.12–6.62)	1.46 (0.62–3.41)	0.97 (0.35–2.66)
Indian or Asian	7.51 (2.72–20.75)	4.01 (1.27–12.70)	2.13 (0.36–12.40)
Marital status			
Married	1.00	1.00	1.00
Single	1.64 (0.89–3.01)	1.51 (0.81–2.83)	1.16 (0.81–1.67)
Separated/divorced	1.44 (0.69–3.01)	0.91 (0.50–1.67)	0.80 (0.45–1.40)
Widowed	1.63 (1.23–2.17)	1.56 (1.11–2.20)	1.18 (0.78–1.80)
Educational level			
Secondary or more	1.00	1.00	1.00
Primary	2.63 (1.75–3.97)	1.83 (1.19–2.80)	1.16 (0.63–2.15)
Less than primary	3.04 (2.15–4.30)	1.94 (1.37–2.76)	1.63 (0.96–2.77)
No schooling	1.57 (0.36–6.79)	1.33 (0.34–5.27)	0.83 (0.27–2.56)
Wealth			
High	1.00	1.00	1.00
Medium	1.73 (1.25–4.05)	1.47 (1.01–2.13)	1.67 (1.03–2.71)
Low	2.25 (1.22–2.47)	2.02 (1.14–3.57)	1.27 (0.80–2.01)
Geolocality			
Rural	1.00		
Urban	0.61 (0.27–1.39)		
Activity limitation and quality of life			
Activity limitation			
Mild	1.00		1.00
Moderate	4.85 (3.04–10.83)		1.29 (0.72–2.31)
Severe	9.47 (5.47–16.41)		2.22 (0.81–6.09)
Instrumental activity limitation			
Mild	1.00		1.00
Moderate	4.85 (3.04–7.74)		3.31 (1.82–6.03)
Severe	17.80 (9.63–32.87)		6.67 (2.74–16.24)
Quality of life			
High	1.00		1.00
Medium	4.39 (2.39–8.07)		3.12 (1.24–7.81)
Low	24.13 (11.71–49.76)		12.78 (7.33–22.27)

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deficiencies. No significant associations remained for ADL in the adjusted models. In terms of QoL, individuals with low (AOR = 12.78; 95% CI 7.33–22.27) to medium (AOR = 3.12; 95% CI 1.24–7.81) levels of personal satisfaction (WHOQoL) were less likely to report ill-health compared to those with low WHOQoL.

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Discussion

This study describes the health status of elderly people in South Africa. As has been the case in previous studies (11), the majority of the respondents viewed their health positively. This can be attributed to the fact that generally individuals tend to over rate their health.

As in previous studies, this study further revealed that increasing age (5, 8, 9, 11, 15, 16, 32), being female (11, 20, 32), being Black or Indian (28, 33), low education (10, 11, 32), low wealth status (10, 11, 13, 16, 32, 34), and not being married (11, 35, 36) were associated with poorer self-rated health, more difficulty in performing tasks, and lower QoL. This gap in health outcomes needs to be addressed. The SES of elderly South Africans has a definite bearing on access to quality health care services. Elderly people with low SES depend mainly on public sector health services for their daily needs, but the health system is not appropriately designed to provide them with secure health services. South Africa has pledged action to address the needs and well-being of older persons through the African Union Africa Health Strategy 2007–2013 (37). The challenge is to overcome the policy inaction and research inadequacies (38, 39).

Similar to other studies (14, 32), increasing levels of deficiencies in ADLs and IADLs and lower QoL were associated with greater odds of reporting poorer health status among the elderly. The health, disability, and living conditions in old age are policy concerns throughout the world. The deterioration of health status of older people with increasing age will induce greater demand for long-term care. Therefore, the South African government needs to predict and prepare for increasing demand for health services for age-related health conditions. It should be noted that although the study outcome is based on self-rated data, which are prone to bias, the self-reported measures, which were used in this study, were validated. Further, in spite of self-rated health being a subjective measure of one's health, it has been found to be a good measure of complex health problems (32, 40). It is referred to as a good predictor for numerous health-related outcomes (41).

However, follow-up surveys are needed to monitor trends and patterns over time. The cross-sectional nature of SAGE Wave 1 does not permit an investigation of the cause–effect relationship between self-reported health and the independent variables. Thus, follow-up SAGE surveys are planned to continue to monitor trends on the health status and well-being of elderly people and how health and social policies can impact on them. Planned follow-up SAGE surveys will be repeated 2–3 times in 5–10 years, and, based on this, it is anticipated that policies and programs will be further refined.

This population-based study has generated generalizable estimates of the health status of the older people in South Africa. It is clear from the foregoing discussion that the health status of older South Africans deteriorates with increasing age. This evidence not only contributes to bridging the gap in knowledge in as far as the health status of elderly people in South Africa is concerned, but it also provides credence for the actions that are required to address the needs of all elderly South Africans.

The evidence generated by this study can be used to inform national health and social development policies to mainstream economic, social, and physical support for the elderly in South African and elsewhere.

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Conflict of interest and funding

The authors declare that they have no competing interests.

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ORIGINAL ARTICLE

Self-reported prevalence of chronic non-communicable diseases and associated factors among older adults in South Africa

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Introduction: Little is known about the prevalence and predictors of chronic non-communicable diseases (NCDs) of older adults in South Africa. This study aims to investigate the self-reported prevalences of major chronic NCDs and their predictors among older South Africans.

Methods: We conducted a national population-based cross-sectional survey with a sample of 3,840 individuals aged 50 years or above in South Africa in 2008. The outcome variable was the self-reported presence of chronic NCDs suffered, namely, arthritis, stroke, angina, diabetes, chronic lung disease, asthma, depression, and hypertension. The exposure variables were sociodemographic characteristics: age, gender, education, wealth status, race, marital status, and residence. Multivariate logistic regression was used to determine sociodemographic factors predictive of the presence of chronic NCDs.

Results: The prevalence of chronic NCDs was 51.8%. The prevalence of multimorbidity (≥2 chronic conditions) was 22.5%. Multivariate logistic regression analysis showed that being female, being in age groups 60–79 and 70–79, being Coloured or Asian, having no schooling, having greater wealth, and residing in an urban area were associated with the presence of NCDs.

Conclusion: The rising burden of chronic NCDs affecting older people places a heavy burden on the healthcare system as a result of increased demand and access to healthcare services. Concerted effort is needed to develop strategies for the prevention and management of NCDs, especially among economically disadvantaged individuals who need these services the most.

Keywords: *self-reported*; *chronic non-communicable diseases*; *ageing*; *South Africa*

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Chronic non-communicable diseases (NCDs) are the principal cause of death; of the 57 million global deaths in 2008, 36 million (or 63%) were due to NCDs (1). Eighty percent (80%) of all of these deaths occur in low- and middle-income countries (1, 2). NCD deaths are projected to rise by 15% globally between 2010 and 2020. The greatest increases are projected to be in low- and middle-income regions like the African region, where they are projected to increase by more than 20% (1). The prevalence of NCDs is predicted to cause almost three-quarters as many deaths as communicable, maternal, perinatal, and nutritional diseases by 2020, and to exceed them as the most common causes of death by 2030 in Africa (2). The most common chronic NCDs reported globally include cardiovascular diseases, diabetes, cancer, and chronic respiratory diseases (3). A similar pattern has been observed in South Africa (4, 5). The impact of NCDs is far-reaching; because they threaten the economies of many countries, place high demands on a health service delivery system that is undergoing transformation

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in the face of shrinking budgets, and impact negatively on the health of older and experienced members of the workforce (because, as people age, their health deteriorates) (1, 6–8).

This is of greatest concern in South Africa given the fact that the size of the older population is rapidly increasing and is estimated to grow at a pace over four times the rate of the total population (9). Overall, the country has the second largest population aged 60 years or above in sub-Saharan Africa (10). Yet, little is known about the prevalence of chronic NCDs in the population aged 50 years and above in South Africa. It is critical to generate evidence on the magnitude of chronic NCDs among the elderly population not only to develop a national surveillance system but also to inform the development of strategies for the prevention of NCDs as well as to strengthen the healthcare system (5, 11). This study aims to investigate the prevalence and predictors of chronic NCDs among older South Africans who participated in the Study of Global Ageing and Adult Health (SAGE wave 1) in 2008.

Methods

We conducted a national population-based cross-sectional survey with a sample of 3,840 individuals aged 50 years or above in South Africa in 2008. The SAGE sample design entails a two-stage probability sample that yields national estimates to an acceptable precision at provincial level, by locality type (urban and rural) and by race (including Black, Coloured, Asian, and White). The individual response rate among those aged 50 years or above was 77%. The SAGE wave 1 survey was carried out in South Africa by the Human Sciences Research Council (HSRC) in partnership with the World Health Organization (WHO) and the South African National Department of Health (NDOH). The study was approved by the HSRC Research Ethics Committee (Protocol REC 5/13/04/06) and the NDOH (J1/14/45, 2007).

The SAGE survey instruments and methods were adapted from those used by the World Health Survey (WHS) and were informed by a review of 16 surveys on ageing, including the US Health and Retirement Survey (HRS) and the English Longitudinal Study of Ageing (ELSA). The instruments assessed health status and health systems from a household and individual perspective. Standardized SAGE survey instruments were used in all countries and consisted of five main parts: (i) a household questionnaire; (ii) an individual questionnaire; (iii) a proxy questionnaire; (iv) a verbal autopsy questionnaire (VAQ); and (v) appendices, including showcards. The procedures for including country-specific adaptations to the standardized questionnaire and translations into local languages from English follow those developed by and used for the WHS. The questionnaire was interview administered. More detailed explanations of research methods for this study have been provided elsewhere (12).

Measures

The outcome variable was the self-reported diagnosis of chronic NCDs which was previously made by a health professional; examples of such NCDs are arthritis, stroke, angina, diabetes, chronic lung disease, asthma, depression, and hypertension. These were assessed by self-reporting through answers to the question 'Have you ever been diagnosed with diabetes (high blood sugar)?' for example. The exposure variables were sociodemographic characteristics: age, gender, education, socioeconomic (wealth) status, race, marital status, and residence.

To estimate economic or wealth status, a random-effects probit model was used to identify indicator-specific thresholds that represent the point on the wealth scale above which a household was more likely to own a particular asset than not. This enabled an estimation of an asset ladder. These estimates of thresholds, combined with actual assets observed to be owned for any given household, were used to produce an estimate of household-level wealth status. This measure was used to create wealth tertiles (13).

A further question was asked regarding whether they had been taking any medications or other treatment for any of the aforementioned chronic NCDs in the past 12 months.

The data from the survey were captured on CSPro and analyzed using STATA Version 10. Data were weighted using post-stratified individual probability weights based on the selection of probability at each stage of selection. Individual weights were post-stratified by province, sex, and age groups according to the 2009 Medium Mid Year population estimates from Statistics South Africa (14). Multivariate logistic regression was used to determine sociodemographic factors predictive of the outcome – the presence of chronic NCDs (coded 1 = yes, 0 = no). In the analysis, weighted percentages have been reported. Both the reported 95% confidence intervals (CIs) and the *p*-value were adjusted for the multistage stratified cluster sample design of the study.

Results

Prevalence of self-reported chronic NCDs by sociodemographic factors

The prevalence of the eight chronic NCDs is shown in Table 1. The most prevalent chronic NCDs reported across the sample were hypertension (30.3%) and arthritis (24.7%). The prevalence of hypertension was higher among women (63.8%), African Blacks (71.8%), individuals with higher wealth (47.1), married individuals (47.7%), and urban residents (69.7%). The distribution of arthritis was similar to that of hypertension, being higher

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Table 1. Prevalence of self-reported NCDs among older South Africans

	Self-reported NCDs, *N* (%)							
Sociodemographics	Arthritis	Stroke	Angina	Diabetes	Chronic lung infection	Asthma	Depression	Hypertension
All	851 (24.7)	139 (4.0)	219 (5.2)	360 (9.2)	89 (2.9)	165 (4.9)	113 (2.9)	1,121 (30.3)
Gender								
Men	264 (33.4)	61 (45.9)	75 (32.5)	127 (33.0)	53 (64.2)	70 (46.4)	73 (54.2)	385 (36.2)
Women	587 (66.6)	78 (54.1)	144 (67.5)	232 (67.0)	36 (35.8)	95 (53.6)	40 (45.8)	736 (63.8)
Age								
50–59	334 (43.3)	57 (39.4)	93 (46.4)	123 (38.1)	36 (43.2)	76 (43.1)	64 (55.5)	421 (39.4)
60–69	316 (37.6)	40 (35.3)	78 (36.7)	129 (935.6)	33 (37.8)	62 (42.4)	33 (32.1)	409 (37.4)
70–79	146 (12.8)	29 (11.8)	37 (14.9)	89 (22.5)	16 (17.1)	20 (6.5)	12 (6.40	225 (17.8)
80 and above	55 (6.3)	134 (13.5)	11 (2.0)	18 (3.8)	4 (2.0)	7 (8.1)	4 (5.9)	66 (5.5)
Race								
African Black	387 (64.1)	57 (58.7)	88 (65.7)	149 (62.9)	49 (59.4)	76 (69.5)	36 (72.7)	575 (71.8)
White	52 (7.6)	11 (8.6)	19 (10.2)	23 (12.1)	9 (21.7)	5 (6.0)	13 (7.3)	76 (9.0)
Coloured	190 (21.8)	33 (29.6)	42 (17.2)	68 (14.9)	13 (16.3)	41 (20.7)	28 (14.5)	216 (14.8)
Asian or Indian	100 (6.5)	13 (3.1)	37 (6.8)	69 (10.0)	9 (2.7)	18 (3.8)	20 (5.6)	111 (4.5)
Wealth status								
Low wealth	271 (35.3)	47 (28.9)	53 (25.9)	67 (26.4)	33 (39.0)	66 (49.2)	24 (35.9)	322 (32.6)
Medium wealth	171 (17.5)	31 (21.7)	57 (22.3)	82 (17.6)	23 (16.5)	37 (17.6)	25 (17.1)	256 (20.3)
High wealth	405 (47.3)	59 (49.4)	109 (51.8)	208 (55.9)	33 (44.6)	62 (33.3)	64 (47.1)	537 (47.1)
Education								
No schooling	215 (35.7)	32 (39.4)	59 (39.6)	78 (27.9)	24 (36.9)	39 (34.2)	23 (33.0)	264 (33.0)
Less than 7 years	173 (32.5)	37 (32.7)	41 (26.8)	89 (34.3)	20 (29.8)	35 (39.0)	30 (37.7)	256 (32.3)
8–11 years	159 (28.9)	22 (19.1)	32 (23.1)	79 (31.7)	16 (31.7)	32 (25.1)	24 (22.1)	187 (30.2)
12 or more years	28 (2.9)	6 (8.8)	11 (10.5)	17 (31.7)	2 (1.6)	3 (1.7)	5 (97.1)	40 (4.5)
Marital status								
Single	115 (13.0)	13 (9.6)	22 (9.6)	37 (13.3)	10 (8.0)	25 (15.9)	12 (7.7)	153 (12.7)
Married	360 (43.6)	65 (56.5)	100 (54.7)	180 (49.6)	40 (59.8)	71 (49.0)	48 (57.7)	487 (47.7)
Cohabiting	18 (3.2)	4 (1.2)	9 (4.6)	3 (0.5)	6 (10.1)	10 (3.7)	3.0 (6.5)	55 (5.9)
Separated or divorced	56 (7.8)	13 (10)	12 (8.1)	16 (2.8)	8 (5.0)	11 (2.7)	7 (5.5)	65 (5.1)
Widowed	282 (32.4)	42 (22.7)	72 (23.0)	120 (33.8)	23 (16.3)	47 (28.6)	40 (22.5)	345 (28.7)
Geolocality								
Rural	221 (30.5)	38 (36.3)	59 (28.6)	62 (21.1)	31 (34.9)	43 (29.9)	18 (33.5)	288 (30.3)
Urban	630 (69.5)	100 (63.7)	160 (71.4)	297 (78.9)	58 (65.1)	122 (70.1)	95 (66.5)	833 (69.7)

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among women (66.6%), African Blacks (64.1%), those with higher wealth (47.3%), married individuals (43.6%), and those residing in urban areas (69.5%). Chronic lung infection and depression were the least reported NCDs (2.9%) in the study sample.

Associations between the number of chronic NCDs and sociodemographic characteristics

About half (48.7%) of the older people reported that they did not have any chronic NCDs, while about a third (28.8%) had one chronic NCD and 22.5% reported more than two chronic NCDs (see Table 2). In the study sample, the number of chronic NCDs differed significantly by gender, age, marital status, wealth status, race, and residence ($p < 0.001$). The number of chronic NCDs did not differ significantly by level of education ($p = 0.187$).

Sociodemographic predictors of chronic NCDs

Multivariate logistic regression analysis showed that being female, being in age groups 60–79 and 70–79, being separated or widowed, being Coloured or Asian, having no schooling, having greater wealth, and residing in an urban area were associated with the presence of NCDs (Table 3).

Discussion

The study revealed that about 50% of the sample had one chronic NCD and that the most prevalent self-reported chronic NCDs were hypertension and arthritis.

Table 2. Associations between the number of chronic NCDs and sociodemographic characteristics

	Number of NCDs			
	0	1	≥2	Chi-square *p*-value
Total	1,754 (48.7)	1,055 (28.8)	829 (22.5)	
Sex				
Female	899 (42.7)	634 (30.9)	559 (26.4)	<0.001
Male	855 (56.3)	421 (26.0)	270 (17.6)	
Age				
50–59	849 (54.2)	454 (28.6)	298 (17.2)	<0.001
60–69	517 (42.3)	350 (30.5)	306 (27.2)	
70–79	264 (42.3)	184 (28.0)	176 (29.8)	
80 and above	124 (51.0)	67 (22.9)	49 (26.1)	
Marital staus				
Never married	219 (48.6)	170 (33.2)	94 (18.2)	<0.001
Currently married	877 (52.2)	466 (25.8)	369 (21.9)	
Cohabiting	116 (57.3)	52 (30.0)	21 (12.7)	
Separated or divorced	103 (46.3)	66 (32.3)	48 (21.4)	
Widowed	404 (39.8)	282 (30.7)	285 (29.5)	
Education				
No schooling	338 (45.7)	239 (27.6)	206 (26.7)	0.187
Less than 7 years	331 (41.2)	216 (32.0)	191 (26.7)	
8–11 years	291 (47.1)	197 (32.1)	145 (20.8)	
12 or more years	85 (61.8)	44 (23.9)	29 (14.3)	
Wealth status				
Low	788 (54.3)	394 (28.9)	206 (16.8)	<0.001
Medium	328 (48.7)	200 (27.3)	190 (24.0)	
High	633 (43.5)	453 (29.0)	430 (27.5)	
Race				
African Black	1,034 (51.4)	572 (29.3)	362 (19.3)	<0.001
White	125 (52.9)	66 (20.6)	63 (26.5)	
Coloured	257 (32.2)	218 (36.1)	172 (31.7)	
Indian or Asian	108 (34.8)	65 (30.7)	113 (34.5)	
Geolocality				
Urban	1,065 (45.8)	734 (29.3)	636 (24.9)	<0.001
Rural	689 (54.1)	320 (27.7)	193 (18.2)	

This supports the assertion that the magnitude of NCDs is high in low-resource settings (1, 2, 15). This is attributed not only to a sedentary lifestyle and poor dietary habits but also to the negative effects of globalization, rapid urbanization, and changing trends of population ageing (6). Of even greater concern is that the 2010 Global Burden of Disease report (16) projects an increase in the disease burden attributed to chronic NCDs.

The prevalence of multimorbidity (≥2 conditions) was 22.5%, which is comparable to that of the United States (about 26%) (17). Other studies in low- and middle-income countries (18) and in high-income countries have reported even higher prevalences of multimorbidity (19–21). A systematic review has also reported wide ranges in the prevalence of multimorbidity, especially in the older age groups (22). It should, however, be noted that the differences observed in multimorbidity between South Africa and other countries may not be comparable due to sociodemographic differences. Furthermore, it should be stated that the chronic comorbidities highlighted in this study were self-reported, and therefore possibilities of information bias that might have contributed to underreporting of the prevalences cannot be overlooked, especially because individuals tend to underreport poor health. Important to note is the fact that the elderly constitute a group with the potential for more health problems, higher health costs, and more complex healthcare needs.

Similar to other studies (6, 23–25), increasing age, being female, being separated or widowed, being Coloured or

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Table 3. Multivariate logistic regression analysis for the outcome – the presence of chronic NCDs

	Unadjusted odds ration (OR) (95% CI)	*p*	Adjusted OR (95% CI)	*p*
Gender				
Male	1.00		1.00	–
Female	1.64 (1.43–1.87)	<0.001	1.75 (1.44–2.11)	<0.001
Age				
50–59	1.00	–	1.00	–
60–69	1.43 (1.23–1.66)	<0.001	1.51 (1.24–1.85)	<0.001
70–79	1.54 (1.28–1.86)	<0.001	1.59 (1.22–2.07)	0.001
80 and over	1.06 (0.80–1.39)	0.69	1.51 (0.98–2.31)	0.06
Marital status				
Currently married	1.00	–	1.00	–
Single	1.26 (1.03–1.55)	0.02	1.27 (0.97–1.68)	0.09
Cohabiting	0.66 (0.49–0.90)	0.008	1.03 (0.66–1.63)	0.89
Separated or divorced	1.16 (0.88–1.54)	0.30	1.57 (1.09–2.26)	0.02
Widowed	1.47 (1.25–1.72)	<0.001	1.28 (1.02–1.62)	0.04
Education				
12 or more years	1.00	–	1.00	–
8–11 years	1.36 (0.96–1.93)	0.082	1.28 (0.88–1.86)	0.19
Less than 7 years	1.43 (1.01–2.02)	0.04	1.38 (0.94–2.04)	0.10
No schooling	1.53 (1.09–2.16)	0.02	1.66 (1.12–2.47)	0.01
Wealth status				
Low	1.00	–	1.00	–
Medium	1.56 (0.88–1.49)	<0.001	1.33 (1.04–1.71)	0.02
High	1.83 (1.58–2.12)	<0.001	1.63 (1.30–2.07)	<0.001
Race				
White	1.00	–	1.00	–
African Black	0.87 (0.67–1.13)	0.31	1.10 (0.79–1.53)	0.57
Coloured	1.47 (1.10–1.97)	0.01	1.50 (1.05–2.15)	0.03
Indian or Asian	1.60 (1.13–2.25)	0.007	1.59 (1.08–2.34)	0.02
Geolocality				
Rural	1.00	–	1.00	–
Urban	1.73 (1.50–1.99)	<0.001	1.54 (1.25–1.90)	<0.001

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Asian, having no schooling, having greater wealth, and residing in an urban area were associated with the presence of chronic conditions. Interventions geared towards equitable health service delivery, like South Africa's National Health Insurance (26), should aim to reach for and achieve sustained benefits for the elderly with the above-mentioned characteristics as they are at higher risk for NCDs.

Caution needs to be exercised in interpreting these results. Notwithstanding, the discussion in this article highlights the need for a better understanding of the magnitude and underlying causes of ill health and morbidity among older people in sub-Saharan Africa. These findings have implications for the demand for healthcare services, health expenditure, and health budgets. This study strengthens the evidence base on the magnitude of NCDs among the elderly population. However, there is still a need to understand how these patterns are evolving over time, the implications of those changes for older people and their families, and patterns of healthcare use over time. Follow-up surveys are therefore needed to monitor trends and patterns over time. The cross-sectional nature of SAGE wave I does not provide these. Thus, SAGE surveys will be repeated 2–3 times in 5–10 years, and based on this, it is anticipated that policies and programmes will be further refined. South Africa, like other developing countries, needs to be prepared to address the escalating demands of chronic diseases. Every country, regardless of the level of its resources, has the potential to make improvements in preventing and controlling chronic disease (27, 28). Population ageing and older persons' health, well-being, and protection are key issues facing contemporary society, and South Africa is no exception (29). This study confirms the need for effective control of NCDs among

the elderly. South Africa is bound by legislation to prioritize NCD prevention and care for the elderly through provisions in its constitution and a myriad of laws with direct bearing on elderly care, including the Aged Persons Amendment Act of 1998, the Domestic Violence Act of 1998, the Housing Development Schemes Act for Retired Persons of 1988, and the Social Assistance Act of 2004. Apart from national laws and policies, South Africa is also a signatory to international agreements and declarations such as the Madrid International Plan of Action on Ageing, the United Nations Principles for Older Persons, the Valetta Declaration, the WHO Policy Framework on Active Ageing, and the African Union's Policy Framework and Plan of Action on Ageing. Future research will be imperative, and future waves of SAGE will be an ideal conduit for policy refinement, as well as support for the monitoring and evaluation of health programming for the elderly.

Conclusion

The rising burden of chronic NCDs affecting older people places a heavy burden on the health system as a result of increased demand and access to healthcare services. Concerted effort is needed to develop strategies for the prevention and management of NCDs, especially among economically disadvantaged individuals who need these services the most.

Conflict of interest and funding

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Social and health determinants of gender differences in disability amongst older adults in South Africa

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There has been an unprecedented increase in population ageing resulting in the increase in prevalence of various health conditions, including disability and associated risk factors. This study aimed to investigate the prevalence and predictors of functional status and disability amongst older South Africans. Little is known about disability amongst older South Africans because most previous health research has focused on younger individuals and infectious diseases. We conducted a national population-based cross-sectional study with a sample of 3840 subjects aged 50 years or older in South Africa. Multivariable regression analysis was performed in order to assess the association of social factors, health variables and functional disability. Overall, 37.2% of the respondents had moderate or severe and/or very severe functional disability, this being higher amongst women. The highest disability was found for the mobility, cognition and participation domains. In all domains, except for the self-care domain, women had a higher disability prevalence. Multivariable analysis amongst men revealed that older age, having some or primary education, being from Indian or Asian race, having chronic conditions, physical inactivity and a lower quality of life were associated with functional disability. Amongst women, older age, as well as having chronic conditions and a lower quality of life, were associated with functional disability. This study has implications for health-sector strategic plans aimed at preventing disabilities, ensuring access to curative and rehabilitative care. This study forms an evidence base upon which future policies and health care management systems can be based.

Daar was 'n ongekende toename in bevolkingsveroudering, wat 'n toename in die voorkoms van verskeie gesondheidstoestande tot gevolg gehad het, insluitende gestremdheid en gepaardgaande faktore. Die studie was daarop gemik om die voorkoms en voorspelbaarheid van die funksionele status en gestremdheid onder ouer Suid-Afrikaners te ondersoek. Daar is min bekennis oor gestremdheid onder ouer Suid-Afrikaners omdat vorige gesondheidsnavorsing meestal op jonger individue en oordraagbare siektes ingestel was. Ons het 'n nasionale bevokings-gebaseerde kruis-seksionele ondersoek uitgevoer op 'n studiemonster van 3840 Suid-Afrikaners, 50-jaar en ouer. Om die verband tussen sosiale faktore, gesondheidsveranderlikes en funksionele gestremdheid te bepaal, is veelvuldig veranderlike regressie-analise uitgevoer. In die algemeen het 37.2% van die respondente matig of ernstige funksionele gestremdheid ervaar wat hoer was onder vroue. Die hoogste vorm van gestremdheid was op die gebiede van beweeglikehid, waarneming en deelname. Die voorkoms van gestremdheid was op alle gebiede hoër in vroue, behalwe op die gebied van selfsorg. Multi-veranderlike ontledings onder mans het getoon dat funksionele gestremdheid geassosieer word met ouderdom, met 'n mate van primêre onderwys, met die Indiese of Asiatiese bevolkingsgroep, en met diegene wat ly aan kroniese toestande (beroerte, slaapprobleme snags), fisiese onaktiwiteit en 'n laer lewenskwaliteit. Die studie het implikasies vir strategiese planne in die gesondheidsektor wat daarop gemik is om gestremdheid te voorkom en om toegang tot genesende en rehabiliterende sorg te verseker. Hierdie studie verskaf 'n grondslag van bewyse waarop beleid- en gesondheidsorg-bestuurstelsels in die toekoms gebaseer kan word.

Introduction

The world's population is ageing rapidly (United Nations Department of Economics and Social Affairs 2009:iv; United Nations Population Division 2005:1) and estimates show that this unprecedented increase will be evidenced even in developing countries, including South Africa (Gómez-Olivé *et al*. 2010:24), thus making the phenomenon of population ageing more significant. Whilst ageing represents a victory of medical, social and economic advances over disease, the other side of the coin is also true: population ageing has a negative effect on the health, economic and social spheres (National Institute on Aging, National Institutes of Health & US Department of Health and Human Services 2007:3). Health-wise, ageing results in deteriorating health and physical strength, inducing a greater demand for long-term care and

creating demands on an already-overwhelmed healthcare system (Dobriansky, Suzman & Hodes 2007:17; Kowal *et al.* 2010:12; United Nations Population Division 2002:2, 2005:4; World Health Organization [WHO] 2005:3, 2006:63). From an economic perspective, population ageing impacts negatively on economic growth by means of old-age pensions, per capita Medicare expenditures and the like (United Nations Department of Economics and Social Affairs 2009:viii). In the social sphere, population ageing affects the composition and living arrangements of the families who may need to provide care for their aged individuals (Dobriansky *et al.* 2007:17; United Nations Department of Economics and Social Affairs 2009:viii).

Thus, the epidemiological transition toward an ageing population makes health, disability, economic security and living conditions amongst the elderly policy concerns throughout the world (Cohen & Menken 2006:38). Velkoff and Kowal (2007:3) emphasise the need for a public policy relevant to the older population as their individual needs and social responsibilities change with increased age. In this regard, the United Nations Madrid International Plan of Action on Ageing (United Nations Population Division 2002) and the 2003 African Union Policy Framework and Plan of Action on Ageing (African Union/Help Age International 2003) were developed in order to urge governments to take account of ageing and older populations. The *Older Persons Act* 13 of 2006 of South Africa provides a comprehensive framework for the protection of older peoples' rights in order to ensure that their interests are advanced and their welfare and safety as well as their status are maintained (Republic of South Africa 2006).

Over a billion (about 15%) of the world's population was estimated to be living with some form of disability in 2010 (WHO 2011:261). A survey conducted in 57 countries showed the prevalence of disability amongst women aged 50 years and older to be almost double that of men (40.1% vs. 23.8%) (Hosseinpoor *et al.* 2012:1). The survey further revealed that about 45% of the inequality between men and women was attributed to differences in the distribution of sociodemographic factors. Of this 'explained' inequality, 81% of the contribution came from social determinants such as employment status (49%), education (15%), marital status (12%) and household economic status (4%). The remaining 19% of this inequality was attributed to differences in the distribution of age (10%) and country of residence (10%) (Hosseinpoor *et al.* 2012:4).

In South Africa, Tollman *et al.* (2008:893) reported that amongst the older population, the number of chronic conditions requiring long-term care has increased 2.66-fold during the past 10 years. South Africa is also the country with the highest prevalence of HIV in the world at 10.8% of its population in 2009 being aged 2 years and older (Shisana *et al.* 2009:xvi). One impact of HIV is that it increases the burden on older South Africans, especially women, who have to nurse their sick children, raise their grandchildren and become breadwinners. Debpuur *et al.* (2010:61) showed that in Ghana, women reported higher levels of disability than men with their respective WHO Disability Assessment Scale (WHODAS-II) means being 30.9 and 26.3; and with an overall national level of disability of 29.1 (0 = no disability; 100 = highest level of disability). In various studies, being female (Debpuur *et al.* 2010:58; Gómez-Olivé *et al.* 2010:31; Mwanyangala *et al.* 2010:40; Razzaque *et al.* 2010:73), increasing age (Debpuur *et al.* 2010:58; Gómez-Olivé *et al.* 2010:31; Mwanyangala *et al.* 2010:39; Razzaque *et al.* 2010), no or less education, single and not working (Gómez-Olivé *et al.* 2010:31), lower economic status (Debpuur *et al.* 2010:59) and lower subjective health status (Debpuur *et al.* 2010:59) have all been found to be associated with functional disability. Another important determinant of functional disability is mental health. About a quarter of the world's disability is attributed to psychiatric disorders (Murray & Lopez 1996:7; Wada *et al.* 2005:272; WHO 2008:9).

This study aims to investigate the social and health determinants of disability amongst older adults in a national probability sample of older South Africans who participated in the Study of Global Ageing and Adults Health (SAGE) Wave 1 in 2008. The research question is: 'what are the social and health determinants of functional disability?' The information generated from this study as well as from planned follow-up SAGE surveys will serve as the basis upon which future policies can be developed.

Research method and design

Sample and procedure

We conducted a national population-based cross-sectional study in South Africa in 2008 with a multi-stage stratified cluster sample of 3840 people aged 50 years or older. The SAGE sample design entails a two-stage probability sample that yields national and subnational estimates to an acceptable precision at provincial level, by locality type (urban and rural) and by population group (including Black, Coloured, Indian or Asian and White). The term Coloured is used in South Africa to denote people of mixed race where descendants of this race of people were couples of European (White) and African (Black African) heritage. The individual response rate amongst those aged 50 years or older was 77%. SAGE was carried out in South Africa in partnership between the WHO, the National Department of Health (NDOH) and the Human Sciences Research Council (HSRC).

Ethical considerations

The study was approved by the HSRC Ethics Committee (Protocol REC 5/13/04/06) and the NDOH (J1/14/45, 2007). Participants provided written informed consent.

Reliability and validity

The questionnaire was interview administered:

> The SAGE survey instruments and methods were adapted from those used by the World Health Survey (WHS) and were informed by a review of 16 surveys on ageing (including the

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> US Health and Retirement Survey (HRS) and the English Longitudinal Study of Ageing (ELSA). The SAGE survey instruments assessed health status and health systems from a household and individual perspective. SAGE also evaluated perceptions of well-being and more objective measures of health, including measured performance tests: 4 m timed walk; spirometry; cognitive battery; near and distance vision; and, grip strength; and biomarkers: blood pressure and pulse rate; height and weight; hip and waist circumference; and, blood spot from fingerprick. Standardized SAGE survey instruments were used in all countries consisting of five main parts: (1) household questionnaire; (2) individual questionnaire; (3) proxy questionnaire; (4) verbal autopsy questionnaire (VAQ); and, (5) appendices including showcards. The procedures for including country-specific adaptations to the standardized questionnaire and translations into local languages from English follow those developed by and used for the WHS. (WHO 2013a:1)

Measures

Outcome variable

In this study, the main outcome variable – functional disability – was measured by the 12-item WHO Disability Assessment Schedule, version 2.0 (WHODAS-II) (Üstün *et al*. 2010:1ff.), designed to measure disability from responses to questions on physical functioning in a range of Activities of Daily Living (ADLs) as well as Instrumental Activities of Daily Living (IADLs):

> ADLs describe a set of daily self-care activities and usually assess the need for help with personal care activities such as eating, bathing, and dressing. IADLs describe somewhat higher-level functioning considered necessary to live independently. These typically assess the need for help with routine needs such as using transportation, housekeeping, and preparing food. (He *et al*. 2012:18).

The domains include: cognition, mobility, self-care, pain and discomfort, interpersonal activities, sleep and energy and participation. Participants were asked about difficulties in the last 30 days with performing activities of daily living, learning a new task as well as instrumental activities of daily living and participation in community activities. Responses to these questions were scored using a five-point Likert-type response scale: 'none', 'mild', 'moderate', 'severe' and 'extreme/cannot do'. The computed WHODAS-II score ranged from 0 to 48 and was later transformed into a score of 0–100 with 100 being severe or extreme disability (Üstün *et al*. 2010:41–45). WHODAS-II subscales and summary indices were coded using the International Classification of Functioning, Disability and Health (ICF) disability categories (Üstün *et al*. 2001:1ff), namely: No problem (0% – 4%); Mild problem (5% – 24%); Moderate problem (25% – 49%); Severe problem (50% – 95%); Extreme problem (95% – 100%); and then dichotomised into > 25% = 1 and < 2 5% = 0.

Exposure variables

Depression and nocturnal sleep problems were assessed as mental-health determinants of disability. About a quarter of the world's disability is attributed to psychiatric disorders (Murray & Lopez 1996; WHO 2008).

In terms of *depression*, symptom-based depression in the past 12 months was assessed based on the World Mental Health Survey version of the Composite International Diagnostic Interview (Kessler & Üstün 2004:104). The diagnosis of depression was based on the International Classification of Diseases, 10th revision (ICD-10), diagnostic criteria for research (DCR) for depressive episodes (WHO 1993) and was derived from an algorithm that took into account respondents reporting symptoms of depression during the past 12 months (Ayuso-Mateos *et al*. 2010:366). The participants reported at least four of 10 depressive symptoms lasting two weeks, most of the day or all of the day. According to the ICD–10–DCR criterion B, at least two of the following three symptoms needed to be present: depressed mood, loss of interest and fatigability. In addition, the participants who responded affirmatively to the question, 'Have you been taking any medications or other treatment such as attending therapy or counselling sessions for depression during the last 12 months?', were added to the symptom-based depression group.

Nocturnal sleep problems were assessed with the question, 'Overall in the last 30 days, how much of a problem did you have with sleeping, such as falling asleep, waking up frequently during the night, or waking up too early in the morning?' Response options were none, mild, moderate, severe and extreme. Responses were collapsed into two categories, namely: none/mild/moderate and severe/extreme (Stranges *et al*. 2012:1176).

Blood pressure (systolic and diastolic) was measured three times on the right arm or wrist of the seated respondent using an automated recording device (OMRON R6 Wrist Blood Pressure Monitor, HEM-6000-E, Omron Healthcare Europe, B.V., Hoofddorp and The Netherlands). Out of three measurements, the average of the last two readings was used, as suggested by the WHO (2013b). In accordance with the Seventh Report of the Joint National Committee of Prevention, Detection, Evaluation and Treatment of High Blood Pressure, individuals with systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg and/or who reported the current use of antihypertensive medication, were considered to be suffering from high blood pressure (Chobanian *et al*. 2003:2562).

Tobacco use. Lifetime tobacco use was assessed with the question 'Have you ever smoked tobacco or used smokeless tobacco?' Lifetime tobacco users were asked 'Do you currently use (smoke, sniff or chew) any tobacco products such as cigarettes, cigars, pipes, chewing tobacco or snuff?' The response options were 'Yes, daily', 'Yes, but not daily' and 'No, not at all'. These questions are based on the WHO Guidelines for Controlling and Monitoring the Tobacco Epidemic (WHO 1998).

Alcohol use. Lifetime alcohol use was assessed with the question 'Have you ever consumed a drink that contains alcohol (such as beer, wine, spirits, etc.)?' Response options

were 'Yes' or 'No, never'. Lifetime alcohol users were asked about current (past month) alcohol use and current alcohol users were asked 'During the past seven days, how many drinks of any alcoholic beverage did you have each day?'

Height and weight were measured. Body mass index (BMI) was used as an indicator of obesity. BMI was calculated as weight in kg divided by height in metre squared. Obesity was defined as ≥ 30 kg/m^2.

Physical activity was measured using the General Physical Activity Questionnaire (GPAQ). The instrument gathered information on physical activity in three domains (activity at work, travel to and from places and recreational activities), as well as time spent sitting down. The questionnaire also assessed vigorous and moderate activities performed at work and recreational activities. Information on the number of days in a week spent on different activities and time spent in a typical day for each activity was also recorded (WHO 2009). For physical activity, in addition to the total minutes of activity, the activity volume was also computed by weighing each type of activity by its energy requirement in metabolic equivalents (METs). The number of days and total physical activity MET minutes per week were used to classify respondents into three categories of low, moderate and high levels of physical activity. Physical inactivity was defined as those who had low levels of physical activity, whilst moderate and high levels of physical activity were collapsed in further analysis (WHO 2009).

Quality of life, a social determinant of disability, was also assessed by means of WHO Quality of Life (WHOQOL) instruments which ranges from 0 to 100 and was evaluated by responses to questions on overall life satisfaction and specific aspects of life. The WHOQOL instruments are a set of international, cross-culturally comparable tools used to assess quality of life and provide a measure of the evaluative component of wellbeing (WHO 1997). They also used two questions in each of the following four broad domains: physical, psychological, social and environmental. Results from the eight items were summarised to get an overall WHOQOL score, which was then transformed to a 0–100 scale, with lower scores indicating a better quality of life. Besides overall satisfaction, SAGE also asked whether an older person was satisfied with a wide range of life aspects such as health, oneself, ability to perform activities of daily living, personal relationships and conditions of living space.

Economic or wealth status. Wealth levels were generated through a multi-step process, whereby asset ownership was converted to an asset ladder, Bayesian post-estimation method was used to generate raw continuous income estimates and these were then transformed into quintiles (Ferguson *et al*. 2003:747).

Chronic conditions. Other chronic conditions such as stroke, angina, diabetes, arthritis, chronic lung disease, depression, hypertension, cataracts, injuries and oral health problems were assessed by self-report.

Data analysis

The data were entered using CSPro and analysed using STATA Version 10 (Stata Corp, College Station, Texas, USA). Data were weighted using post-stratified individual probability weights based on the selection probability at each stage of selection. Individual weights were post-stratified by province, sex and age-groups according to the 2009 Medium Mid-Year population estimates from Statistics South Africa (2009).Weights were not normalised. Associations between the key outcome of functional disability (≥ 25%, indicating moderate/severe/very severe) and social and health variables were evaluated, calculating odds ratios (OR) for men and women separately. Unconditional multivariable logistic regression was used for the evaluation of the impact of explanatory variables for the outcome of functional disability (binary dependent variable). Predictor variables, which have been found to be associated with functional disability in previous studies (Debpuur *et al*. 2010; Gómez-Olivé *et al*. 2010; Hosseinpoor *et al*. 2012; Murray & Lopez 1996; Mwanyangala *et al*. 2010; Razzaque *et al*. 2010; Wada *et al*. 2005; WHO 2008), were put into the regression models. All variables that were significant statistically at the $p < 0.05$ level in bivariate analyses were included in the multivariable models. The models were adjusted for sociodemographic variables and separate models were run for men and women. In the analysis, weighted percentages are reported. Both the reported 95% confidence intervals and the *p*-value are adjusted for the multi-stage stratified cluster sample design of the study.

Results

Descriptive results

The total sample included 3840 South Africans, aged 50 years or older – 44.1% men and 55.9% women. The most prevalent population group was African Black (74%); almost half (49.9%) were between 50 and 59 years old. The educational level of most participants (71.6%) was lower than secondary-school education and almost two-thirds (64.9%) lived in an urban area. Almost half (46.7%) of the older adults were obese, 77.3% had hypertension and 9.2% had diabetes. In addition, 4.0% had had a stroke, 5.2% angina, 4.9% asthma, 4% depression, 24.7% arthritis and 8.9% a nocturnal sleep problem. More than half (60.5%) engaged in low physical activity, 20.4% were daily tobacco users and a small proportion (3.7%) were hazardous or harmful alcohol users. With a possible total score of 100, functional disability scored a mean of 21 (low) and quality of life scored a mean of 47 (also low). Overall, 37.2% had moderate/severe or very severe functional disability, 32.6% amongst men and 40.9% amongst women (see Table 1).

On analysis of the different domains of functional disability, the highest disability was found for the domain of mobility, followed by cognition and participation. In all domains women had higher disability prevalence than men except for one, namely, self-care (see Table 2).

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TABLE 1: Sample characteristics and prevalence of disability amongst older South Africans by gender.

Variables	Disability (moderate, severe or extreme)				Total sample	
	Male		Female		*N*	%
	n	%	*n*	%		
Age						
50–59	163	23.1	271	35.2	1695	49.9
60–69	161	33.9	251	41.1	1233	30.6
70–79	117	51.6	210	49.8	661	14.0
80 and over	54	72.3	90	63.9	251	5.5
Population group						
African Black	255	36.0	503	43.7	2053	74.0
White	20	17.4	32	23.6	269	9.3
Coloured	68	30.1	133	32.5	655	12.8
Indian or Asian	56	51.6	73	47.5	307	3.8
Marital status						
Single	45	36.4	123	38.3	512	14.3
Married	363	31.3	240	35.2	2007	55.9
Separated/Divorced	22	25.8	46	37.8	230	5.9
Widow	61	46.2	394	48.5	1020	23.9
Educational level						
No schooling	202	29.9	202	45.2	854	25.2
Less than primary	111	40.1	166	46.0	803	24.0
Primary	110	46.9	127	40.1	779	22.4
Secondary	72	20.9	94	30.4	923	28.3
Wealth						
Low	208	38.6	327	45.9	1482	40.6
Medium	81	29.7	191	42.2	731	18.2
High	204	28.4	300	34.4	1608	41.2
Geolocality						
Rural	185	38.0	265	41.4	1276	35.1
Urban	309	29.7	556	40.6	2561	64.9
Chronic conditions						
High blood pressure	373	33.7	660	43.3	2842	77.3
Stroke	38	76.0	46	67.2	139	4.0
Angina	33	47.3	87	66.8	219	5.2
Diabetes	57	44.7	121	54.0	360	9.2
Obesity (BMI ≥ 30)	142	35.8	319	46.4	1539	46.7
Arthritis	142	62.0	319	61.1	851	24.7
Asthma	35	62.7	49	58.1	165	4.9
Depression	32	64.4	63	67.5	160	4.0
Sleep problem (nocturnal)	60	67.5	123	83.8	249	7.4
Health habits						
Daily tobacco use	136	33.6	153	38.7	810	20.4
Alcohol use (10 drinks or more a week)	42	35.0	18	42.6	158	3.7
Physical inactivity	386	43.4	632	47.3	2455	60.5
Quality of Life (QoL)						
Low	228	67.8	375	67.1	956	28.5
Medium	175	29.5	292	39.6	1384	33.5
High	92	14.4	155	18.4	1500	38.1
QoL range 0–100; M (SD)	40.3	11.7	39.1	12.0	47.1	12.5

M, Mean; s.d., Standard deviation.

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Predictors of functional disability

In *univariate* analysis amongst men, older age, having primary education, being from the Indian or Asian population group, suffering from chronic conditions (stroke, angina, asthma, depression, nocturnal sleep problem), physical inactivity and lower quality of life were associated with functional disability. In *multivariate* analysis amongst men, older age, having some or primary education, being from the Indian or Asian population group, suffering from chronic conditions (stroke, nocturnal sleep problem), physical inactivity and lower quality of life were associated with functional disability.

In *univariate* analysis amongst women, older age, having primary education, being from the Indian or Asian population group, suffering from chronic conditions (stroke, angina, asthma, depression, nocturnal sleep problem), physical inactivity and lower quality of life were associated with functional disability. In *multivariate* analysis amongst women, older age, suffering from chronic conditions (angina, obesity, arthritis, nocturnal sleep problem) and lower quality of life were associated with functional disability (see Table 3).

Discussion

This study was aimed at investigating the prevalence and associations of functional disability amongst older South

TABLE 2: Functional disability by gender.

Domain	Question In the last 30 days, how much difficulty did you have ...	Moderate disability		Severe or very severe disability	
		Men (%)	Women (%)	Men (%)	Women (%)
Cognition	... concentrating on doing something for 10 minutes?	15.1	18.9	6.3	8.9
	... in learning a new task (for example, learning how to get to a new place, learning a new game, learning a new recipe)?	22.3	23.6	8.2	13.6
Mobility	... in standing long periods?	18.5	22.4	13.3	19.0
	... in walking a long distance such as a kilometre?	15.4	19.9	18.8	24.3
Self-care	... in bathing/washing your whole body?	2.6	1.7	0	0
	... in getting dressed?	3.1	4.1	2.3	1.8
Getting along	... with dealing with strangers?	4.8	8.2	0	0
	... with making new friendships or maintaining current friendships?	2.8	6.4	0	0
Life activities	... in taking care of your household responsibilities?	5.8	9.2	0	0
	... in your day to day work?	5.2	6.0	0	0
Participation	... in joining in community activities (for example, festivities, religious or other activities) in the same way as anyone else can?	6.1	9.2	0	0
	In the last 30 days, how much have you been emotionally affected by your health condition(s)?	19.7	21.7	7.4	10.2

TABLE 3: Regression analyses with functional disability by gender.

Sociodemographics	Men		Women	
	Crude Odds Ratio (95% CI)	Adjusted Odds Ratio (95% CI)	Crude Odds Ratio (95% CI)	Adjusted Odds Ratio (95% CI)
Age				
50–59	1.00	1.00	1.00	1.00
60–69	1.71 (1.15–2.53)**	1.03 (0.67–1.48)	1.28 (0.94–1.74)	1.41 (1.08–1.84)*
70–79	3.54 (1.81–6.91)***	4.40 (1.87–10.36)***	1.83 (1.20–2.78)**	2.36 (1.41–3.94)**
80 and over	8.68 (3.71–20.28)***	5.30 (1.32–21.33)*	3.26 (2.06–5.16)***	5.05 (2.59–9.84)***
Population group				
African Black	1.00	1.00	1.00	1.00
White	0.38 (0.12–1.14)	0.66 (0.20–2.19)	0.40 (0.19–0.86)*	0.64 (0.28–1.45)
Coloured	0.77 (0.43–1.36)	0.40 (0.17–0.91)*	0.62 (0.37–1.04)	0.50 (0.23–1.07)
Indian or Asian	1.90 (1.04–3.47)*	1.99 (1.09–3.66)*	1.16 (0.68–2.00)	1.47 (0.78–2.76)
Marital status				
Single	1.00	-	1.00	-
Married	0.79 (0.38–1.66)	-	0.87 (0.47–1.61)	-
Separated/Divorced	0.61 (0.29–1.25)	-	0.98 (0.55–1.73)	-
Widow	1.50 (0.60–3.71)	-	1.51 (0.86–2.66)	-
Educational level				
No schooling	1.00	1.00	1.00	1.00
Less than primary	1.57 (0.88–2.80)	2.36 (1.31–4.24)**	1.03 (0.66–1.61)	1.01 (0.59–1.72)
Primary	2.07 (1.37–3.12)***	2.47 (1.28–4.75)**	0.81 (0.49–1.35)	0.90 (0.47–1.73)
Secondary	0.62 (0.42–0.93)*	0.98 (0.37–2.45)	0.53 (0.32–0.88)*	0.75 (0.36–1.55)
Wealth				
Low	1.00	-	1.00	-
Medium	0.67 (0.36–1.27)	-	0.86 (0.50–1.47)	-
High	0.63 (0.32–1.23)	-	0.62 (0.30–1.25)	-
Geolocality				
Rural	1.00	-	1.00	-
Urban	0.69 (0.32–1.47)	-	0.97 (0.43–2.20)	-
Chronic conditions				
High blood pressure	1.14 (0.62–2.10)	-	1.50 (0.84–2.70)	-
Stroke	6.92 (4.32–11.07)***	5.61 (1.28–24.62)*	2.99 (1.41–6.37)**	1.77 (0.71–4.44)
Angina	1.85 (1.15–2.96)*	1.88 (0.72–4.90)	3.02 (1.58–5.79)***	2.73 (1.15–6.49)*
Diabetes	1.68 (0.83–3.39)	-	1.76 (0.97–3.19)	-
Obesity (BMI ≥ 30)	1.27 (0.90–1.79)	-	1.61 (1.18–2.20)**	1.52 (1.00–2.32)*
Arthritis	4.51 (2.34–871)	-	3.11 (2.01–4.80)***	3.30 (2.10–5.19)***
Asthma	3.63 (1.74–7.58)***	1.50 (0.69–3.27)	2.02 (1.11–3.66)*	1.30 (0.68–2.48)
Depression	3.96 (1.96–7.99)***	1.15 (0.46–2.85)	3.15 (1.61–6.18)***	1.37 (0.61–3.08)
Sleep problem (nocturnal)	4.66 (2.43–8.94)***	3.02 (1.21–7.54)*	8.70 (5.07–14.93)***	6.26 (2.68–14.62)***
Health habits				
Daily tobacco use	1.02 (0.57–1.83)	-	0.87 (0.48–1.55)	-
Alcohol use (10 drinks or more a week)	1.09 (0.44–2.69)	-	1.04 (0.32–3.36)	-
Physical inactivity	3.49 (2.02–6.01)***	3.18 (1.53–6.60)**	2.10 (1.37–3.23)***	1.87 (0.99–3.52)
Quality of Life				
Low	1.00	1.00	1.00	1.00
Medium	0.20 (0.14–0.29)***	0.27 (0.18–0.43)***	0.32 (0.22–0.46)***	0.41 (0.28–0.59)***
High	0.08 (0.03–0.19)***	0.09 (0.04–0.21)***	0.11 (0.05–0.23)***	0.18 (0.09–0.38)***

*, $p < 0.05$; **, $p < 0.01$; ***, $p < 0.001$

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Africans. Overall, the prevalence in functional disability found in this study, measured with the WHODAS-II, was, with a mean score of 21, low. This seems to be lower than that found in other studies, including one in Ghana (mean of 29) (Debpuur *et al.* 2010) and a 57-country population-based survey in mainly low- and middle-income and a few high-income countries (mean 32) (Hosseinpoor *et al.* 2012:1). Similar to other studies (Debpuur *et al.* 2010; Gómez-Olivé *et al.* 2010; Hosseinpoor *et al.* 2012:1; Mwanyangala *et al.* 2010; Razzaque *et al.* 2010), we found that women have higher levels of disability compared with men. The highest disability was found in the domain of mobility, which was also the case in other studies (Aijänseppä *et al.* 2005:413).

A key finding of this study was that non-communicable diseases (NCDs) are important determinants of health and disability in South Africa. More than three-quarters (77.3%) had high blood pressure and close to half (46.7%) were obese. We also noted some gender differences in this regard. Chronic NCDs which were associated significantly with functional disability for both sexes were stroke, angina, asthma, depression and sleep problems (nocturnal), which was also found in a previous review (Rodrigues *et al.* 2009). We also found that physical inactivity was associated significantly with disability for both men and women. The study further revealed that sleeping problems and depression contributed to functional disability amongst both elderly men and women. This may lead to negative effects such as institutionalisation and dependency as well as serious public-health implications which may include increased utilisation of public-health services, an increase in the need for long-term care and ongoing social support (Fried & Guralnik 1997:92). Thus, it creates some implications with regard to caring for the elderly as comprehensive interventions incorporating not only disability but also psychological and social components are critical in order to provide relief for depressed elderly persons, especially those who may not respond positively to antidepressant medication treatment.

Obesity and arthritis were only associated with functional disability for women. A few studies (Rodrigues *et al.* 2009; Taş *et al.* 2007:276) also seem to suggest that it is possible that obesity and arthritis may represent a greater risk of functional disability. One reason for this gender difference may be because the prevalence of obesity and arthritis is higher amongst women as compared with men. Furthermore, it was found that lack of schooling was only associated with functional disability for men. Grundy and Glaser (2000:149) also found that increased severity of disability and new incidence of disability were associated with lower socioeconomic status, but did not find gender differences. Further to this, research is needed for understanding of socioeconomic status in relation to gender differences in functional disability. These gender disparities in health status during old age need to be taken note of. Whilst women have higher life expectancies than men (Apt 2007), these findings show that they experience poor or ill health and higher levels of disability. Other studies have also found similar results (Debpuur *et al.* 2010; Gómez-Olivé *et al.* 2010; Hosseinpoor *et al.* 2012):

> Whilst national health-sector strategic plans in South Africa and other sub-Saharan African countries have started to highlight the need for policies to prevent disabilities and ensure access to curative and rehabilitative care among older individuals, there is only a limited understanding of the trajectories of health and disability among mature and elderly adults in sub-Saharan Africa, and of the health needs that will result from the oncoming growth of the mature adult and elderly population in many sub-Saharan African contexts. The required health sector responses to population aging in sub-Saharan African are thus inadequately informed by the existing literature, which has often focused on the health of younger individuals and/or health concerns resulting from infectious diseases, rather than chronic and/or noncommunicable diseases and disabilities that affect older individuals. (Payne, Mkandawire & Kohler 2013:3)

Recommendations

In terms of policy, a life-course approach to addressing these gender disparities in health has been recommended (Nyirenda *et al.* 2012:12). Such inequalities to be addressed are linked to gender-related differences in access to education, participation in the labour market and access to material resources. The risk factors for most of these chronic NCDs are modifiable and can be managed from an early age through lifestyle changes. The policy implication is that health promotion programmes, for example, smoking cessation, physical activity and nutritional programmes, should be a priority. This form of primary prevention will ensure healthy ageing and lesser costs for managing conditions later in life. Our findings call for a policy shift, specifically on how management of chronic NCDs and functional disability can be integrated within the existing healthcare system, especially at a primary-healthcare level.

Limitations of the study

This study had several limitations. Firstly, the self-report of health variables such as depression symptoms, tobacco or alcohol use should be interpreted with caution; it is possible that measurement errors occurred. Secondly, this study was based on data collected in a cross-sectional survey. We cannot, therefore, ascribe causality to any of the associated factors in the study. However, follow-up studies are planned. Finally, data were collected from older adults who were available in the household on the day of the survey. Respondents who were institutionalised (prison, hospital, care home) and not returning to the household within seven days, as well as those who had moved more than 50 kilometres away from the study household, were not included and we may this have underestimated the prevalence of disability.

Conclusion

This study found that disability is prevalent amongst older adult South Africans. The highest disability was found for the domain of mobility, followed by cognition and participation and in all domains women had higher disability prevalence

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than men, except for the domain of self-care. Amongst men, older age, having some or primary education, being from the Indian or Asian population group, suffering from chronic conditions (stroke, nocturnal sleep problem), physical inactivity and lower quality of life were associated with functional disability. Amongst women, older age, suffering from chronic conditions (angina, obesity, arthritis, nocturnal sleep problem) and lower quality of life were associated with functional disability. Future research is suggested to ascertain whether results found are replicable longitudinally and with different samples of older South Africans.

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Competing interests

The authors declare that they have no financial or personal relationship(s) which may have inappropriately influenced them in writing this article.

Authors' contributions

K.P. (Human Sciences Research Council) conducted the analysis, N.P.M. (Human Sciences Research Council) and all other authors (S.R., W.C., Z.K.) (Human Sciences Research Council) wrote, corrected and approved the article.

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ORIGINAL ARTICLE

COACTION

Sociodemographic predictors of multiple non-communicable disease risk factors among older adults in South Africa

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Background and objective: Unhealthy lifestyle behaviours are important risk factors of morbidity and mortality. This study aimed to explore the sociodemographic predictors of multiple non-communicable disease (NCD) risk factors experienced by elderly South Africans.

Methods: We conducted a national population-based cross-sectional survey with a sample of 3,840 individuals aged 50 years or above in South Africa in 2008. The outcome variable was the co-existence of multiple NCD risk factors (tobacco use, alcohol, physical inactivity, fruit and vegetable intake, overweight or obesity, and hypertension) in each individual. The exposure variables were sociodemographic characteristics, namely, age, gender, education, wealth status, population group, marital status, and residence. Multivariate linear regression was used to assess the association between sociodemographic variables and multiple NCD risk factors.

Results: The mean number of NCD risk factors among all participants was three (95% confidence interval: 2.81–3.10). Multivariate linear regression analysis revealed that being female, being in the age group of 60–69 years, and being from the Coloured and Black African race were associated with a higher number of NCD risk factors. Marital status, educational level, wealth, and residence were not significantly associated with the number of NCD risk factors experienced.

Conclusions: The co-existence of multiple lifestyle NCD risk factors among the elderly is a public health concern. Comprehensive health-promotion interventions addressing the co-existence of multiple NCD risk factors tailored for specific sociodemographic groups are needed.

Keywords: *self-reported*; *risk factors*; *ageing*; *South Africa*

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There are well-documented key risk factors for non-communicable diseases (NCDs). These risk factors include unhealthy lifestyle behaviours such as high tobacco and alcohol consumption, an unhealthy diet, physical inactivity, and raised blood pressure. They define the occurrence and severity of NCDs (1, 2) such as cancers and cardiovascular diseases which generally develop from the interaction of multiple risk factors. There is an increase in NCD risk factors in South Africa (3, 4), including among elderly South Africans (3), which may place a heavy burden on the already constrained healthcare system (3, 5).

Limited studies have been conducted to determine the association between sociodemographic characteristics and multiple NCD risk factors among the elderly in developing countries. Most previous studies have concentrated on the significance of one unhealthy behaviour in an individual and focused less on other unhealthy behaviours that may coexist within an individual. In a cross-sectional study in three rural sites in Malawi, Rwanda, and Tanzania, results from five risk factors that were examined (alcohol intake, smoking, vigorous physical activity, hypertension, and overweight) showed that individuals aged 50 years and above were more likely to have multiple

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risk factors (6). Among men aged 50 years and above, 49.5% had two or more risk factors in comparison to 52.0% of women of the same age. Alcohol intake among men aged 50–59 years was reported to be at its peak (i.e. women are reported to have increased alcohol intake with increased age). In a study conducted by Minh et al. (7) in Vietnam, hypertension was directly associated with socio-economic status among men. Inequalities in health between socioeconomic groups and the contribution of lifestyle factors to these inequalities have been evident from other international studies as well (8, 9). In order to reduce the burden of NCDs, healthy lifestyles need to be promoted from an early age as prevention is better than cure.

While the association between sociodemographic characteristics and multiple NCD risk factors has been reported elsewhere, limited studies, if any, have reported this among elderly South Africans (10, 11). Research identifying the association between sociodemographic characteristics and multiple NCD risk factors among elderly South Africans is imperative given the urgent need to address health disparities. Against this background, this study explores the association between sociodemographic characteristics and multiple NCD risk factors among elderly South Africans who participated in the Study of Global Ageing and Adult Health (SAGE wave 1) in 2008.

Methodology

Description of survey and study population

We conducted a national population-based cross-sectional survey with a sample of 3,840 aged 50 years or above in South Africa in 2008. The SAGE sample design entails a two-stage probability sample that yields national estimates to an acceptable precision at the provincial level, by locality type (urban and rural), and by race (Black Africans, Coloured/mixed race, Indian or Asian, and White). The individual response rate among those aged 50 years or older was 77%. Further sampling details have been published elsewhere (12). SAGE wave 1 was carried out in South Africa by the Human Sciences Research Council (HSRC) in partnership with the World Health Organization (WHO) and the National Department of Health (NDOH). The study was approved by the HSRC Research Ethics Committee (REC 5/13/04/06) and the NDOH (J1/14/45).

Measures

The outcome variable was the number of multiple NCD risk factors (tobacco use, alcohol, physical inactivity, fruit and vegetable intake, overweight or obesity, and hypertension) in each individual. The exposure variables were sociodemographic characteristics, namely, age, gender, education, wealth status, race, marital status, and residence.

Blood pressure (systolic and diastolic)

Blood pressure (systolic and diastolic) was measured three times on the right wrist of the seated respondent using an automated recording device (OMRON R6 Wrist Blood Pressure Monitor, HEM-6000-E, Omron Healthcare Europe, Hoofddorp, the Netherlands). Out of three measurements, the average of the last two readings was used, as suggested by WHO (13). In accordance with the Seventh Report of the Joint National Committee of Prevention, Detection, Evaluation, and Treatment of High Blood Pressure, individuals with systolic blood pressure $\geq$140 mm Hg and/or diastolic blood pressure $\geq$90 mm Hg and/or who reported the current use of antihypertensive medication were considered to be suffering from high blood pressure (14).

Tobacco use

Lifetime tobacco use was assessed with the question 'Have you ever smoked tobacco or used smokeless tobacco?' Lifetime tobacco users were asked, 'Do you currently use (smoke, sniff, or chew) any tobacco products such as cigarettes, cigars, pipes, chewing tobacco, or snuff?' The response options were 'Yes, daily', 'Yes, but not daily', and 'No, not at all'. These questions were derived from the WHO Guidelines for Controlling and Monitoring the Tobacco Epidemic (15). Participants who responded with 'Yes, daily' were classified as daily tobacco users.

Alcohol use

Lifetime alcohol use was assessed with the question 'Have you ever consumed a drink that contains alcohol (such as beer, wine, spirits, etc.)?' Response options were 'Yes' or 'No, never'. Lifetime alcohol users were asked about current (past month) alcohol use, and current alcohol users were asked, 'During the past 7 days, how many drinks of any alcoholic beverage did you have each day?' Risky drinking was defined in two ways: heavy drinkers (>7 drinks/week) and binge drinkers (>3 drinks/one occasion/week). These are considered 'risky drinking', according to the National Institute on Alcohol Abuse and Alcoholism (NIAAA) (16).

Fruit and vegetable consumption

Fruit and vegetable consumption was assessed using two questions: 'How many servings of fruit do you eat on a typical day?' and 'How many servings of vegetables do you eat on a typical day?' using 24 h dietary recall data as the gold standard (17). Researchers were trained to standardize the serving size and number of servings reported. Insufficient fruit and vegetable consumption was defined as fewer than five servings of fruits and/or

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vegetables per day (17). Cronbach's α for the two questions in this sample was 0.74.

Height and weight

Height and weight were measured using a stadiometer and a calibrated weighing scale, respectively. Body Mass Index (BMI) was used as an indicator of obesity (≥ 30 kg/m^2). BMI was calculated as weight in kilograms divided by height in metres squared. Overweight was defined as having a BMI ≥ 25, and obesity as BMI ≥ 30.

Physical activity

Physical activity was measured using the General Physical Activity Questionnaire (GPAQ). The instrument gathered information on physical activity in three domains (activity at work, travel to and from places, and recreational activities), as well as time spent sitting. The questionnaire also assessed vigorous and moderate activities performed at work and for recreational activities.

Information on the number of days per week spent on different activities and the time spent in a typical day for each activity was also recorded (18). For physical activity, in addition to the total minutes of activity, the activity volume was also computed by weighing each type of activity by its energy requirement in metabolic equivalents (METs). One MET was defined as the energy cost of sitting quietly and was equivalent to a caloric consumption of 1 kcal/kg/hour. A MET-minute showed the total activity volume on a weekly basis, and it was calculated by multiplying time spent on each activity during a week by the MET values of each level of activity. MET values for different level activities were set as 4 MET for moderate-intensity physical activity, 8 MET for vigorous physical activity, and 4 MET for transport-related walking or cycling. The total physical activity for GPAQ was calculated as the sum of total moderate, vigorous, and transport-related activities per week. The number of days and total physical activity in MET-minutes per week were used to classify respondents into three categories of physical activity: a low, moderate, or high level. A person reaching any of the following criteria is classified in the 'high physical activity' category: vigorous intensity activity for at least 3 days per week, achieving a minimum of at least 1,500 MET-minutes per week; or 7 or more days of any combination of walking and moderate vigorous intensity activities per week, achieving a minimum of at least 3,000 MET-minutes per week. A person who is not meeting the criteria for the 'high' category but is meeting any of the following criteria is classified in the 'moderate physical activity category': 3 or more days per week of vigorous intensity activity for at least 20 minutes per day, 5 or more days per week of moderate-intensity activity or walking for at least 30 minutes per day, or 5 or more days per week of any combination of walking and moderate- or vigorous intensity activities, achieving a minimum of at least 600 MET-minutes per week. A person not meeting any of the above-mentioned criteria falls in the 'low physical activity' category. Physical inactivity was defined as those who had low levels of physical activity; moderate and high levels of physical activity were collapsed in further analysis (18).

Economic or wealth status

It is not easy to obtain accurate income data from household surveys, yet these are crucial because of the relationship between health and wealth. We therefore used household assets and characteristics of the dwelling, retirement and retirement benefits, financial security, income, consumption, and financial transfers as income estimates. A random-effects probit model was used to identify indicator-specific thresholds that represent the point on the wealth scale above which a household is more likely than not to own a particular asset. This enabled an estimation of an asset ladder using a Bayesian post-estimation (empirical Bayes) method. These estimates of thresholds, combined with actual assets observed to be owned for any given household, were used to produce an estimate of household-level wealth status. This was used to create wealth quintiles (19). The wealth quintiles were collapsed in the analysis to tertiles (1st and 2nd quintiles: low; 3rd quintile: medium; and 4th and 5th quintiles: high).

Data analysis

The data were entered into CSPro and analysed using STATA Version 10. Data were weighted using post-stratified individual probability weights based on the selection probability at each stage of selection. Individual weights were post-stratified by province, sex, and age groups according to the 2009 Medium Mid Year population estimates from Statistics South Africa, which are available at http://www.statssa.gov.za/publications/P0302/P03022009.pdf. Multivariate linear regression was used to assess the effect of sociodemographic variables on frequency of NCD risk factors. Non-collinear variables statistically significant at the $p < 0.05$ level in bivariate analyses were included in the multivariate model. In the analysis, weighted percentages are reported.

Results

Sample characteristics

The total sample included 3,840 older South Africans aged 50 years and above; 44.1% were men and 55.9% were women. The most prevalent population group was Black Africans (74%), and almost half of the participants (49.9%) were aged between 50 and 59 years. The educational level of most participants (71.6%) was lower than secondary school education, and almost two-thirds (64.9%) lived in an urban area (Table 1).

Table 1. Sociodemographic sample characteristics of older South Africans

Variables	Total sample *N* (%)	Men *N* (%)	Women *N* (%)
All	3,840 (100)	1,636 (44.1)	2,204 (55.9)
Age			
50–59	1,695 (49.9)	757 (52.1)	938 (48.1)
60–69	1,233 (30.6)	537 (30.7)	696 (30.6)
70 and over	912 (19.5)	344 (17.2)	568 (21.3)
Race			
African Black	2,053 (74.0)	803 (73.8)	1,250 (74.2)
White	269 (9.3)	132 (10.7)	137 (8.3)
Coloured	655 (12.8)	232 (11.8)	423 (13.6)
Indian or Asian	307 (3.8)	136 (3.7)	171 (3.9)
Marital status			
Single	512 (14.3)	142 (8.5)	370 (19.0)
Married or cohabiting	2,007 (55.9)	1,230 (80.0)	777 (36.6)
Separated or divorced	230 (5.9)	87 (3.8)	143 (7.6)
Widow	1,020 (23.9)	159 (7.7)	861 (36.8)
Educational level			
No schooling	645 (25.5)	371 (33.9)	274 (18.2)
Less than 7 years	874 (27.0)	340 (25.4)	534 (28.4)
8–11 years	1,068 (32.7)	417 (26.1)	651 (38.4)
12 or more years	399 (14.9)	195 (14.7)	204 (15.0)
Wealth status			
Low	1,482 (40.6)	621 (40.6)	39.3 (40.6)
Medium	731 (18.2)	259 (13.2)	21.5 (22.2)
High	1,608 (41.2)	748 (46.2)	39.2 (37.2)
Geolocality			
Rural	1,276 (35.1)	561 (34.1)	715 (35.9)
Urban	2,561 (64.9)	1,076 (65.9)	1,485 (64.1)

NCD risk factors

The distribution of the six NCD risk factors by sociodemographic variables is shown in Table 2. The overall prevalence of daily tobacco consumption was 19.7%, and it was relatively higher for individuals who are male (22.7%), are in a younger age group (20.9%), are Coloured (33.9%), and possess medium wealth (22.5%). The prevalence of risky alcohol use was generally low (3.7%), and it is also relatively higher for those who are male (5.9%), in a younger age group (4.2%), and Coloured and White (both 4.5%), and highest for individuals with medium wealth (22.5%). More than two-thirds of the sample (68.5%) took insufficient fruits and vegetables, with more females (70%), Coloureds (73%) and African Blacks (71%), and individuals with low wealth (72.4%) and medium wealth statuses (68.5%) having higher prevalence of insufficient fruit and vegetable intake; the prevalence was evenly distributed among age groups. The prevalence of inadequate physical activity was 60.5% across the sample. This was higher among women (63.1%), the 70 and above age group (71.2%), Coloureds (76.9%), and individuals with high wealth status (62.3%). The prevalence of overweight or obesity was very high (68.2%), with females (71.9%), age group 60–69 years (71.2%), Whites (75.9%), and individuals with high wealth status having higher prevalence. Three-quarters of the sample (75.3%) had hypertension. This was higher than 70% across gender, age, race, and wealth status.

Table 3 shows the calculated number of risk factors by sociodemographics. The majority of the participants (68.9%) had three or more risk factors. Table 3 shows the calculated number of risk factors by sociodemographics. The majority of the participants (68.9%) had three or more risk factors. A higher percentage of women (70.9%), individuals aged 60–69 years (84.1%), Coloured individuals (79.9%), and individuals with low (68.5%) and medium (68.9%) wealth status had three or more risk factors.

Factors associated with multiple NCD risk factors

The mean number of NCD risk factors among all participants was 3 (95% CI: 2.81–3.10). Multivariate linear regression analysis revealed that being female, in the age group of 60–69 years and being from the Coloured and Black African population groups were associated with higher number of NCD risk factors. Marital status, educational level, wealth and residence were not significantly associated with the number of NCD risk factors experienced (Table 4).

Discussion

This study found that on average, elderly people in South Africa had three [95% confidence interval (CI): 2.81–3.10] NCD risk factors or unhealthy behaviours. The findings confirm the idea that unhealthy lifestyle behaviours do not happen in isolation but rather co-exist. The co-existence of unhealthy behaviours may have synergistic effects on disease risk (20).

The suffering of multiple co-existing risk factors puts elderly South Africans at an increased risk of NCDs. This may result in straining an already overburdened healthcare system. Therefore, there is a need for comprehensive and coordinated interventions within the healthcare system targeting multiple NCD risk factors that elderly South Africans face. Considering that all the NCD risk factors investigated in this study are modifiable, it signifies the urgent need for health promotion initiatives targeted at the elderly to reduce the risk for NCDs.

The study showed variations in co-existence of NCD risk factors by gender, age, and race. Women, older

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Table 2. Prevalence of behavioural and biological risk factors

	NCD risk factors: *N* (%)					
Sociodemographics	Daily tobacco use	Risky alcohol use	Insufficient fruits and vegetables	Inadequate physical activity	Overweight or obese	Hypertension
All	810 (19.7)	158 (3.7)	2,833 (68.5)	2,455 (60.5)	2,505 (68.2)	2,842 (75.3)
Gender						
Men	406 (22.7)	114 (5.9)	1,077 (62.7)	983 (57.2)	970 (63.6)	1,159 (74.4)
Women	404 (17.4)	44 (2.0)	1,534 (70.0)	1,472 (63.1)	1,535 (71.9)	1,683 (79.6)
Age						
Age 50–59	375 (20.9)	76 (4.2)	1,130 (67.7)	952 (53.2)	1,118 (68.3)	1,202 (74.9)
Age 60–69	259 (18.6)	45 (3.7)	855 (66.4)	837 (65.4)	818 (71.2)	954 (80.6)
Age 70 and above	176 (18.5)	37 (2.5)	626 (65.1)	666 (71.2)	569 (63.3)	686 (78.4)
Race						
African Black	378 (17.2)	91 (4.0)	1,478 (71.0)	1,207 (57.7)	1,338 (67.3)	1,550 (77.3)
White	58 (21.1)	7 (4.5)	144 (46.1)	169 (55.7)	190 (75.9)	193 (79.6)
Coloured	205 (33.9)	33 (4.5)	502 (73.0)	518 (76.9)	430 (71.2)	545 (85.0)
Asian or Indian	56 (18.7)	9 (1.8)	166 (52.9)	182 (52.3)	203 (67.5)	214 (76.8)
Wealth status						
Low wealth	360 (20.3)	71 (4.2)	1,074 (72.4)	931 (59.8)	817 (59.0)	1,075 (75.4)
Medium wealth	155 (22.5)	30 (4.5)	527 (68.5)	463 (58.1)	505 (72.1)	574 (78.3)
High wealth	289 (17.9)	57 (3.0)	993 (60.4)	931 (62.3)	1,170 (75.6)	1,176 (78.6)
Educational level						
No schooling	196 (21.0)	32 (2.9)	706 (71.3)	511 (59.7)	475 (67.0)	653 (76.4)
Less than 7 years	179 (21.5)	43 (4.5)	607 (69.0)	518 (59.5)	519 (70.8)	631 (78.9)
8–11 years	166 (21.7)	38 (5.3)	567 (68.6)	522 (64.4)	532 (73.3)	596 (79.2)
12 or more years	154 (17.5)	27 (3.1)	524 (60.1)	510 (59.6)	619 (81.9)	598 (75.8)
Marital status						
Single	110 (16.2)	25 (2.7)	401 (73.0)	324 (60.9)	327 (70.3)	389 (80.1)
Married or cohabiting	421 (21.3)	95 (4.4)	1,432 (64.5)	1,226 (58.2)	1,290 (71.6)	1,441 (74.2)
Separated or divorced	71 (30.2)	12 (7.3)	164 (70.7)	139 (61.8)	147 (72.8)	176 (77.7)
Widow	200 (19.1)	22 (1.7)	770 (70.9)	725 (65.4)	689 (75.2)	787 (82.9)
Geolocality						
Rural	285 (21.7)	47 (3.1)	1,036 (74.2)	780 (58.1)	748 (64.8)	916 (77.5)
Urban	523 (19.7)	111 (4.1)	1,778 (64.2)	1,673 (61.8)	1,754 (76.5)	1,923 (77.2)

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adults, Coloured, and Indian elderly individuals reported to have multiple NCD risk factors. Other studies also found that women had on average more NCD risk factors compared to their male counterparts (6). This calls for gender-specific interventions in addressing the risk factors for NCDs. This is in particular reference to risk factors such as physical inactivity and obesity which have been reported to be more prevalent among women than men (21, 22). Obesity among Black South African women is associated with vitality, attractiveness, physical well-being, happiness, respect, dignity, affluence, and a husband's ability to look after his wife (23–32). As in other low- and middle-income countries, contextual factors such as the absence of physical activity education, lack of safety in the neighbourhood, lack of conducive infrastructure, lower educational status, and lack of access to facilities prevent people from engaging in physical activity (26, 33). These factors must be taken into consideration when designing healthy lifestyle programmes to ensure their effectiveness. Previous studies have also reported higher numbers of NCD risk factors amongst older people (6, 34). Contextual factors, such as poverty, violence, rapid social and economic changes, lack of education, inadequate services, globalization, and urbanization, contribute to chronic NCDs in South Africa (25, 26). For example, racial differentials in the prevalence of NCD risk factors have been reported in South Africa (35). Programme developers and policy makers should address these health disparities, especially given the fact that Section 27 of the South African

Table 3. Multiple risk factors classified by sociodemographics

Sociodemographics	Number of risk factors: *N* (%)					Weighted mean number of NCD risk factors (95% CI)
	0	1	2	3	4 or more	
All	19 (0.5)	246 (7.3)	909 (23.2)	1,343 (38.7)	1,323 (30.2)	3.01 (2.87–3.15)
Gender						
Men	10 (0.7)	142 (10.5)	408 (22.9)	437 (37.9)	523 (28.0)	3.03 (2.90–3.17)
Women	9 (0.4)	104 (4.7)	501 (23.5)	788 (39.4)	800 (32.0)	3.03 (2.90–3.17)
Age						
Age 50–59	11 (0.7)	138 (8.8)	437 (25.0)	585 (37.8)	524 (27.8)	2.89 (2.69–3.08)
Age 60–69	4 (0.4)	63 (5.4)	265 (20.0)	446 (41.6)	455 (32.5)	3.05 (2.93–3.18)
Age 70 and above	4 (0.3)	45 (6.4)	207 (23.8)	312 (36.7)	344 (32.8)	2.99 (2.81–3.17)
Race						
African Black	11 (0.5)	133 (7.1)	483 (23.0)	752 (40.0)	674 (29.4)	2.94 (2.84–3.05)
White	1 (0.9)	27 (10.8)	73 (26.7)	85 (33.6)	83 (28.0)	2.83 (2.48–3.17)
Coloured	0 (0.0)	20 (4.7)	93 (15.4)	200 (24.9)	342 (55.0)	3.45 (3.21–3.69)
Asian or Indian	1 (0.3)	25 (9.2)	95 (35.6)	119 (36.3)	67 (18.6)	2.69 (2.52–2.87)
Wealth status						
Low wealth	7 (0.4)	86 (7.1)	364 (23.1)	548 (42.9)	477 (26.6)	2.91 (2.78–3.04)
Medium wealth	1 (0.1)	50 (7.5)	149 (22.6)	252 (36.4)	279 (33.5)	3.04 (2.81–3.26)
High wealth	11 (0.9)	110 (7.5)	393 (23.7)	536 (35.9)	558 (32.1)	2.97 (2.75–3.18)
Educational level						
No schooling	3 (0.3)	45 (5.5)	204 (23.9)	318 (40.5)	284 (29.7)	2.84 (2.67–3.01)
Less than 7 years	1 (0.2)	45 (7.8)	173 (20.9)	277 (37.2)	307 (33.8)	3.01 (2.85–3.17)
8–11 years	3 (0.4)	51 (7.0)	157 (19.6)	272 (39.2)	296 (33.8)	3.04 (2.84–3.23)
12 or more years	7 (1.0)	62 (7.9)	202 (25.6)	282 (34.7)	270 (30.9)	2.87 (2.55–3.18)
Marital status						
Single	2 (0.2)	32 (7.5)	113 (23.8)	173 (39.0)	192 (29.5)	2.91 (2.78–3.04)
Married or cohabiting	12 (0.7)	159 (9.1)	513 (24.1)	682 (38.0)	641 (28.1)	3.04 (2.81–3.26)
Separated or divorced	0 (0.0)	15 (6.8)	52 (22.3)	78 (33.6)	85 (37.4)	2.97 (2.75–3.18)
Widow	4 (0.5)	37 (3.4)	210 (20.9)	386 (41.4)	383 (33.8)	3.09 (2.98–3.20)
Geolocality						
Rural	6 (0.3)	76 (6.4)	313 (22.4)	460 (43.9)	421 (26.9)	2.94 (2.77–3.10)
Urban	13 (0.6)	170 (7.7)	596 (23.7)	883 (36.0)	899 (32.0)	2.97 (2.77–3.16)

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Constitution clearly spells out the right to health services for all citizens irrespective of race, colour, and creed. The findings of this study call for the provision of prevention, early detection, and cost-effective management of non-communicable diseases, which remains inadequate.

This study and its follow-up surveys provide a firm basis on which to monitor and evaluate health risk patterns among the elderly population in South Africa. The timing of these studies is opportune as it will inform the NHI system that South Africa is currently piloting in its quest to reduce health disparities. Monitoring health risk factors is the first step in responding to the need to reduce the burden of chronic diseases (25). However, the results of this study must be interpreted with caution as there are several limitations. First, the self-report of health variables such as tobacco or alcohol use should be interpreted with caution. It is possible that self-reports of unhealthy behaviours may be subject to social desirability biases; thus, the findings may be underestimated.

Self-reported assessments of physical activity remain the most feasible and affordable instruments for global surveillance. However, objective population measures of physical activity, such as pedometers or accelerometers (18), may be beneficial to determine whether differences between groups revealed in this study represent true differences in physical activity behaviour.

Second, this study was based on data collected in a cross-sectional survey. We cannot, therefore, ascribe causality of unhealthy behaviours to any of the associated factors in the study. Planned longitudinal studies following a cohort of the elderly will show trends and patterns of unhealthy behaviours over time. Finally, data were collected from older adults who were available in the

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Table 4. The association between multiple risk factors and sociodemographic factors

	Unadjusted		Adjusted[1]	
Sociodemographics	β	Standard error (SE)	β	SE
Gender				
Female	Reference		Reference	
Male	−0.17***	0.05	−0.12*	0.06
Age				
50–59	Reference		Reference	
60–69	0.17*	0.07	0.26**	0.09
70 and above	0.10	0.07	0.14	0.10
Race				
African Black	Reference		Reference	
White	−0.12	0.16	−0.12	0.13
Coloured	0.51***	0.13	0.47**	0.14
Indian or Asian	−0.25*	0.10	−0.34**	0.11
Marital status				
Single	Reference			
Married or cohabiting	−0.06	0.10	–	
Separated or divorced	0.25	0.24		
Widow	0.15	0.13		
Educational level			–	
No schooling	Reference			
Less than 7 years	0.17	0.10		
8–11 years	0.20	.09		
12 or more years	0.03	0.12		
Wealth status				
Low	Reference			
Medium	0.13	0.09	–	
High	0.06	0.12		
Geolocality				
Rural	Reference			
Urban	0.03	0.12	–	

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*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.
[1]$R^2 = 0.05$; –, not available.

household on the day of the survey. Respondents who were institutionalized (e.g. in a prison, hospital, or care home) and not returned to the household within 7 days and those who had moved more than 50 km away from the study household were not included.

Conclusions

The study confirms the view that unhealthy lifestyle behaviours should not be considered in isolation from one another as they may co-exist and may also have synergistic effects on disease risk.

Thus, comprehensive health-promotion interventions not only should be tailored for specific demographic groups but also should focus on addressing multiple chronic NCD risk factors.

Conflict of interest and funding

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