Prevalence of and risk factors for falls in older people in an urban community in South Africa

Sebastiana Zimba Kalula

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Prevalence of and risk factors for falls in older people in an urban community in South Africa

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Declaration

I, the undersigned, hereby declare that the work contained in this thesis is my own work, except where due acknowledgement is made with full references in the text and the thesis has not previously been submitted to any university or institution of higher learning for any qualification or certificate.

_________________________ _______________

Sebastiana Zimba Kalula Date

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Abstract

Prevalence of and risk factors for falls in older people in an urban community in South Africa

Sebastiana Zimba Kalula

February 2012

Background. Falls are a major cause of disability and mortality in older people. Little is known of the extent and gravity of the problem in South Africa.

Methods. A cross-sectional study with a 12-months follow-up was conducted on 837 randomly sampled, ambulant community-dwelling subjects aged ≥ 65 years to determine the prevalence and incidence of, and risk factors for falls. Data were collected on socio-demographic characteristics, self-reported health status, comorbid disease, medications, functioning, physical performance (lower limb power, balance and gait, hand grip strength), and mental function (memory, concentration, depression).

Prevalence rate of falls was calculated with a 95 per cent confidence interval. Odds ratios and confidence intervals were used to measure effect for predictors of falls at 0.05 level of significance.

Results. Prevalence rates of 26.4 per cent and 21.9 per cent for falls and of 11 per cent and 6.3 per cent for recurrent falls, were established at baseline and follow-up, respectively. Rates differed for ethnic groups: at baseline; whites 42.9 per cent, coloureds 34.4 per cent and black Africans 6.4 per cent (p=0.0005). The incidence rate was 236, 405.7 and 367 per 1000 person years for men, women and both genders, respectively

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Independent risk factors for falls were self-reported conditions (poor mobility, poor vision, poor urine control, depression, Parkinson's disease, foot disorders), self-rated health status, use of antidepressants and anti-inflammatory drugs and the Geriatric Depression Scale score. Ethnicity had the strongest association with fall risk at baseline in whites (OR 14.94; 95% CI 7.46–29.92 for a fall and OR 21.25; 95% CI 5.54–81.51 for recurrent falls) and coloureds (OR 7.93; 95% CI 4.29–14.65 for a fall and OR 13.33; 95% CI 3.66 – 48.62 for recurrent falls); at follow-up, history of previous falls had the strongest association (OR 2.16; 95% CI 1.40–3.33 for a fall and OR 10.53; 95% CI 4.17–26.56 for recurrent falls). Age, gender, IADLs and timed Up & Go test were independent predictors of a fall on exclusion of history of a previous fall from the model.

Conclusion. Effective management of falls and falls prevention intervention for older persons are indicated and recommended.

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Summary

Background

Falls are a major cause of disability and mortality in older people, and often result from intrinsic and extrinsic factors that are modifiable or reversible. Studies on falls in older persons have mainly been conducted in developed countries, with scant attention given to the problem in developing countries. The studies have established that falls are common in older persons: between 24 and 60 per cent are at risk of falling at least once a year, and about 30 per cent will suffer serious injury. Even in the absence of injury, a fall has a negative psychological impact on an older person. The incidence and prevalence of falls, and complications arising from a fall increase steadily with advancing age. Management costs of fatal and non-fatal falls, and the direct and indirect costs to society, families and individuals are high. Despite potentially serious consequences of falls for older people, very little is known of the extent and gravity of the problem in South Africa, and neither is there any co-ordinated response to the problem in place.

Aims

The overall aim of the study was to estimate the prevalence of falls and to identify risk factors associated with falls in a sample of urban, community based persons aged ≥ 65 years, as well as to identify modifiable risk factors to inform the design of falls prevention intervention.

Methods

Study design

The study design comprised a cross-sectional descriptive/analytic survey and a longitudinal 12-month follow-up survey. Data were collected with the use of specially structured questionnaires, including instrumentation for physical assessments and measurements. The questionnaires were translated into isiXhoza, back translated and piloted. A pilot study was conducted to calculate the sample size for the study. A

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chair validation study was conducted to validate a portable chair for use in subjects' dwellings to assess physical performance.

Subjects

The subjects were randomly sampled, ethnically diverse, community-dwelling older persons aged ≥ 65 years: n=837 at baseline and n=632 at follow-up, with an attrition rate of 24.5%. All subjects were able to walk independently with or without a walking aid, and to give informed consent.

Study setting

The study was conducted in three randomly selected suburbs in the Cape Town Metropolitan Area in the Western Cape Province: Gugulethu, Plumstead and Wynberg.

Analysis

The prevalence of falls was calculated with a 95 per cent confidence interval. A relationship between falls, and (potential) predictors of falls was determined through logistic regression analysis. Parametric and non-parametric tests were used for analyses of continuous variables. Odds ratios and confidence intervals were used as a measure of effect of association. A risk model for any fall and multiple falls (≥ 2 falls) in a 12-month period between baseline and follow-up was obtained through logistic regression analyses (stepwise selection, $P < 0.05$). Multinomial logistic regression analysis was used to compare "fallers", "non-fallers" and subjects lost to follow-up.

Results

The distribution of study subjects at baseline was Gugulethu: 283; Plumstead: 188; and Wynberg: 366. Women constituted 76.5 per cent of the baseline sample and 77.2 per cent of the follow-up sample. There were no meaningful differences in the

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characteristics of the subjects in the two survey samples; the mean age was 74 years (±6.4) and 75 years (±6.2).

Prevalence rates of falls of 26.4 per cent and 21.9 per cent and of recurrent falls of 11 per cent and 6.3 per cent were established at baseline and follow-up, respectively. Prevalence rates differed for ethnic groups: at baseline, a prevalence of 42.9 per cent in white subjects; 34.4 per cent in coloureds; and 6.4 per cent in black Africans (p=0.0005). The overall incidence rate was 367/1000 person years. The incidence rate for men and women was 236.1/1000 and 405.7/1000 person years, respectively (p=0.002). Recurrent falls were common in women.

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Independent risk factors for falls were mainly self-reported conditions (poor mobility, poor vision, poor urine control, depression, Parkinson's disease, foot disorders), self-rated health status, and use of medications (antidepressants and anti-inflammatory drugs). Ethnicity at baseline and history of a previous fall at follow-up were independent risk factor for falls across all models. Ethnicity had the strongest association with fall risk in whites (OR 14.94; 95% CI 7.46 – 29.92 for a fall and OR 21.25; 95% CI 5.54 – 81.51 for recurrent falls) and in coloureds (OR 7.93; 95% CI 4.29 – 14.65 for a fall and OR 13.33; 95% CI 3.66 – 48.62 for recurrent falls), when compared to black Africans. History of previous falls (OR 2.16; 95% CI 1.40–3.33 for a fall and OR 10.53; 95% CI 4.17–26.56 for recurrent falls) had the strongest association with falls at follow-up. Of the assessments and measurements, only the Geriatric Depression Scale score was an independent predictor of falls and baseline hand grip strength. Age, gender and IADLs were independent predictors of a fall on exclusion of history of a previous fall from the model. The timed Up & Go test was a significant predictor of a fall on exclusion of history of a previous fall and ethnicity from the model.

The most prominent consequence of a fall in the study population was injuries, largely soft tissue injuries. Reported fractures included fractures of the hip. Other

consequences were fear of falling again, not having fully recovered from the effects of the fall, and having to alter or forego certain activities previously engaged in.

Interpretation

The overall prevalence and incidence rates of falls established in the study are higher than rates reported in Asian countries, but lower than those reported in Western countries. Risk factors for falls were identified as mainly self-reported medical conditions and treatments, linked to chronic non-communicable diseases, which are preventable and/or modifiable. A finding of marked differences in the prevalence of falls in the different ethnic groups was unexpected, and may be partially explained by differences in life-style and socio-economic status. An understanding of factors contributing to differences in prevalence in different ethnic groups through future investigation will enhance an understanding of causality and risk factors, as well as procedures to prevent falls in older people.

Conclusions

Falls are common in the older population, and impact individuals' function and quality of life. However, falls are not inevitable in ageing, and some risk factors for falls are modifiable or reversible. The study found that risk factors for falls are largely intrinsic, but that certain environmental factors, or hazardous obstacles in under resourced environments may "trigger" falls. Variation found in the prevalence rates of falls across different ethnic groups raises questions for future inquiry. Falls prevention intervention and improved clinical management of falls are indicated and recommended.

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Chapter 1

Background and motivation for the study

1.1 Introduction

Population ageing is most advanced in developed regions, but the pace of the demographic shift is more rapid in the developing world (United Nations Department of Economic and Social Affairs, Population Division, 2009). An escalation in the number of older persons in developing countries, who will not only live longer than previous cohorts, but will experience morbidity and/or disability over a longer duration, will expose a greater number of individuals in these regions to the risk of a fall. Of a projected 6.26 million hip fractures globally in 2050, 4.43 million (71%) are expected to occur in developing regions, which includes Africa (Melton, 1993)

For the purpose of this thesis, an “older person” is defined as an individual aged 65 years or over. The terms ”developing country” and ”developed country” are used in the thesis in accordance with the United Nations General Assembly’s categorisation of developing countries as being those within the regions of Africa, Latin America and the Caribbean, Asia – excluding Japan, and Oceania – excluding Australia and New Zealand (United Nations Department of Economic and Social Affairs, Statistics Division, 2011).

The majority of developing countries have limited resources, and are challenged by multiple health care needs and a high disease burden, mainly of a developmental nature, e.g. due to HIV/AIDS, tuberculosis and malaria, and reproductive and child health disorders (UNAIDS, 2009). These diseases, particularly in sub-Saharan Africa (SSA), constitute priorities for health care, and health conditions associated with ageing, such as an increased risk of falls, are not prioritised in government spending or research on health and health care.

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A fall in an older person has the potential to impact not only the individual negatively, but also his/her family members and carers, and to affect the community and society in general. Despite potentially serious consequences of falls for older people, very little is known of the extent and gravity of the problem in South Africa, and neither is any co-ordinated response to the problem in place. This thesis will 1) examine the prevalence of and associated risk factors for falls in an older, community-dwelling urban population in South Africa, in order to 2) yield empirical evidence to inform policy and practice, and intervention to prevent falls.

This chapter examines the prevalence and incidence of falls in, and the consequences of falls for older people broadly, as well as risk factors associated with falls in this population as identified in the literature. Falls prevention measures are then considered, drawing mainly on outcomes of studies conducted in urban community dwelling older populations in developed countries; few studies have been conducted in this area in developing countries. The aims and objectives, and relevance of the present study, and the organisation of the chapters in this thesis are outlined thereafter.

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1.2 Prevalence and incidence, and consequences of falls

A fall is defined in this thesis as an episode in which a person unintentionally comes to rest on the ground, floor or other lower level with or without injury. The definition includes falls which result from a contributing factor/s, such as the individual being pushed or falling due to syncope (Hauer and others, 2006; Zecevic and others, 2006).

Although falls occur, and are a cause of morbidity and mortality in all age groups, they occur most commonly in children under the age of five and in persons aged 65

years and over (Fuller, 2000; Runge, 1993). Older persons are particularly vulnerable to the consequences of a fall, such as injury, particularly osteoporotic related fractures, as well as fatality, and the psychological impact of the fall even in the absence of injury (Tinetti, Liu & Claus, 1993). The incidence and prevalence, and the severity of complications following a fall increase steadily after the age of 60 (Campbell, Borrie & Spears, 1989; Lord and others, 1993). In developed countries, unintentional injuries have been listed as the fifth cause of death in older persons, after cardiovascular disease, cancer, stroke and pulmonary disorders (American Geriatric Society/ British Geriatric Society, 2001).

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Retrospective and prospective studies conducted in community dwelling older populations in developed countries have reported fall rates of at least one fall a year in 30 to 60 per cent of non-institutionalised persons age 65 years and over (Berg and others, 1997; Campbell and others, 1990; Dolinis, Harrison & Andrews, 1997; Gill, Taylor & Pengelly, 2005; Lord & Ward, 1994; Luukinen and others, 1994; Tinetti, Speechley & Ginter, 1988). A fall incidence rate of 30–40 per 100 persons aged 65 and over has been reported, increasing to 50 per 100 in the age group 80 years and over (Campbell, Borrie & Spears, 1989; Nevitt and others, 1989; Tinetti, Speechley & Ginter, 1988; Tromp and others, 1998). Higher rates have been reported in women than in men (Blake and others, 1988; Cesari and others, 2002; Chan and others, 1997; Sayer and others, 2006). Surveys in nursing homes have reported an average incidence rate of 43 per cent (range 16 to 75 %) per year (Graafmans and others, 1996; Jensen and others, 2002; Rubenstein & Josephson, 2002). Differences in incidence rates may be partially accounted for by institutionalised older individuals' frailty and reporting based on recall in community populations. Studies in nursing homes have tended to use more accurate reporting systems. Reported incidence rates have also varied due to differences in case-mix (Rubenstein & Josephson, 2002). Forty to fifty per cent of older persons who fall have been found to have recurrent falls (Nevitt and others, 1989; Vellas and others, 1998). Falls are a risk factor for institutionalisation; indeed, rates of institutionalisation in long-term care

have been found to be 2-5 times greater after a single fall compared to individuals who have not fallen, and 2-14 times greater in those with ≥ 2 falls (Tinetti & Williams, 1997).

Incidence rates of falls reported for non-Caucasian populations are approximately half of those for Caucasian populations in Canada, America, Australia, United Kingdom and Europe. A mean fall rate of 18 per cent has been reported in Chinese, native Japanese and Japanese-American older populations (Aoyagi and others, 1998; Chu, Chi & Chiu, 2005; Davis and others, 1997; Yasumura and others, 1994; Yu and others, 2009). Prevalence rates reported in single studies in Africa are as follows: In Nigeria, Bekibele and Gureje (2010) reported a prevalence rate of 23 per cent in a cross-sectional study. In Umutara Province, Rwanda, Ntagungira (2005) reported a recurrent fall rate of 23.3 per cent for a sample of older persons with a history of falls.

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Seven to 14 per cent of older persons who fall suffer serious injury such as hip and/or other fractures, subdural haematoma and head injury (Chu, Chi & Chiu 2005, Tinetti et al. 1995, Tinetti 2003). Fractures, particularly of the hip, are a major cause of morbidity and mortality in older people globally. Studies indicate a mortality rate of 15 to 35 per cent (Keene, Parker & Pryor, 1993; Magaziner and others, 1989; Roche and others, 2005) in the first year following a fracture. Mortality following a fall is particularly high in people age 75 years and over (Donald & Bulpitt, 1999; Gribbin and others, 2009). Up to 35 per cent of survivors of a fall will be disabled or unable to walk (Lips & van Schoor, 2005). Diseases such as osteoporosis and age related physiological changes such as slowed protective reflexes increase a propensity to incur fall related injuries (Rubenstein & Josephson, 2002). Falls have been shown to account for 10 per cent of emergency hospital visits and six per cent of hospital admissions (Tinetti, 2003). Falls that do not result in serious injury may still have serious psychological consequences for an older person, who may fear falling again, which leads to dependence and self-protective immobility.

A fall that results in injury is costly: not only in terms of its impact on an individual's functional independence, or death, but also on health service utilisation costs (King & Tinetti, 1995; Stevens and others, 2006). Treatment of fractures and other injuries is expensive moreover: estimated costs are £1 billion/year in the United Kingdom, 402 million/year in Ireland and $18 billion/year in the USA (Gannon, O'Shea & Hudson, 2007; Scuffham, Chaplin & Legood, 2003; Steffen, Hacker & Mollinger, 2002; Stevens and others, 2006). Direct costs (hospitalisation, office based visits and home health care) from fall related medical conditions in older persons in the United States cost 6 to 8 billion dollars per year in 2002 (Carroll and others, 2005).

1.3 Risk factors for falls

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Falls typically result from the interaction of multiple and diverse, and sometimes correctable, risk factors and situations (Rubenstein & Josephson, 2002; Rubenstein, 2006). The factors and situations may vary from one community to another (Vellas and others, 1998). Falls are often a marker of underlying, preventable problems relating to health and other intrinsic or biological factors, the environment, behaviour and socio-economic factors. A risk of falling increases with an increase in the number of risk factors for an individual. A risk of recurrent falls in a 12-month period in a community dwelling older sample has been shown to increase from 10 to 69 per cent, as the number of risk factors increases from one to four or more (Nevitt and others, 1989; Tinetti, Speechley & Ginter, 1988; Tinetti & Williams, 1998).

Over 400 potential risk factors have been implicated as causative factors for falls (NHS Centre for Reviews and Dissemination, University of York, 1996). Investigators have studied various combinations of these factors, collected by various methods including self-reports, reviews of records, physical assessment and performance measurement. The large number of risk factors identified reflects complexity in the causation of falls. Studies on risk factors for falls to date have mainly been conducted in developed countries. In a review article that summarised data of 12

large studies (six community based, six institution based) in developed countries in which causes of falls in older persons were carefully evaluated, Rubenstein & Josephson (2002) listed major causes of falls as accident and environment related, gait and balance disorder – or weakness, dizziness and vertigo, drop attacks, confusion, postural hypotension, visual disorder, syncope and other chronic medical conditions. In addition, the authors summarised findings of 16 studies that examined the interaction of multiple risk factors for falls. Significant risk factors in both univariate and multivariate analyses were muscle weakness, history of falls, gait deficit, balance deficit, use of an assistive device, visual deficit, arthritis, impaired activities of daily living, depression, cognitive impairment and age (> 80 years) (Rubenstein & Josephson, 2002).

1.4 Intervention to prevent or reduce falls

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Assessment of an older person at risk of a fall, and identification of risk factors that may contribute to a fall and circumstances surrounding a fall are important in the planning and implementation of intervention programmes. Various methods to prevent falls in older persons have been devised and tested by practitioners and researchers in different environments such as community settings, nursing homes (long-term care facilities) and hospital emergency departments. A Cochrane review (2009) described these methods as including: 1) Single factor intervention (consisting of a major intervention category for all participants – such as a multi-component exercise, a specific exercise regimen such as Tai Chi, or the withdrawal of offending medications); 2) multiple intervention (consisting of a combination of two or more categories of intervention delivered to all participants); and 3) multi-factorial intervention (consisting of more than one main intervention category, with participants receiving different combinations of intervention, and involving a multi-professional team, based on findings of an individual assessment and need). The 2009 Cochrane review included 111 randomised trials (55,303 participants) of interventions for preventing falls in older people living in the community. Primary

outcomes for the review were rate of falls and number of fallers. The review concluded that 1) exercise based intervention reduces risk and rate of falls; 2) assessment and individualised multi-factorial intervention is effective in reducing the rate of falls, but further research is required to explore the effectiveness of different approaches in the provision of these interventions; and 3) the effectiveness of home safety intervention, and vitamin D supplementation in high risk groups and other interventions requires further research to confirm the contexts in which they are effective (Gillespie and others, 2009).

1.5 Falls prevention in South Africa

No falls prevention and education programmes are implemented in South Africa. In developing countries, which includes South Africa, it may be speculated that environmental factors may be a greater contributor to intrinsic causes of falls, because of poor infrastructure in several areas: in particular, poorly maintained external environments, roads and public buildings; poor street lighting; overcrowding and hazards in small dwellings in urban informal settlements; and outdoor hazards where older people access amenities. Findings in this regard in developing countries were highlighted in a focus group discussion with older people in Jamaica. Environmental factors perceived by participants to put them at increased risk of a fall were open street gutters, living on a farm, no seating on buses, slippery banana-bark mats, bumping into other people (e.g. on sidewalks), sidewalks cluttered with vendors' wares, violent attacks by robbers and tree stumps left in the road (James, 2007). Environmental hazards which may precipitate a fall, such as the foregoing, are indeed seldom identified in literature emanating from developed countries.

Although no study has established the incidence and prevalence rates of falls in older persons in South Africa, single studies within an ongoing research programme on the burden of trauma have focused fairly narrowly on intentional and unintentional falls related injuries. The National Injury Mortality Surveillance System in South

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Africa has reported that deaths due to falls occur commonly in people age 65 years and over, and have accounted for 68 per cent of total deaths secondary to a fall. Alcohol intoxication was found to play a role in 32.1 per cent of these fall related deaths. However, the circumstances surrounding the falls were not reported (Marais, Sukhai & Donson, 2004).

In a hospital based study in Johannesburg, South Africa, Solomon (1968) established an incidence rate for hip fractures of 12 per 100 000 per annum in black African patients and 100 per 100 000 per annum in Caucasian patients (Solomon, 1968) (reported in Schnaid, MacPhail & Sweet, 2000). The incidence of hip fractures following a fall has been reported to be lower in black Africans than whites, and various theories pertain in this regard: 1) Black Africans engage in a high level of physical activity across the life course due to the nature of their livelihoods and poverty (they walk long distances, engage in agriculture, and collect firewood and fetch water), which may confer a protective effect on them; 2) black Africans have a shorter hip axis length – an anatomical feature of the hip that has been associated with lower risk of hip fracture in some studies (Dibba and others, 1999); and 3) black Africans have lower life expectancy, and therefore reduced longevity and decreased risk of a fall (Marmot, 2005).

Establishment of risk factors for falls in older people in a South African population could indeed serve to inform the development of protocols and/or intervention programmes through an identification of individuals at risk of a fall, towards setting specific targets for fall prevention activities.

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1.6 Objectives of the study

The overall aim of the study was to estimate the prevalence of falls and to identify risk factors associated with falls in a sample of urban, community based persons aged ≥ 65 years, as well as to identify modifiable risk factors to inform the design of a falls prevention programme.

Specific study objectives were set as follows:

- To determine the prevalence of falls in an urban, community-dwelling older population.
- To determine the consequences of a fall in this population.
- To identify modifiable and non-modifiable risk factors for falls in the population
- To compare risk factors associated with falls in the study sample with those identified in studies conducted in developed and other developing countries.
- To provide evidence to inform the design of appropriate and locally relevant falls prevention programmes for implementation in the older population.

1.7 Delimitation of the study

The study area was delimited to suburbs constituting a catchment area for Groote Schuur Hospital in the Cape Town Municipality of the Western Cape Province. The study sample population was delimited to community dwelling older persons; no institutionalised individuals were sampled. The study focused on establishment of a prevalence rate and identification of risk factors. Although bone health and frailty play a part in a propensity to fall and injuries sustained, these potential contributing factors to a fall are viewed as topics for independent investigation and are not examined as such in the study. Where appropriate, they are referred to nevertheless. Although fall risk screening tools designed for use in specific settings, e.g. in the community, in hospital emergency departments and in long-term care facilities, to

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identify individuals at risk of falls who would benefit from intervention, the merits of different fall assessment tools are neither a focus of the study.

1.8 Relevance of the study

In 2011, South Africa's population aged 65 and over numbered approximately 2.5 million, and represented more than 5 per cent of the total population. By 2050, the older population is projected to more than double, reaching 5.7 million, and to represent 10 per cent of the total population (United Nations Department of Economic and Social Affairs, Population Division 2011). South Africa has a multi-ethnic population. The ethnic distribution of the older population is black Africans 63.3 per cent, whites 25.2 per cent, people of mixed ancestry (coloureds) 8.0 per cent, and Indians/Asians 3.5 per cent (Statistics South Africa 2011). The expanding older population will lead to an increase in age associated disorders including falls.

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The relevance of the study lies in the potential contribution it has to make, in terms of how it was conducted and its outcome can contribute to 1) knowledge on falls in older people in a developing country – in this case South Africa; 2) the development and employment of appropriate methodology for a study in this subject area in a developing country setting; and 3) the design and implementation of future intervention programmes to prevent or reduce falls in the older population.

1.8.1 Relevance to knowledge

The study will contribute to knowledge on falls in the older population of South Africa through the establishment of a prevalence rate for falls, and identification of specific risk factors for falls in historically or relatively disadvantaged urban community settings. Although substantial knowledge on falls in older people and associated risk factors exists in developed countries, only scant knowledge is available in this subject area in the developing world, particularly in the Africa region. The study will

thus aim to fill this gap in knowledge – not only in terms of the situation in South Africa, but contribute to knowledge for developing countries as a whole.

1.8.2 Relevance to methodology

The contribution of the study to methodology will lie in the research design that is devised, the selection of research methods that are employed and the instrumentation that is developed to collect the data – specifically within a developing country setting. Particular methodological challenges to the study, to be conducted in an older population in a largely deprived environment, will include low literacy in some study participants; a need to conduct interviews in multiple languages; and cultural diversity in the sample, possibly confounding subjects' understanding, for example, of a need to perform timed physical tests, (the five chair stands and the Timed Up and Go test) optimally; sub-optimal effort on the part of subjects will affect results. Other methodological challenges will include entry and legitimacy obstacles for interviewers working in the field; transportation of some of the instrumentation, such as the chair for performance assessments, by field workers using public transport; and communication with study participants where telecommunication is not available. Key methodological contributions of the study will therefore be how the challenges are overcome, and the development and employment of methodology appropriate for undertaking similar studies in environments with under developed infrastructure and limited resources.

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1.8.3 Relevance to individuals and society

The study outcomes will have the potential to enhance the well-being of older persons in the following ways: Scant information is available on falls in South Africa's older population and there is no organised response to the problem. The findings will provide evidence to inform the design and implementation in terms of health promotion and falls intervention programmes. An identification of risk factors

associated with falls in local settings in the study will similarly help to inform such intervention, and to enhance the education and participation of health professionals and the public in preventive strategies. The evidence will also help to motivate the health care system to institute protocols towards comprehensive management of older patients who present with fall related injuries, as opposed to current management procedures which focus on trauma resulting from a fall, and do not investigate or address causative factors for falls, or indeed for potential recurrent falls.

The study outcomes will contribute to society broadly in that prevention of and a reduction in falls, through appropriate, evidence based intervention, will reduce the direct and indirect care and cost burden of managing the falls, and resultant impairment or disability on the health system, community care agencies, informal carers and older individuals alike.

Overall, the study will contribute to filling a gap in knowledge, and yielding empirical evidence for policy makers and planners, service providers, government and other stakeholders with which to inform the development of appropriate responses to prevent and reduce falls, and to enhance the health and well-being of older people.

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1.9 Organisation of the thesis

The study is organised in six chapters, outlined briefly below:

Chapter 1 gives background to, and states the problem for investigation, the study objectives, a rationale for the study and the potential contribution of the study.

Chapter 2 provides a comprehensive review of epidemiological evidence of the prevalence and incidence of falls and risk factors for, and consequences of falls (e.g.

trauma, change in activities) in older persons in developed countries and developing countries. An aim of the chapter is to compare methodologies and outcomes of studies conducted in this subject area in developed countries and developing countries.

Chapter 3 describes the research design, the sampling strategy and selection criteria for the study sample, the instrumentation and the study procedure. Sample size calculations are provided for an evaluation of statistical power to answer the research questions. Statistical analysis of the data (in Chapter 4) and ethical considerations underpinning the study are discussed.

Chapter 4 gives the results of statistical analyses of the data.

Chapter 5 discusses and interprets the main findings of the study, and outlines causative factors of falls in the study population, as identified in analyses of the data, which can serve to inform the design of a falls intervention programme.

Chapter 6 sets forth conclusions of the investigation and makes recommendations for policy action, intervention and future research.

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Chapter 2

Review of the relevant literature

2.1 Introduction

In this chapter relevant literature on falls in older persons is reviewed. A broad differentiation is made, where indicated, between literature emanating from countries in the developed world and that from developing countries.

The literature is reviewed in terms of four main thrusts of studies conducted in this area: 1) The incidence and prevalence of falls; 2) risk factors for falls; 3) the consequences of falls – for individuals, society and economies; and 4) the prevention of falls through intervention programmes. Thereafter, the literature is evaluated critically, and conclusions are drawn regarding the body of knowledge in the area, gaps in knowledge, and how the present investigation may contribute to filling some of those gaps. In the context of the problem statement for this thesis, the review focuses on literature on falls in urban community dwelling older people.

The literature on falls in older people has proliferated in recent years, particularly in the last decade. In the 1980s a Medline search yielded fewer than 100 citations on the subject, whereas the current count is several thousands. Nonetheless, for the greater part the extant literature is based on studies conducted in developed countries, dating from around 1986. Studies on falls in older persons have only been conducted comparatively recently in developing regions, and then only in certain countries. Only a handful of studies in this area have been conducted in sub-Saharan African countries (SSA).

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A search of the relevant literature was conducted using the following databases: PubMed, Scopus, EBSCOhost (Medline, CINAHL, PsycInfo, Health source: Nursing/Academic edition, Academic Search Premier and Africa-wide information). The search only included articles published in English, between 1986 and July 2012. Key words used in various combinations for the search included: "elderly," "older person," "aged," "old age," "ageing," "geriatrics," "seniors," "falls," "accidental falls," "unintentional injuries," "fractures," "prevalence," "incidence," "risk factors and prevention," "developing country," and country names and regions of the developing world.

Due to the relative paucity of studies conducted on this topic in developing countries, the methodology used in a particular study was not an exclusion criterion for an article. A search of "grey" literature was conducted on the internet using Google and Google Scholar. A manual search was also conducted of referenced material in the WHO Global Report on *Falls Prevention in Older Age* (World Health Organization. Ageing & Life Course Unit, 2008), Cochrane reviews on fall prevention (Gillespie and others, 2001; Gillespie and others, 2009; Gillespie and others, 2003), and references in the systematic and other reviews. A summary of the search is presented in PRISMA diagrams (page 16 and Annexure 6)

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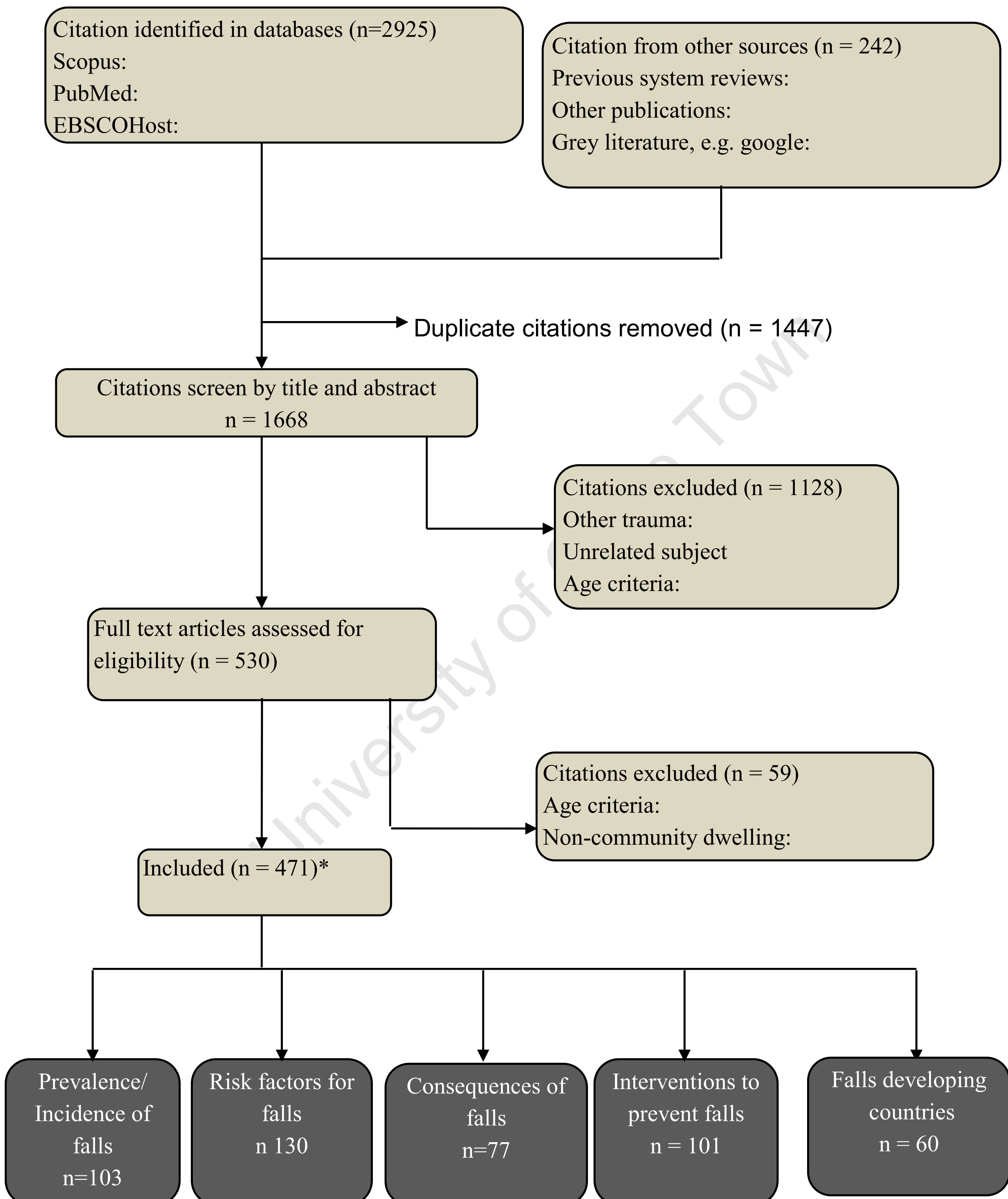
2.2 Incidence and prevalence of falls

The incidence and prevalence of falls in older persons has been investigated extensively, and have been a main focus of studies in the subject area since the 1980s and 1990s (e.g. Blake & Morfitt, 1986; Campbell and others, 1990; Morgan and others, 1985; Studenski and others, 1994; Tinetti, Speechley & Ginter, 1988). Prevalence studies have been conducted both prospectively and retrospectively. A seminal paper authored by Mary Tinetti in 1988 (Tinetti, Speechley & Ginter, 1988) constituted a reference point for numerous researchers and stimulated a research

Figure 2.1: Flow diagram of article search and selection, a summary of the literature review for the sub-titles*



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* Some articles cover a combination of the sub-titles topics. References on literature for methods are not included. See Annexure 6 for individual search results for the sub-titles.

focus on falls. Other studies on falls conducted during the same period (Blake and others, 1988; Campbell and others, 1990; Campbell and others, 1990; Nevitt and others, 1989) added emphasis of the gravity of the problem of falls in older people. In turn, greater recognition was given to falls in health planning and policy, and guidelines were subsequently developed for the management of falls – but primarily in developed countries (Feder and others, 2000; National Collaborating Centre for Nursing and Supportive Care (UK), 2004; American Geriatric Society/British Geriatric Society, 2001). South Africa is the only country in sub-Saharan Africa thus far to have developed fall prevention guidelines, but which largely draw on literature from developed countries (Department of Health 2000).

2.2.1 Prevalence rates in prospective and retrospective studies

Following on initial impetus given to studies in this area by Tinetti (1988), prospective community based studies were conducted in the US (Berg and others, 1997; Chan and others, 2007; Cumming, 1998; Hale, Delaney & McGaghie, 1992; Hanlon and others, 2002; Li and others, 2006; Sai and others, 2010; Studenski and others, 1994; Vellas and others, 1998; Volpato and others, 2005); in Canada (Maki, 1997; O'Loughlin and others, 1993); in the United Kingdom (Bath & Morgan, 1999; Clough-Gorr and others, 2008; Sayer and others, 2006); in Australia (Graafmans and others, 1996; Hill and others, 1999; Lord & Ward, 1994; Stalenhoef and others, 1997; Tiedemann and others, 2008a); in New Zealand (Campbell and others, 1990); in Finland (Luukinen and others, 1994); in Germany (Clough-Gorr and others, 2008); and in Switzerland (Clough-Gorr and others, 2008) – all which recorded prevalence rates of falls. The rates recorded range from 24 to 60 per cent. (See Table 2.I) The majority of studies such as these were conducted in the US; some targeted specific communities, such as a Japanese community in Hawaii (Davis and others, 1997).

Although the prevalence rate of falls is generally high, considerable variation may be noted in findings across studies, even within a country. Differences in fall rates may

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Table 2.1: Epidemiology of falls in prospective community-based studies: developed countries

Source	Country/City	Age in years	Sample Size	Fall per year n (%)	Annual fall incidence
Lord, 1994	Australia	≥ 65	414	134 (39.3%)	Total number of falls not provided
Hill, 1999	Australia	≥ 70	96 women	47 (49%)	Total number of falls not provided
Stalenhoef, 1997	Netherlands	≥ 70	311	95 (33%) 36 – week follow-up	Total number of falls not provided
Davis, 1997	USA Hawaii (Japanese)	≥ 70 (men) ≥ 60 (women)	1093 (657 women, 436 men)	107 (16.3%) women 38 (8.7%) men	275/1000 person years women 139/1000 person years men
Luukinen, 1994	Western Europe Finland (Rural)	≥ 70	979 833 (examine)	294 (30%) one fall	368/1000 person years men 611/1000 person years women
Campbell, 1990	New Zealand	≥ 70	761 (465 women, 296 men)	268 (35%)	707/1000 person years women 644/1000 person years men Total 683/1000 person years
Studenski, 1994	USA North Carolina	≥ 70	306	102 (33.3%)	1633/1000 person years
O'Loughlin, 1993	Canada Montreal	≥ 65	409	119 (29.1%) 11.5% multiple falls	497/1000 person years
Sai, 2010	USA Omaha City	65 – 85	137 (112 completed study)	70/112 (62.5%) 46(66%) female 24 (34%) male	men 710 /1000 person years women 590 /1000 person years
Tinetti, 1988	USA Yale	≥ 75	336	108 (32%)	809/1000 person years

Table 2.1 (continued)

Source	Country/City	Age in years	Sample Size	Fall per year n (%)	Annual fall incidence
Graafmans, 1996	Netherlands	≥ 70	354 Homes and apartments for elderly	126 (36%)	251 falls reported in 28 weeks 1318/1000 person years
Berg, 1997	USA Ohio	60 – 88	96 Volunteers	50 (52%)	948/1000 person years
Pluijm, 2006	Netherlands Amsterdam	≥ 65	1365	24.9% women24.4% men	
Vellas, 1998	USA New Mexico Albuquerque	≥ 60	482 Study recurrent falls	61% (53.7% men 65.7% women)	564/1000 person years
Hale, 1992	USA	≥ 65	102	37 (36%)	549/1000 person years
Cumming, 1998	USA San Francisco	≥ 60	304	179 (58.9%)	1553/1000 person years
Bath, 1999	UK Nottingham	≥ 65	n = 690 At risk, n = 444	117 (26.4%)	525/1000 person years
Nevitt, 1989	USA	≥ 60	325	184 (57%)	1508/1000 person years
Maki, 1994	Canada	≥ 62	96	59 (61.5%)	1250/1000 person years
Davis, 1997	USA Honolulu, Hawaii	≥ 70 men ≥ 60 women	1093	8.7 % men 16.3% women	Men 139/1000 person years Women 275/1000 person years
Tiedemann, 2008	Australia	74 – 98	362	179/362 (49%) 99/362 (27%) single fall 80/362 (22%) ≥ 2 falls	
Chan, 2007	USA	≥ 65	5995	1489/5867 (25.4%) Within the first year	

Table 2.1 (continued)

Source	Country/City	Age in years	Sample Size	Fall per year n (%)	Annual fall incidence
Clough-Gorr, 2008	UK, London; Germany, Hamburg; Switzerland, Solothurn	≥ 65 ≥ 60 ≥ 65	1644	395 falls / 1644 24% incident falls over 12 months	240 / 1000 person years
Li, 2006	USA	≥ 45 (47% age ≥ 65)	2193	512 (23%)	
Volpato, 2005	USA	≥ 65	878	64.9% (cumulative over 3) years) 22% per year	

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be explained partially by heterogeneity in the studies in terms of study design, sample size, settings and method of reporting outcome events. Equally, methods of recording outcomes are varied, and have ranged from study participants keeping weekly or quarterly diaries in which they record falls, to telephone call reminders to participants, to yearly reporting in face to face interviews. Age and other inclusion and exclusion criteria in the studies also vary: some studies recruited only participants with a previous history of falls (Nevitt and others, 1989) which increased the number of frail individuals in the study sample. The majority of the studies report a proportion of subjects who fell at least once during the study period, rather than the total number of falls, which is of value in a determination of the incidence rate, and is of greater health importance, since persons with recurrent falls are at high risk of injury (Cumming and others, 1991; Lipsitz and others, 1991). Although the majority of the studies had a one-year follow-up design, the follow-up period varied from six months (Graafmans and others, 1996; Studenski and others, 1994) to three or four years (Bath & Morgan, 1999; Hanlon and others, 2002; Tinetti, Speechley & Ginter, 1988).

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A number of retrospective cross-sectional studies conducted in developed countries reported slightly lower rates (for the main part, 35 per cent or less) of falls than in studies conducted prospectively (Blake and others, 1988; Dolinis, Harrison & Andrews, 1997; Gill, Taylor & Pengelly, 2005; Lord and others, 1993; Morris and others, 2004). (See Table 2.2) Retrospective studies may underestimate fall rates due to poor recall (Chu, Chi & Chiu, 2005; Cummings, Nevitt & Kidd, 1988). Cummings and others, (1988) tested the problem of poor recall in research in a study in which falls were recorded and confirmed by a nurse prospectively. At the end of a 12-month follow-up period, subjects were interviewed about the falls: 13 per cent did not recall having fallen and 28 per cent did not recall being injured from a fall. This finding was particularly notable in subjects who were older, or who had low scores on the Mini-Mental State Examination (MMSE) (Cummings, Nevitt & Kidd, 1988).

Table 2.2: Epidemiology of falls in retrospective community based studies: developed countries

Source	Country/City	Age in years	Sample size	Fall in previous year n (%)
Blake, 1988	United Kingdom Nottinghamshire	≥ 65	1042	356 (34.8)
Cesari, 2002	Italy Italian Silver Network Home Care Project	77.2 (mean age) Age range not defined	5570	35.9 (fall previous 3 months)
Aoyagi, 1998	Japan (Rural) Hawaii (Japanese Americans)	≥ 65 ≥ 65	1534 1054	233 (14.6) 154 (15.1)
Friedman, 2002	USA Salisbury, Maryland	65 – 84	2212	615 (27) falls at baseline
Yasumura, 1994	Japan Tokyo (urban)	65 – 84	807	142 (17.6)
Davis, 1997	USA Japanese, Hawaii	≥ 70 (men), ≥ 60 (women)	1093	38 (11) 112 (17)
Shumway-Cook, 2009	USA Medicare Current Beneficiary Survey	≥ 65	12 669	22.1% 10% recurrent falls
Sai, 2010	USA Independent living, community assisted living, and institutions	65 – 85	137	95 (69.3)
Morris, 2004	Australia	≥ 65	1000	282 (29%)
Lord, 1993	Australia Sydney	≥ 65	704	33.9%
Gill, 2005	Australia	≥ 65	2 619	798 (29.8%)
Graafmans, 1996	Netherlands	≥ 70	354 Homes and apartments for elderly	33%
Fletcher and Hirdes, 2002	Canada Ontario	≥ 65	2 304	27% Recurrent falls 10%
Sayer, 2006	United Kingdom	59 – 73	2 148	413/2148 (19.2%) 124/866 (14.3%) men 289/1282 (22.5%) women
Lamoureux, 2008	Singapore	40 – 80 Mean 58.7	3280	480/3266 (14.7%)

A difference in fall prevalence rates is noted in prospective and retrospective studies in Caucasian and Japanese populations. The rate of falls in Japanese-Americans and native Japanese has been almost half that reported in studies in Caucasian populations of the US and Europe (Aoyagi and others, 1998; Davis and others, 1997; Yasumura and others, 1994). This difference is evident in both rural and urban dwellers (Yasumura and others, 1994). A lower risk of falls in Japanese compared to Caucasian people has been attributed to better neuromuscular function from being seated on the floor (traditional Japanese custom) and Japanese people having shorter legs than Caucasians (a partly genetic factor) (Aoyagi and others, 1998; Fujita, 1994). Similar falls prevalence rates to those in Japanese older populations have been reported in a retrospective study in South Korea (Shin and others, 2009), and prospective and retrospective studies in Taiwan (Chang and others, 2010; Lin and others, 2002). In addition to poor recall associated with data gathered retrospectively, has been an unwillingness reported in some communities, such as in Korea, for subjects to admit to a fall for cultural reasons, possibly shame (Davis and others, 1997), or the older person fearing a loss of independence and associated stigma of ageing because of the fall.

Low fall rates have not only been reported in Japanese and Taiwanese studies, however. Rates are similarly low in mainland China (Chu, Chi & Chiu, 2005; Yu and others, 2009) and in Hong Kong (Chu, Chiu & Chi, 2006; Ho and others, 1996; Lee and others, 2006) when compared to rates reported in both prospective and retrospective studies in Caucasian populations (Table 2.3). Studies on falls in developing countries have particular challenges: not only is recall of events in retrospective studies a challenge, but recording of events in prospective studies is equally challenging in communities with a low literacy level. In one study, 51 per cent of older Chinese participants (Chu, Chiu & Chi, 2006) had received no formal education and were unable to record events on calendars, which impacted on the quality of the information that was collected.

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Table 2.3: Studies on prevalence and/or incidence of falls in developing countries

Region Country and author /s	Study aim	Study design	Sample	Findings	Comment
Africa					
Nigeria Bekibele & Gureje, 2010	Examine prevalence and factors associated with falls in older persons	Cross-sectional random sample of households Fall in previous 12 months	Age ≥ 65 years n = 2096	Prevalence 23% n = 482	Risk factors: female gender, arthritis, insomnia
Rwanda Ntagungira & Frantz, 2005	Determine prevalence and risk factors for falls in community dwelling elderly	Cross-sectional Only with reported history of fall after age 60 years	Age ≥ 60 years n = 200	Fall prevalence (multiple falls) 23.2% Fracture: Hip 45%, ankle 18%, wrist 15%	Risk factors: Advanced age, male gender, joint stiffness, lower limb weakness, loss of balance and coordination, visual deficits, medications
Asia					
China Yu and others, 2009	Understand prevalence, consequences and risk factors of falls in elderly in Beijing	Cross-sectional Random sample	Age ≥ 60 years n = 1512	Prevalence 18% Fall induced injuries 37.7%	Risk factors: Age 60–70, female gender, low physical activity, fear of falls, living alone, severe visual impairment impaired ADLs, chronic disease, medications, high bed, poor lighting on stairway

Table 2.3 (continued)

Region Country and author /s	Study aim	Study design	Sample	Findings	Comment
Hong Kong Chu and others, 2005	Estimate the incidence and prediction for falls in a Chinese population resident in Hong Kong	Population based prospective cohort study. One year follow up	Age ≥ 65 years n = 1517	Fall prevalence 14.1% Prevalence of recurrent falls 4.75% Incidence of falls: 270/1000 person years, Men 220/1000 person years, and Women 324/1000 person years	Predictors of falls: Previous falls, advanced age, dementia, stroke, Parkinson's disease, knee extension power, gait speed
Ho and others, 1996	Occurrence of falls and correlates of falls	Cross-sectional Random sample Fall in past 12 months	Age ≥ 70 years n = 1947	Fall prevalence falls 18%	Risk factors: White collar employment, self-perceived poor health, dizziness, presence of cerebral vascular disease, slow gait velocity, difficulty ADL, BMI 20-24
Chu, 2008	Investigate the impact the impact of falls on health services utilisation in Chinese adults	Prospective cohort	Age ≥ 65 years n = 1517	Previous falls 14.1% Falls during follow-up 19.6%, recurrent falls 4.8% Serious injuries 7.25% 55.5% subjective mobility problems 33.2% fear of falling	Recurrent fallers had increased hospital utilization Cost estimates US$71 million

Table 2.3 (continued)

Region Country and author /s	Study aim	Study design	Sample	Findings	Comment
Lee, 2006	Test hypothesis that underlying medical illnesses are the cause of falls rather than medications among functionally independent community-dwelling older individuals.	Cross-sectional Retrospective history of falls	≥ 65 years n = 4000	Fall previous year 19.7% Recurrent falls 5.9%	Association with falls Multivariate analysis Female sex Heart disease Shorter length stride Eye disease Lower body muscular pain Previous stroke Antidiabetics Nitrate Medications not associated with falls
Chu, 2006	Investigate the impact of incident falls on the balance, gait and ADL functioning in community-dwelling older adults	Prospective population based cohort 1 year follow-up	Age ≥ 65 years N = 1517 (Hong Kong Chinese)	Incidence of falls 264/1000 person years Functional decline high among fallers, magnitude of decline greater in recurrent fallers	Independent predictor of functional decline: Incident falls, old age. Fear falling, Parkinson's disease, slow gait speed
Leung, 2010	Examine the relationship between psychosocial factors and falls in community-dwelling older adults in Hong Kong	Cross-sectional survey community dwelling older subjects. History of falls in previous 90 days.	Age ≥ 60 years N = 1573 (Frail group applying for long-term care)	Previous fall 32.6%	Factors associated with fall, logistic regression: Visual impairment Unsteady gait Hip and other fractures Use of walking aid indoors

Table 2.3 (continued)

Region Country and author /s	Study aim	Study design	Sample	Findings	Comment
India Johnson, 2006	Survey frequency and nature of falls and fall-related injuries in community and institutionalized older women in Kerala	Cross-sectional Fall in previous 12 months	Age ≥ 60 years n = 82 community dwelling n = 63 institutionalized	Fall prevalence: 45% community dwelling, 64% institutionalized Injuries 74%), fractures 21%	Small samples Risk factors not discussed Discussed injuries in those who fell
Shanthi & Krishnaswamy, 2005	Identify risk factors for falls in elderly population in Chennai	Cross-sectional Hospital based recruitment (outpatient clinics) Presented with a fall	Age ≥ 60 years n = 100	68% female, extrinsic causes 56%, intrinsic causes common age ≥ 70 years, Recurrent falls associated with intrinsic causes Fracture associated with sedentary lifestyle	Risk factors: Sedentary lifestyle, female gender, advanced age, musculoskeletal disorders, visual defects, peripheral neuropathy, cognitive impairment, sedative drugs
South Korea Ansan City Shin and others, 2009	Examine prevalence, characteristics and correlates falls among community-dwelling older adults in Korea	Cross-sectional population based	Age > 60 n = 335	Fall prevalence 15%	Predictor of fall: Poor ADLs
Singapore Lamoureux and others, 2008	Report of visual impairment and main causes of visual loss with falls in an older Asian population	Cross-sectional Fall previous 12 months	Age: 40 – 80 n=3280 Malay	Fall revalence14.75	Predictor of fall: Poor : unilateral severe visual impairment Glaucoma

Table 2.3 (continued)

Region Country and author /s	Study aim	Study design	Sample	Findings	Comment
Koh and others, 2007	Study fall incidence and fall prevention practices at acute care hospitals	Retrospective audit of hospital records (5hospitals) for documented fall incident report	Age ≥ 16 years Random sample of 6000 medical records	825 patients identified as fallers: 59% aged ≥ 65 years, and non fallers: 61% age ≤ 65 years Fall rates in 5 hospitals range 0.68 to 1.44 per 1000 patients bed days	No record of risk factors. Un-coordinated implementation of fall prevention programme. Risk assessment and fall prevention is standard policy in Singapore. Compliance for use of risk assessment tools was 77%. Fall prevention strategies: Regular ambulation, review and modification of medications, toileting rounds, environmental modifications, treatment of underlying medical condition
Chan and others, 1997	Examine epidemiology of falls in elderly	Cross-sectional Community- based	Age ≥ 60 years n = 401	Fall prevalence 17%	Factors associated with falls: Age > 75%, female gender, Malay race, poor vision, history of hypertension, polypharmacy, and Barthel's score < 20.

Table 2.3 (continued)

Region Country and author /s	Study aim	Study design	Sample	Findings	Comment
Taiwan **Taichung County** Lin and others, 2002	Determine the incidence and risk factors for falls among 368 rural elderly people aged 65 years and older	Prospective cohort study	Age ≥ 65years n = 368	Incidence of falls 226/1000 person years	Predictors of falls: Previous falls (Relative hazard 1.76, 95^% CI, 1.08 – 2.88 Impaired ADLs RH 1.22, 95%CI 1.08 – 1.39 Long duration of Timed Up & Go
Taiwan **Taipei** Chang and others, 2010	Investigate the relationship among falls, fear of falling and health related quality of life (HRQOL) in elderly people living in the community	Cross-sectional community based	Age ≥ 65years 4056	Fall prevalence 13.8%	Prevalence FOF : women , 62.6% Men, 46.5% Fear of falling was a major factor related to HRQOL
Thailand Chaiwanichsiri and others, 2009	Explore foot musculo-skeletal disorders and their relationship to falls in Bangkok	Cross-sectional analytical study. Community dwelling volunteers. Healthy, independent in self-care and walking	Age 60 – 80 years n = 213	Fall prevalence 21%	Risk factors: Female gender, plantar fasciitis, knee osteo-arthritis, visual deficit, impaired proprioception

Table 2.3 (continued)

Region Country and author /s	Study aim	Study design	Sample	Findings	Comment
Thiamwong and others, 2008	Develop a fall risk assessment test for community dwelling Thai elderly	Cross-sectional. History of fall in past 6 months	Age ≥ 60 years n = 270	Fall prevention 13%	Risk factors: Previous falls, impaired body balance, specific medication use, impaired visual acuity, living in a Thai style house (high steep stairs)
Assantachai and others, 2003	Determine common intrinsic factors for falls in an urban community in Bangkok	Cross-sectional Fall in previous 6 months	Age ≥ 60 years n = 1043	Fall prevalence 19.8%	Independent risk factors for falls: Female gender, hypertension, deafness, poor memory, poor self-perceived health status, poor performance in IADLs kyphoscoliosis, use of spectacles, tachycardia after 5 minutes rest, high serum transferrin, poor nutritional status.
Jitapunkul and others, 1998	Determine fall prevalence and their associated factors in Thai elders	Cross-sectional Fall over previous 6 months	Age ≥ 60 years n = 4480	Fall prevalence 18.7% Single fall 10.5% Multiple falls 8.2%	Associated factors for falls: Problem with crouching, reported poor health, underlying illness, lack of electricity in the house, female gender, poor mobility indoors, taking less than 3 meals a day.

Table 2.3 (continued)

Region Country and author /s	Study aim	Study design	Sample	Findings	Comment
Turkey Halil and others, 2006	Determine clinical and social correlates for falls in elderly	Cross-sectional Hospital based recruitment (outpatient clinics) Fall in previous 12 months	Age ≥ 65 years n = 2322	Fall prevalence 28.5%	Risk factors: Female gender, visual and auditory problems, use of mobility aids, mobility problem, depression
Latin America and the Caribbean					
Brazil Goncalves and others, 2008	Examine prevalence of falls in institutionalized elderly in Rio Grande	Cross-sectional A fall in the past 12 months	Age ≥ 65 years Institutionalized n =180	Fall prevalence 38% 62.3% falls occurred indoors and 23% in the bedroom	Risk factors: Caucasian, depression, separated/divorced and polypharmacy
Rozenfield and others, 2003	Assess prevalence of falls and the association with use of medication in Rio de Janeiro	Cross-sectional study Independent and active community dwelling History of fall in previous 12 months	Women age ≥ 60 years n= 634	Prevalence: Single fall 23.3% Prevalence of ≥ 2 falls 14.0%	Risk factors: Single fall: Diuretics plus musculoskeletal disorders Recurrent falls: Anxiolytics/sedatives, other psychoactive agents

Table 2.3 (continued)

Region Country and author /s	Study aim	Study design	Sample	Findings	Comment
Perrancini and others, 2002	Determine factors for falls in community dwelling older persons	Prospective multidimensional survey and 2-year follow up	Age ≥ 65 years n = 1667	Fall prevalence 31% Prevalence of recurrent falls 11% Incidence of falls 29%. 2% sustained a fracture	Predictors of recurrent falls: Absence of a spouse, no reading habit, history of fractures, visual impairment, difficulty performing 1-3 ADLs
Chaimowicz and others, 2000	Determine association between falls and psychoactive medication, in Campo Belo	Cross-sectional Community- dwelling Falls in past 12 months and use of psychoactive drugs	Age ≥ 65 years n = 161	Fall prevalence 16.8% Fractures in (14.8%) (4)	Significant association between falls and psychoactive drug use (P = .02)

ADLs = Activities of daily living; IADLs = Instrumental activities of daily living; AMT = Abbreviated Mental Test.

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It is noteworthy that studies in developing countries such as Thailand (Assantachai and others, 2003; Chaiwanichsiri, Janchai & Tantisiriwat, 2009; Jitapunkul, 1998; Johnson, 2006; Thiamwong and others, 2011) (Table 2.3) have also reported rates lower than studies in Caucasian populations, but their rates are similar to those found in populations of other Asian countries such as China and Hong Kong (Chu, Chiu & Chi, 2006; Chu, Chiu & Chi, 2008; Ho and others, 1996; Lee and others, 2006; Yu and others, 2009). A Hong Kong based study reported a high prevalence rate of 38 per cent (Leung and others, 2010), but the study participants were community dwelling, although possibly frail as they had applied for long-term care. Of note is that the studies in Thailand are all based on retrospective reports and their populations included younger populations, age ≥ 60 years, who may have been fitter than Caucasian subjects. On the other hand studies in Latin America, largely retrospective and mainly conducted in Brazil (Gonçalves and others, 2008; Perracini & Ramos, 2002; Rozenfeld, Camacho & Veras, 2003), reported fall rates similar to those in developed countries, with the exception of a study (Chaimowicz, Ferreira & Miguel, 2000) which had rates similar to those in Asian studies (Table 2.3). Participants in Chaimowitz' study (2000) were relatively young (mean age 71 years) which may account for the low fall rate. Participants in the Rozenfield (2003) study were all women, and a gender difference in fall rate may have accounted for a high fall rate in this study.

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Two studies conducted in India reported higher fall rates (Johnson, 2006; Shanthi & Krishnaswamy, 2005) than those reviewed above. However, these studies differ in the methodology used in other Asian studies: Johnson's (2006) small study combined community-dwelling (82) and institutionalised (63) subjects. Shanthi and Krishnaswamy's (2005) study only recruited participants with a previous fall. Only two prevalence studies have been reported from sub-Saharan countries: In Nigeria, Bekibele and Gureje (2010) reported a rate of 23 per cent. In Rwanda, in a study of participants with a previous history of falls, Ntagungira and Frantz (2005) reported a single fall in 23 per cent of participants and recurrent falls in 77 per cent of those who

fell (Table 2.3.). A cross sectional study in Turkey (Halil and others, 2006) reported a rate of 28.5 per cent, which approximates rates in developed countries. Ethnic differences in fall rates have been studied in the US, but findings are inconsistent. Some studies (Nevitt and others, 1989; Tinetti, Speechley & Ginter, 1988), but not all (Faulkner and others, 2005; Hanlon and others, 2002; Means, O'Sullivan & Rodell, 2000) suggest a higher rate of falls in Caucasians than in African-Americans and other ethnic groups

The relative paucity of literature on falls in developing countries has recently drawn considerable global interest in falls and related injuries in older persons in these countries. Such interest was manifested in a World Health Organization (WHO) Technical Meeting on Falls Prevention in Older Age, held in Victoria, BC, Canada in February 2007. Review articles from various WHO regions presented in the meeting confirmed the paucity of literature in this area in developing regions. The few studies conducted vary widely moreover in the prevalence rates reported, with fall prevalence in India ranging from 14 to 51 per cent (Krishnaswamy & Usha, 2008), in China from 6.5 to 30.6 per cent (Hua and others, 2008) and in Latin America and the Caribbean from 21.6 to 34 per cent (Marin, 2008). Other developing regions – Africa (Kalula, 2008), Eastern Mediterranean (Al-Faisal, 2008) and Jamaica (James and others, 2008) (Table 2.4) – had no recorded prevalence data for falls. Experts in the Canada meeting determined that the prevention of falls is an urgent Public Health concern relating to the rapidly growing older population of these countries. A pressing need was identified to address a lack of understanding of the scope of the problem, a lack of attention given to falls as a major health issue, and a lack of strategic planning to overcome challenges in implementing health promotion in a climate of competing health issues. In its publication *The WHO Global Report on Falls Prevention in Older Age* (2008), the Technical Committee highlighted the following priority action: “The design and implementation of culturally - appropriate evidence-based interventions that will significantly reduce the number of falls among older persons” (World Health Organization. Ageing & Life Course Unit, 2008, p. 47).

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Table 2.4: Review articles on falls in older persons in developing regions

Author and Location	Study Aim	Study design	Sample	Findings	Comments
Africa Kalula, 2008	*Prevention of falls in older persons: An African case study.* Background paper to the WHO Global Report on Falls Prevention in Older Age (WHO, 2008).	Literature review of publications falls from countries in Africa.	14 articles that included falls in older persons in sub-Saharan Africa	Scant information on prevalence or incidence and risk factors for falls in Africa. Most articles discuss falls in older persons as part of a review of causes of trauma in the general population	Research needed to determine risk factors, incidence rates and fall related injuries to inform the design of appropriate falls prevention programmes
Eastern Mediterranean Al-Faisal, 2008	*Falls prevention of older persons: Eastern Mediterranean Regional Review.* Background paper to the WHO Global Report on Falls Prevention in Older Age (WHO, 2008).	Literature review of publications on falls from the Eastern Mediterranean	3 articles reviewed	Two articles were on injury in the general population, and one on epidemiology of hip fracture. Scarcity of studies on falls and injuries	Research needed on the extent of falls in older persons and falls prevention interventions

Table 2.4 (continued)

Author and Location	Study Aim	Study design	Sample	Findings	Comments
Latin America and the Caribbean Marin, 2008	*Latin-American regional review on falls in older people*. To estimate the prevalence of falls and risk factors associated with falls among elders in Latin America and the Caribbean, Background paper to the WHO Global Report on Falls Prevention in Older Age	Literature review of publications on falls from Latin America and the Caribbean	Presented data collected in 2000-2001 for the Hispanic Established Populations for Epidemiological Studies in the Elderly (H-EPESE) in the Mexican American population (1,483 subjects). A cross-sectional analysis of the H-EPESE and of data from a multi-centre study (of seven cities, 9,765 subjects) called Health, Well-being, and Aging in Latin America and the Caribbean.	Risk factors associated with falls among older persons: Age (older), female gender, heart Attack, low cognitive function, depression , urinary incontinence, diabetes and arthritis	Prevalence of falls had large variation in countries studied, ranging from 21.6% in Bridgetown, Barbados to 34% in Santiago, Chile. Most risk factors are preventable. No fall prevention initiatives

Table 2.4 (continued)

Author and Location	Study Aim	Study design	Sample	Findings	Comments
India Krishnaswamy & Usha, 2008	*Falls in older people: A National and regional review from India*. A background paper to the WHO Global Report on Falls Prevention in Older Age (WHO, 2008).	Literature review of publications on falls in India.	Reviewed 4 studies in India	Prevalence varied from 14% to 51.5%. Fractures more common in females than male Risk factors for falls: Advanced age, urban dwelling (29.4% vs. rural 13.4%) disability, psychological distress, musculoskeletal disorders, visual defect, low BMI, drug use (sedatives), sedentary lifestyle	More research is needed to identify factors associated with falls and development of effective fall prevention programmes
West Pacific Asia Hua and others, 2008.	*Falls prevention in older age in Western Pacific Asia Region*. Background paper to the WHO Global Report on Falls Prevention in Older Age	Literature review of publication on falls in the West Pacific Asia region.	Papers published in Chinese. Little information provided on methodologies, etc	Prevalence rate for falls among the elderly varied widely, ranging 6.5% to 30.6% within China. Risk factors: Female gender, increase with age, outdoors (in the street), falls indoors were seen in bedroom, bathroom, or on the stairs Day more often than night Autumn and winter months Higher risk in Western Regions of China Rural areas (general injury) Urban areas (mortality related to falls)	A study looking at the effects of Tai Chi, found that this intervention could prevent a decline in functional balance and gait in older adults.

Table 2.4 (continued)

Author and Location	Study Aim	Study design	Sample	Findings	Comments
Jamaica James and others, 2008.	*Falls and fall prevention in the elderly: Insights from Jamaica.* Background paper to the WHO Global Report on Falls Prevention in Older Age (WHO, 2008)	Literature review of published articles, data records and interviews from Jamaica	Two publications on falls in older persons in Jamaica.	Hospital record review with high frequency of fall related injuries. Fractures sustained by 79.3% of the patients Risk factors: Female gender, diabetes, hypertension, sensory impairment, cardiovascular disease, mobility problems and predominance of outdoor factors	Research on falls in older persons is limited. Most data presented is hospital-based. More research is required
Forjuoh & Li, 1996	A review of successful transport and home injury interventions to guide interventions in developing countries	Review of interventions developed in and for industrialized countries to determine applicability to developing countries. Criteria used to evaluate interventions included: Efficacy of the interventions, affordability, feasibility with regard to socio-cultural context and sustainability	Prevention of transportation related and all home injuries	Findings relevant for falls in older persons: Prevention strategies ranked relevant were: Fall prevention equipment, such as grab bars in the bathroom and handrails on both sides of stairs and steps Education programmes for the elderly on fall prevention	Domestic falls in Nigeria viewed as a major problem in persons at extreme ages

2.2.2 Other falls related studies in developing countries

In sub-Saharan Africa, data on falls in older persons are largely reported as part of studies on general trauma. The studies are generally based on convenience samples such as hospital or clinic populations, and mainly take the form of a retrospective search of hospital records to assess epidemiology of fractures, particularly of the hip (Adebajo, Cooper & Evans, 1991; Amuyunzu and others, 1997; El Maghraoui and others, 2005; Fasola, Obiechina & Arotiba, 2003; Mock and others, 1999; Zebaze & Seeman, 2003), or mortuary records for causes of domestic deaths (Seleye-Fubara & Ekere, 2003). These studies have generally aimed to assess all causes of trauma or accidental death, and study samples have included children and young adults. The studies report that older persons aged 60 years and older have a high incidence of low energy trauma fractures (Amuyunzu and others, 1997; El Maghraoui and others, 2005; Zebaze & Seeman, 2003); suffer increased disability following trauma (Mock and others, 1999); and account for a high number of fall related injuries. A comparison of the incidence of hip and forearm fractures reported in developed countries and developing countries was conducted retrospectively in Ibadan, Nigeria, and Southampton and Newcastle in the UK (Adebajo, Cooper & Evans, 1991). The incidence of fractures in older people in the UK sample was 20 times higher than the Nigerian sample. Although the study's findings support similar findings in the literature, comparison is difficult because the Nigerian sample had a relatively younger population with an inclusion criterion age ≥ 50 years, compared to an inclusion criterion of age ≥ 65 years for the UK sample. The results were however presented standardised for age and sex. A study on falls in older people in South Africa conducted a retrospective review of hospital records and assessed management of falls in older people in a tertiary hospital Emergency Department (Kalula and others, 2006). The management of older patients after a fall focused on injuries sustained, and little effort was made to identify and manage risk factors.

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Other regions of the developing world similarly have a greater number of retrospective studies on general trauma than studies on falls in the older population; again, the studies have mainly been hospital based. These studies were conducted in Hong Kong, Malaysia, Singapore and Thailand (Chu and others, 1999; Lau and others, 2001); India (Cardona and others, 2008); Iran (Abolhassani and others, 2006; Ghodsi and others, 2003; Moayyeri and others, 2006; Valizadeh, Mazloomzadeh & Azizi, 2008); Vietnam (Huang & Acton, 2004); Brazil (Coutinho and others, 2008; Fabrício, Rodrigues & Costa Junior, 2004); and Jamaica (James, 2007; McDonald, Dawkins & Titus, 2001; Williams-Johnson, Wilks & McDonald, 2004). Table 2.5 summarises the findings of the studies which generally support a high incidence of falls related trauma in the older age group, and an increased incidence of disability and mortality following such trauma, in comparison to the younger age group. In some studies the incidence of hip fracture was reported to be lower than that reported in developed countries (Moayyeri and others, 2006); for the main part, older people were found to fall indoors and younger people to fall from trees (McDonald, Dawkins & Titus, 2001).

Hong Kong is the only developing country with rapid growth of research on falls. The studies include assessment of a link between fear of falling and depression (Chou & Chi, 2008), environmental risks for falls (Poh-Chin and others, 2009) (Table 2.6), and dissertations on fall related topics (Lok, 2006; Low, 2008; Lui, 2005; Maw, 2002) (Table 2.7). Overall, research on falls in developing countries has mainly dealt with acute events that attract immediate attention, such as fractures and other injuries. Reasons for this focus in the research could be relative ease in raising funding for such studies. Community based epidemiological studies are more demanding on resources and time. Although the use of retrospective studies and convenience samples contribute to the body of knowledge, the findings are not generalisable to the community, and no real causes and effects can be drawn from the studies. According to the literature, not only is the prevalence and incidence of falls in

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Table 2.5: Studies in developing countries on a fall as a contributing factor to trauma or death

Region country and author/s	Study aim	Study design	Sample	Findings	Comments
Africa					
Cameroon Zebaze & Seeman, 2003	Assess the epidemiology of hip and wrist fractures	A 2-year retrospective medical record review of admission for fractures	Age ≥ 35 513 sustained fractures (192 women, 321 men)	Total of 26 hip fractures in women, 21 (80%) were in age group ≥ 50 years Total of 29 hip fractures in men, 14 (48%) were in age group ≥ 50 years	Incidence rate per 100 000 for low energy trauma falls hip fracture in age group ≥ 65 was 24.4 for females and 20.7 for males.
Ghana Mock and others, 1999	Measure incidence and outcome of injury	Household survey Two-stage cluster sampling	All ages n= 21105	1609 injuries resulted in one or more days of loss of activity Transport and fall related injuries most common. In rural areas, agricultural related injuries predominate	Injury disability incidences higher in older people Falls were highest in oldest group (age ≥ 60 years)
Kenya Amuyunzu and others, 1997	Aetiology and implications of domestic injuries in the elderly	Retrospective medical record review (10 hospitals)	Random sample of 20% of the records Total records 9648, 197 (2%) were age ≥ 55 years 83 female and 111 male	Leading cause of injury were falls inside the house (35%) and falls outside the house 12.2% 61.9% fractures were from falls inside the house	Age group 60-64 accounted for most (29.4%) of injuries due to falls in the house Risk factors not studied

Table 2.5 (continued)

Region country and author/s	Study aim	Study design	Sample	Findings	Comments
Morocco El Maghraoui and others, 2004	Investigate the incidence rate of hip fractures in 2002, in Rabat,	Retrospective review of hospital records	150 hip fractures (83 women and 67 men)	Age 70 ± 10 years Incidence rate per 100,000 was 52.1 for women and 43.7 for men.	Incidence rate increased with age Incidence rate lower than in most European and North American, and Asian countries but higher than sub-Saharan Africa.
Nigeria Fasola and others, 2003	Determine the incidence and pattern of maxillo-facial fractures in elderly patients	Hospital records review over a 15-year period	Total 1 689 patients with maxillo-facial fractures 53 (3.1%) age ≥ 60	Falls occurred in 11 of the 53, in 9/53 falls occurred in the home	Road traffic accidents common cause for fracture (39.6%) followed by falls 20.8%
Adebajo and others, 1991	Compare incidence rates of hip and distal forearm fractures between Ibadan, Nigeria and England (Southampton and Newcastle)	Retrospective medical record review for 1 year period Age ≥ 50 years	Number of hip fractures: Nigeria 5 Britain 57 Forearm fractures: Nigeria 16 Britain 488	Age and sex specific incidence 100,000 per year for hip fracture: Age 65-74 Male Nigeria 2.1, Male Britain 56.8 Female Nigeria 2.0, Female Britain 172.3 and Forearm fracture: Male Nigeria 4.2, Male Britain 150 Female Nigeria 3.8, Female Britain 825	Incidence of fracture lower in Ibadan than England with a risk ratio of up to 20 Higher physical activity and socio-cultural lifestyle are protective factors in Africans

Table 2.5 (continued)

Region country and author/s	Study aim	Study design	Sample	Findings	Comments
Seleye-Fubara & Ekere, 2003	Highlight the burden of domestic deaths	Six-year retrospective audit of mortuary records	All ages (six months – 81 years) 1184 autopsies Accidental deaths 424 83 (19.6%) were domestic accidents	Falls caused 11 deaths. Commonly in elderly	Head injury and multiple fractures were common cause of death
South Africa Kalula and others, 2006	Evaluate the management of falls in a hospital Emergency Department	Hospital record review over 6 months period	Age ≥ 65 years Random sample n= 100	Patient management focused on injuries. No referral for management of risk factors	Need identified for guidelines for management of falls in older persons
Asia					
Hong Kong, Malaysia Singapore, Thailand Lau and others, 2001	Study incidence of hip fractures in developing countries in Asia	Retrospective collection of hospital data for non-pathological hip fractures over 12-months period	Age ≥ 50 years Malaysia: n= 2272 Hong Kong: n = 4059 Singapore: n= 1825 Thailand: n = 391	Female: Male fracture ratio for all countries 2.5 (lower than 2.9 for USA) Rate increased with age Rates increased in urbanised Hong Kong and Singapore Age-adjusted rates range from 88/100,000 in Malaysian men to 459/100,000 in Hong Kong women	Fracture rates highest in Chinese, lowest in Malay and midway in Indians

Table 2.5 (continued)

Region country and author/s	Study aim	Study design	Sample	Findings	Comments
Hong Kong Chu and others, 1999	Determine predictors of falls	Case-control study in hospital fallers and matched control	Age ≥ 65 years 51 fallers 51 controls	Descriptive data Comparison of fallers and non fallers	Risk factors: Lower limb weakness (power MRC grade < 4, Tandem walk 2 meters (> 2 errors) Clinical factors: Active neoplastic disease, stroke, postural hypotension, disorientation, low AMT score, psychoactive drugs
India Cardona and others, 2008	Study the burden of fatal and non-fatal injury in rural India	Retrospective verbal autopsy base on mortality data and morbidity survey Mortality surveillance study and a cross-sectional morbidity survey from	All ages 1354 deaths recorded, 1329 verbal autopsy interviews Morbidity survey age ≥ 30 yrs 5.627 invited and 4535 (80.6%) participated	Falls responsible for 20% deaths. 86% of all fatal falls occurred in persons age ≥ 60 years Most falls 72.3% were attributable to slipping and tripping	Falls are a major cause of death and injury in women Leading causes of injury in rural India are falls, road traffic accidents and suicides

Table 2.5 (continued)

Region country and author/s	Study aim	Study design	Sample	Findings	Comments
Iran Moayyeri and others, 2006	Epidemiology of hip fracture in Iran	Prospective survey of hospitals for patients age ≥ 50 years with radiologically confirmed proximal femur fractures over 4.5 months period	555 femur fractures	Annual incidence of hip fracture per 100,000 person-year 115.2 (95% CI 107-124) in men: 73.2% fall related 115.6 (95% CI 107-124) in women:89.2% fall related Age standardised incidence rates : 127.3 for men and 164.6 for women per 100,000 person-year	Incident rates increase exponentially after age 60 years Incidence rates are lower than those in Western countries In comparison to Asian countries, Iranian females are lowest next to China
Valizadeh and others, 2008	Estimate incidence of hip fracture, in Zanjan	Prospective records of hip fracture Hospitalisations over a 12-month period	Age ≥ 50 years 244 hip fractures	190 fractures were low trauma (fall induced)	Highest fracture rate in age ≥ 80 years Annual age – standardized incidence rate: 214.8/100,000 women 206.5/100,000 men

Table 2.5 (continued)

Region country and author/s	Study aim	Study design	Sample	Findings	Comments
Abolhassani and others, 2006	Determine incidence and characteristics of falls leading to hip fracture	Prospective population based study for accidental injuries over 4.5 months conducted in 9 provinces of Iran in 2003	Fall events n = 2186 572 (26.2%) sustained hip fracture	Age ≥ 50 years Annual incidences of injurious fall events 237.1 per 100 000 person years Annual incidence for hip fractures 93.6 per 100 000 person years	Risk factor: Predictors of falls walking and stairs 71% fall injuries and 76% hip fractures occurred indoors For age ≥ 80 years falls indoors were 84.7% of men and 73.1% of women
Ghodsi and others, 2003	Determine the extent of trauma related hospitalisation in Tehran	Prospective record of trauma related hospitalisations in 6 hospitals over 13 months	800 trauma admissions 963 (12%) age ≥ 65 years	262 (27%) traffic accidents 675 (70%) due to falls 520 (77%) falls occurred at home 91 (13%) occurred on the street Mortality from fall related injuries 2.6%	Risk factors for falls: Intrinsic: muscle weakness, visual disturbances, equilibrium disturbances Outdoors: Poor design and maintenance of streets, and drainage ditches
Vietnam Hang and others, 2004	Document unintentional injuries in rural community dwelling of Bavi	Quarterly home visits to record injuries in household over preceding 3 months for a 12-month period	All ages n = 24776	2079 non fatal, injuries over 23,338 person – years, a rate of 89/1000 person years	Fall related home injuries common in age group ≥ 60 years, especially females

Table 2.5 (continued)

Region country and author/s	Study aim	Study design	Sample	Findings	Comments
Latin America and the Caribbean					
Brazil Coutinho and others, 2008	Identify risk factors for fall related severe fracture in Rio de Janeiro	Case-control Hospital-based study from same community	Age ≥ 60 years 250 cases 250 controls	Falls occurred between 6am – 6pm 67% falls occurred at home	Risk factors: BMI ≥ 20 kg/m^2, cognitive impairment, previous stroke, urinary incontinence, benzodiazepines, muscle relaxants Protective factors; Use of alcohol once a week Use of calcium channel blockers
Fabricio and others, 2004	Investigate occurrence and consequences of a fall in Sao Paulo	Hospital based. Random selection of patients presenting with falls. Home visit and structured interview	Age ≥ 60 years 251 admissions with falls in 2000. Randomly selected 51 patients	Environmental factors accounted for 54% of falls 64% sustained fractures	Risk factors: Previous falls, female gender, advanced age, underlying disease (neurological, cardiac), Environmental: Slippery surfaces, objects on the floor, bumping into people, problem with steps, Small sample hospital based study
Jamaica James and others, 2007	Provide insight on falls in older persons in Jamaica	Retrospective medical records review 2004-06	5412 person visits 27 were fall related	Presented with injuries. Head injury, lower limbs, fractures, lacerations,	Risk factors: Female gender, diabetes, hypertension, sensory impairment, mobility problems, poor road surfaces, poor constructed stairs, poor design of public transport

Table 2.5 (continued)

Region country and author/s	Study aim	Study design	Sample	Findings	Comments
Williams-Johnson, 2004	Examine modifiable risk factor of hip fractures in the elderly	Retrospective review of medical records over 48 months	152 patients with hip fractures 111 female; 41 males	137 (90%) had a fall 75% were age ≥ 65 years	Risk factors for falls: Hypertension; diabetes mellitus;, chronic ischaemic heart disease; dementia; hearing loss; loss of vision Environmental factors: Slipped (67.8), tripped (7.2%) mostly occurred in doors
McDonald and others, 2001	Determine patterns of trauma in rural versus urban Jamaica	Data collection from hospital admissions with injury	458 from St Ann's Bay Hospital (rural) 974 from the University Hospital of the West Indies (urban) 10.5% admissions were age ≥ 60 years	Motor vehicle accident commonest cause of injury followed by falls. Falls accounted for 31.5% of unintentional injuries. At the rural hospital (41%) and at urban hospital (26%)	Falls occurred indoors in the elderly. Young children fell from trees

developing countries lower than in the developed world, but the incidence of fractures is lower as well. High rates of physical activity and socio-cultural life-styles are some of the arguments put forward for such differences.

What is evident in a review of the literature is the paucity of epidemiological studies in developing countries, particularly in SSA, and the relatively low rates of falls reported in studies in Asia. In addition, it is accepted that wide differences in study design, literacy levels of study populations and cultural factors all impact the results of studies conducted in different settings.

2.3 Risk factors for falls

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Risk factors for falls are conditions or circumstances identified in studies that distinguish fallers from non-fallers after controlling for confounders, such as age and gender. Within the body of research on falls in older persons, risk factors have been assessed and classified which facilitates comparison between studies, and helps to inform the design and introduction of preventive strategies. The risk factors have commonly been grouped in two broad categories: 1) Intrinsic factors – that reside within an individual, and include demographic, health and behavioural factors (e.g. advanced age, gender, impaired mobility, chronic disease, acute illness, history of falls, medication use, alcohol use, physical activity or inactivity), and 2) extrinsic factors – that resort with the physical and socio-economic environment (e.g. environmental hazards, a poor living environment) (Rubenstein, 2006). It is increasingly recognised however that falls result from an interaction of multiple causative factors, and that a combination of intrinsic and extrinsic factors constitutes a risk for a fall. A classification of risk factors for falls (Scott and others, 2001; Scott and others, 2007) takes account all such factors based on an understanding that the modification of risk factors requires consideration of four sets of inter-related factors: biological, behavioural, socio-economic and environmental (see Table 2.8).

Table 2.6: Other studies on falls conducted in Hong Kong

Region country and author /s	Study aim	Study Design	Sample	Findings	Comment
Asia					
Hong Kong (Mong Kok) Poh-Chin, 2009	Study environmental risk factors to falls among the elderly using geographical information systems (GIS) technology to visualize spatial association of falls and environmental factors.	Patients with falls recruited via the Accident and Emergency department.	Standard questionnaire administered telephonically. Phase I 123 records Phase II 158 records	Hot spots for falls: Busy streets and junctions Outdoor markets Refuse collection points Public transport stations (Mass Transit Railway)	Causes: Open markets – carelessly discarded waste Traffic junctions – overcrowding Curbs – trip Vendors – obstruct visibility
Hong Kong Chou, (2008)	Assess the association between fear of falling and depression in primary care setting and to examine the mediating role of physical disability and social activity withdraw in the link between fear of falling and depression	Cross-sectional and 1-year follow up. Sample recruited from older persons accessing Primary Health care centres. The Minimal Data Set for Home Care Instrument was used	Age ≥ 65 n = 457 at baseline n = 321 at 12 month follow up	Fear of falling at baseline predicted depression Depression at baseline did not predict fear of falling	Fear of falling leads to social withdraw and depressive symptoms

Table 2.7: Dissertations on topics related to falls in older persons, by regions

Region country and author /s	Study aim	Study design	Sample	Findings	Comment
Africa					
Rwanda Ntagungira and Frantz, 2005	Determine prevalence and risk factors for falls in community dwelling elderly	Cross-sectional Only with reported history of fall after age 60 years	Age ≥ 60 years n = 200	Fall prevalence (multiple falls) 23.2% Fracture: Hip 45%, ankle 18%, wrist 15%	Risk factors: Advanced age, male gender, joint stiffness, lower limb weakness, loss of balance and coordination, visual deficits, medications
Asia					
Hong Kong Low, 2008	Estimate the incidence and prediction for falls in a Chinese population resident in Hong Kong Determine environmental characteristics of outdoor falls	Prospective survey of patients presenting to hospital with history of a fall using Analytical functions of a Geographic Information System (GIS)	Age ≥ 20 years n = 488	Outdoor falls n=281 203 (72%) age > 64 years Outdoor falls are as common as indoor falls in the elderly Hot spots for falls: Busy streets and junctions; refuse collection points; outdoor markets Major reasons for falls: uneven and wet slippery floors	The design of walker friendly built environments will reduce outdoor falls

Table 2.7 (continued)

Region country and author /s	Study aim	Study Design	Sample	Findings	Comment
Lok, 2006	Assess the relation between mortality and recurrent falls	Cohort study Record review of an Elderly Health Service Cohort database (1998-2000) and death records to 2003 Cross-sectional	Age ≥ 65 years n = 56,167	Association between recurrent falls and mortality: All cause mortality, RR 1.38 (1.18-1.61) Stroke mortality, RR 2.09 (1.45-3.08) Cardiovascular mortality, 148 (108-203) Respiratory disease mortality, 1.60 (1.11-2.32)	Recurrent falls has a positive association with all cause and specific disease mortality
Lui, 2005	To investigate the validity and reliability of the Chinese Modified Falls Efficacy Scale (CMPES) in community dwelling older people	Prospective cohort design Six-month follow up Fall occurrence recorded	Age ≥ 65 years n =152	Inter-rater reliability, intra-class correlation coefficient was 0.97, intra-rater reliability 0.94. At cut-off point of 9.5, sensitivity was 67 % , specificity 54%	The CMFES was a reliable tool for measuring fear of falls and was predictive of falls
Maw, 2002	Determine risk factors for falls in community-dwelling elderly	Cross-sectional study Hospital based recruitment Fall in previous 6 months	Age ≥ 65 years n = 12 920 Attendants of Elderly Health Centres	Fall prevalence: 15.5%	Risk factors for falls: Female gender, older age, history of falls, musculoskeletal problem, urinary incontinence, depression, higher education, availability of a caregiver, receipt of comprehensive social security

Table 2.8: Risk factors for falls in older persons, by category

Biological/Intrinsic	Behavioural	Socio-economic	Environmental
Impaired mobility History of falls	Fear of falling	Low income	Poor building design and/or maintenance
Balance deficit	Multiple medications	Poor living condition	Slippery or uneven surface
Gait deficit	Excessive alcohol	Lack of transport	Obstacle and trip hazards
Muscle weakness	Lack of exercise	Living alone	Home hazards, rugs, lack of hand rails and grab bars, easy access toilets
Advanced age	Inappropriate footwear/clothing	Poor nutrition	
Visual impairment	Risk taking behaviour		
Acute illness	Inappropriate assistance devices use		
Chronic illness/ Disability Stroke Dementia Arthritis Diabetes Heart disease Incontinence	Lack of sleep		

Adapted from Scott and others, 2007.

Biological risk factors include advanced age and gender which are non-modifiable; impaired mobility due to deficits in balance and gait, and muscle weakness; and chronic medical conditions – such as cognitive impairment, stroke, Parkinson's disease, rheumatic disease, cardiovascular disease, bladder and bowel problems, and foot disorders, visual impairment and acute illness, and history of falls, which is merely an indication of underlying cause for the propensity to fall. *Behavioural* risk factors include fear of falling; use of medications; excessive alcohol intake; risk taking behaviours such as climbing on chairs or stools to reach difficult to reach places; lack of exercise; inappropriate foot wear and clothing; use of assistive

devices; and poor nutrition. *Social and economic* risk factors include low income, a low education level; living alone; and poor living conditions. *Environmental* risk factors include home hazards (a lack of hand rails, throw rugs and mats, loose carpets, electrical cords, cluttered floors, poorly lit or poorly designed stairs, slippery floors, lack of aids such as grab bars or hand rails in showers or baths); and outdoor hazards (poor lighting), slippery or uneven surfaces, ramps and stairways, obstacles and trip hazards in the immediate and community environment, poor building design and/or maintenance, and a lack of places to rest (Scott and others, 2001).

This review of the literature on risk factors for falls focuses primarily on factors reported in prospective community-based studies, where there is likely to be strong interaction, or causality association of risk factors with a fall outcome. The interrelationship of older persons who fall, and intrinsic and extrinsic causal factors of the fall is then discussed.

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2.3.1 Biological factors

Biological risk factors include a continuum of normal ageing-related changes to those secondary to pathology. Normal ageing is accompanied by sensory, neuromuscular, neurological and metabolic changes which affect gait and balance (Lam, 2011; Lord & Ward, 1994; Lord, Sherrington & Menz, 2007; Sudarsky, 1990). Risk factors secondary to pathology include medical conditions that affect the normal functioning of a body system.

2.3.1.1 Impaired mobility

Balance and gait deficits (Biderman and others, 2002; Bootsma-van der Wiel and others, 2003; Cesari and others, 2002; Chu, Chi & Chiu, 2005; Covinsky and others, 2001; Graafmans and others, 1996; Luukinen and others, 1996; Nevitt and others, 1989), muscular weakness of lower extremity (Graafmans and others, 1996; Luukinen and others, 1995; Nevitt and others, 1989; Tinetti, Speechley & Ginter,

1988; Tinetti and others, 1995) and upper limbs (Campbell, Borrie & Spears, 1989; Tinetti and others, 1995; Tromp and others, 2001) have been investigated insofar as they impair mobility (Moreland and others, 2004). The foci of the studies have varied from those reporting associations with any fall (Bootsma-van der Wiel and others, 2003; Cesari and others, 2002; Chu, Chi & Chiu, 2005; Covinsky and others, 2001; Graafmans and others, 1996), to those focusing on recurrent fallers (Biderman and others, 2002; Bootsma-van der Wiel and others, 2003; Chu, Chi & Chiu, 2005; Graafmans and others, 1996; Luukinen and others, 1996; Nevitt and others, 1989) and injurious falls (Kosk and others, 1996; O'Loughlin and others, 1993; Vellas and others, 1998). Gait and balance disorders affect 20-40% of people age > 65 years and 40-50% of those aged >85, and are known to have multifactorial causation (Rubenstein, Josephson & Robbins, 1994; Sudarsky, 1990). Changes in gait and balance impair an individual's ability to control or correct posture in order to avoid falling after slipping or tripping (Gehlsen & Whaley, 1990; Pijnappels and others, 2008; Rubenstein, 2006).

2.3.1.2 Gender and age

Gender has been reported as a risk factor for falls in some studies (Chu, Chi & Chiu, 2005; Friedman and others, 2002; Gassmann, Rupprecht & Freiberger, 2009; Graafmans and others, 1996; Luukinen and others, 1996; O'Loughlin and others, 1993; Perracini & Ramos, 2002; Reyes-Ortiz and others, 2004; Salva and others, 2004; Tromp and others, 1998; Tromp and others, 2001; Vellas and others, 1998), but has not been found to be a significant risk factor in other studies (Bootsma-van der Wiel and others, 2003; Cesari and others, 2002; Clough-Gorr and others, 2008; Snijder and others, 2006; Stel and others, 2003b; Tinetti and others, 1995; Van Der Velde and others, 2007). It has been argued that older women have a greater number of comorbid conditions, higher medication usage and higher rates of depression than men, which may predispose them to falls, as well as greater fear of falling, and more gait and balance disorders (Chu, Chi & Chiu, 2005). Advanced age as such has not been shown to contribute to falls, but to changes associated with

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ageing; falls and recurrent falls are nevertheless a common occurrence in persons aged 80 years and over (Chu, Chi & Chiu, 2005; Delbaere and others, 2006; Pluijm and others, 2006). Changes in the visual system (acuity, depth perception, contrast sensitivity and field of vision), vestibular system, and somatosensory system (proprioception, muscle weakness), and cognitive changes have been identified as factors contributing to falls (Pijnappels and others, 2008). Poor postural control, poor muscle strength and tone, gait disorders, slow reflex responsiveness resulting from ageing related changes have been shown to impair ability to stop a fall (Rubenstein, 2006).

2.3.1.3 Chronic conditions and acute illness

Several studies have examined and found an association between medical conditions and falls (and/or recurrent falls), and mental health conditions (cognitive impairment and depression). Cognitive impairment has been reported as a risk factor for falls (Biderman and others, 2002; Bootsma-van der Wiel and others, 2003; Chu, Chi & Chiu, 2005; Graafmans and others, 1996; Luukinen and others, 1996; Stalenhoef and others, 2002; Stel and others, 2003a; Stel and others, 2003b; Stone and others, 2008; Tinetti, Speechley & Ginter, 1988; Tinetti and others, 1995; Tromp and others, 1998; van Bemmel and others, 2005). Cognitive impairment diminishes an ability to correct posture in order to recover balance and prevent falls (Hauer and others, 2003). Impaired judgement, poor attention span, impaired set shifting and dual tasking, and visuospatial dysfunction are additional risk factors for falling (Hauer and others, 2003; Rubenstein & Josephson, 2002). Depression has been reported as a risk factor for falls (Bergland & Wyller, 2004; Berkman and others, 1986; Biderman and others, 2002; Bootsma-van der Wiel and others, 2003; Cesari and others, 2002; Gassmann, Rupprecht & Freiberger, 2009; Iinattiniemi, Jokelainen & Luukinen, 2009; Reyes-Ortiz and others, 2004; Tinetti, Speechley & Ginter, 1988; Tinetti and others, 1995; Tromp and others, 1998); indeed, depression and falls have common risk factors, which include poor self-rated health, poor cognitive status, impaired activities of daily living (ADL), frequent visits to a clinic and slow walking

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speed (Biderman and others, 2002). In addition, a link has been identified between depression and fear of falling (Arfken and others, 1994). Use of medications to treat depression, and behavioural and psychological disorders associated with cognitive impairment have been found to further compound a risk of falling (Rubenstein, 2006).

Cardiovascular disease has been noted to be a common cause of unexplained or recurrent falls (Rubenstein & Josephson, 2002; Rubenstein, 2006; Van Der Velde and others, 2007). Carotid sinus sensitivity and postprandial hypotension are more common causes of neurally mediated syncope in older persons than vaso-vagal syncope (Soteriades and others, 2002). Cardiovascular associated falls have greater mortality than non cardiovascular falls (Soteriades and others, 2002). Other common cardiovascular causes of falls are orthostatic hypotension (Chu, Chi & Chiu, 2005; Soteriades and others, 2002), and bradyarrythmias and tachyarrhythmia's (Cronin & Kenny, 2010; Sheldon and others, 2006). Orthostatic hypotension and an association with falls warrants further investigation, as it has a multitude of causes (drug use, warm environment and food and alcohol ingestion (Mathias & Kimber, 1998).

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Other chronic medical conditions that affect balance and gait have been identified as risk factors for falls and recurrent falls such as stroke (Chu, Chi & Chiu, 2005; Graafmans and others, 1996; Luukinen and others, 1996; Stone and others, 2008; Tinetti and others, 1995; Tromp and others, 1998; van Schoor and others, 2002); Parkinson's disease (Chu, Chi & Chiu, 2005; Fink and others, 2005; Friedman and others, 2002; Nevitt and others, 1989; Northridge, Nevitt & Kelsey, 1996; Stone and others, 2008); rheumatic disorders (Chu, Chi & Chiu, 2005; Hanlon and others, 2002; Northridge, Nevitt & Kelsey, 1996; Perracini & Ramos, 2002; Reyes-Ortiz and others, 2004; Reyes-Ortiz, Al Snih & Markides, 2005; Stel and others, 2003a; Stel and others, 2003b; Tromp and others, 1998; Tromp and others, 2001); and injurious falls (Bergland & Wyller, 2004). Visual impairment as a risk factor for falls has been

reported in a number of studies (Bergland & Wyller, 2004; Bootsma-van der Wiel and others, 2003; Chu, Chi & Chiu, 2005; Heesch, Byles & Brown, 2008; Nevitt and others, 1989; Perracini & Ramos, 2002; Pluijm and others, 2006; Reyes-Ortiz and others, 2004; Stel and others, 2003a; Tinetti and others, 1995; Tinetti and others, 1995; Tromp and others, 1998). Trips, slips, bumping into objects and impaired judgement increase the risk of a fall in visually impaired older persons, especially in the presence of other risk factors for falls. Several studies have found urinary incontinence to be a risk factor (Gassmann, Rupprecht & Freiberger, 2009; Graafmans and others, 1996; Heesch, Byles & Brown, 2008; Luukinen and others, 1996; Nevitt and others, 1989; Pluijm and others, 2006; Stel and others, 2003a; Tinetti, Speechley & Ginter, 1988; Tinetti and others, 1995; Tromp and others, 1998; Tromp and others, 2001). Incontinence and urgency create distraction, and slip and trip hazards which predispose to a fall. Foot disorders such as corns, bunions, hallux valgus and resultant pain alter gait and balance, and increase a risk of falling (Chaiwanichsiri, Janchai & Tantisiriwat, 2009; Menz & Lord, 2001; Menz, Morris & Lord, 2006; Spink and others, 2011).

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Diabetes mellitus has been associated with an increased risk of falling due to effects from treatment, neurological disorders such as peripheral neuropathy and other foot disorders (Hanlon and others, 2002; Luukinen and others, 1996; Reyes-Ortiz and others, 2004; Schwartz and others, 2002). Apart from chronic conditions, acute illness is a risk factor for falls (O'Loughlin and others, 1993; Tinetti, Franklin Williams & Mayewski, 1986; Tinetti, 2003). Falls can represent a “non-specific” presentation of acute illness in old age. The mechanism of increased falls is not known. However, the effects of weakness, fever and dehydration, dizziness and other symptoms as well as from effects of medication treatments may contribute to an increased risk of falling. Other chronic medical conditions associated with an increased risk of falling include dizziness and vertigo (Bootsma-van der Wiel and others, 2003; Gassmann, Rupprecht & Freiberger, 2009; Graafmans and others, 1996; Luukinen and others, 1996; Pluijm and others, 2006; Stel and others, 2003a; Tinetti and others, 1995;

Tinetti and others, 1995; Tromp and others, 2001), and hearing impairment (Pluijm and others, 2006; Stel and others, 2003a; Stel and others, 2003a; Tinetti and others, 1995). The number of comorbid conditions (Bergland & Wyller, 2004; Covinsky and others, 2001; Friedman and others, 2002; Gassmann, Rupprecht & Freiberger, 2009; Heesch, Byles & Brown, 2008; Perracini & Ramos, 2002; Pluijm and others, 2006; Stone and others, 2008; Tinetti, Speechley & Ginter, 1988; Tinetti and others, 1995; Tromp and others, 1998; Tromp and others, 2001), self perceived health (Biderman and others, 2002; Gassmann, Rupprecht & Freiberger, 2009; Iinattiniemi, Jokelainen & Luukinen, 2009; Perracini & Ramos, 2002; Stel and others, 2003a; Tinetti and others, 1995) and pain (Arden and others, 1999; Leveille and others, 2002; Leveille and others, 2009; Nevitt and others, 1989; Pluijm and others, 2006; Stel and others, 2003a) have additionally been associated with falls.

On the whole, a multiplicity of chronic conditions has been associated with falling, but more significantly in some studies than others. However, attribution of a degree of fall risk to specific medical conditions is problematic because the relative severity of a condition varies and the impact may be dependent on other attributes in an affected individual, such as physical and mental disability and impairment they cause, and the environment.

2.3.1.4 History of falls

Previous falls as a risk factor for falls has been investigated in several studies, and linked to an increase in risk of falling and recurrent falls (Bergland & Wyller, 2004; Bootsma-van der Wiel and others, 2003; Chu, Chi & Chiu, 2005; Clough-Gorr and others, 2008; Friedman and others, 2002; Graafmans and others, 1996; Iinattiniemi, Jokelainen & Luukinen, 2009; Orwoll and others, 2005; Orwoll and others, 2006; Pluijm and others, 2006; Stel and others, 2003a; Teno, Kiel & Mor, 1990; Tinetti, Speechley & Ginter, 1988; Tromp and others, 2001; van Bemmel and others, 2005; Van Der Velde and others, 2007). Lord (Lord, Menz & Tiedemann, 2003) argues that while a history of falls is not a risk factor itself, underlying physiological deficits that

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predispose to falls that are amenable to prevention (through corrective postural action) are risk factors. Previous falls, fear of falls and increased risk of falls are interrelated (National Collaborating Centre for Nursing and Supportive Care (UK), 2004; Public Health Agency of Canada. Division of Aging and Seniors, 2005) which complicates decision making on causality of falls.

2.3.2 Behavioural factors

Behavioural risk factors for falling broadly include an individual's actions, choices and emotions. Fear of falling, use of medications, excessive alcohol intake, risk taking behaviour, a lack of exercise, use of assistive devices, inappropriate clothing and footwear are included in this group of factors.

2.3.2.1 Medication use

Medication use and an increased risk of falling have been investigated extensively, although the approaches of studies have varied. Some researchers have reported the total number of medications as a risk factor for falls (Biderman and others, 2002; Clough-Gorr and others, 2008; Delbaere and others, 2006; Gassmann, Rupprecht & Freiberger, 2009; Luukinen and others, 1995; Pluijm and others, 2006; Tinetti and others, 1995; Tromp and others, 1998; Tromp and others, 2001). After adjusting for comorbid conditions, polypharmacy (≥ 5 drugs) has been found to increase a risk of falling (Ziere and others, 2006). Other studies have found no significant association between number of medications and falling (Bergland & Wyller, 2004; Davis and others, 1999; Gassmann, Rupprecht & Freiberger, 2009; Hanlon and others, 2002; Perracini & Ramos, 2002). Yet other studies have reported an increased risk of falls with use of specific groups of drugs such as sedatives (Bootsma-van der Wiel and others, 2003; Chu, Chi & Chiu, 2005; Ensrud and others, 2002; Friedman and others, 2002; Hanlon and others, 2002; Luukinen and others, 1995; Nevitt and others, 1989; Stone and others, 2008; Tinetti, Speechley & Ginter, 1988; Tinetti and others, 1995; Tromp and others, 2001), and antihypertensive (Cauley and others,

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1993; Chu, Chi & Chiu, 2005; Tinetti and others, 1995; Tromp and others, 1998). Use of benzodiazepines has been found to increase risk of a fall regardless of half life or period of use (Ensrud and others, 2002; Neutel, Perry & Maxwell, 2002; Ray, Thapa & Gideon, 2000; Wang and others, 2001), and concomitant use of two or more benzodiazepines increased hip fracture risk by 2-fold (Pierfitte and others, 2001).

Other groups of medications studied include antiepileptic drugs (Cauley and others, 1993; Ensrud and others, 2002; Luukinen and others, 1995; Tinetti, Speechley & Ginter, 1988; Tromp and others, 1998; Tromp and others, 2001). Antiepileptic drugs have been shown to be a risk factor for falls; their use has moreover increased, as they are increasingly used for pain control (Savica and others, 2007). Antidepressants, including tricyclic antidepressants (TCAs) and selective serotonin reuptake inhibitors (SSRIs) have been associated with falls and/or fractures (Chaimowicz, Ferreira & Miguel, 2000; Ensrud and others, 2002; Wang and others, 2001; Kelly and others, 2003; Liu and others, 1998; Hubbard and others, 2003). The risk in this case is reported to be dose dependent and to persist even after long-term use (Thapa and others, 1998). However, some studies have found no association between antidepressants and risk of falls (Bergland & Wyller, 2004; Graafmans and others, 1996; Mustard & Mayer, 1997; Tromp and others, 2001). Antipsychotic drugs including the new atypical antipsychotic drugs have been found to increase risk of falls (Katz and others, 2004; Mustard & Mayer, 1997; Neutel, Perry & Maxwell, 2002). Nonetheless, as with other medication, findings have been contradictory, with some studies finding no association between falls and antipsychotic drugs (Bergland & Wyller, 2004; Ebly, Hogan & Fung, 1997; Kallin and others, 2002). Medications other than central nervous system modifying drugs have also been linked to increased fall risk, and include cardiovascular drugs such as beta blockers, nitrates, and other vasodilators (Bergland & Wyller, 2004; Graafmans and others, 1996; Rozenfeld, Camacho & Veras, 2003).

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An association between falls and medication use has been variably reported across studies. The inconsistency may be explained in that only a few studies have been designed specifically to investigate an association, and definitions of drug groups investigated have varied. The studies have commonly been observational and not randomised controlled trials for the study of a particular drug and fall risk. An additional problem in community-based studies, in particular, is that few study participants would have been on a particular drug, which reduced the power of the study to detect any association. Uncontrolled confounders that may lead to erroneous conclusions is another problem, and the prescribing pattern itself may be influenced by a need to limit fall risk.

2.3.2.2 Alcohol intake

Studies on an association between alcohol and falls have been few and their findings contradictory. Studies to have found an association are those of Kanis (2005), Mukamal (2004), Kurtzhaler (2005) , Lima (2009), Cawthon (2006) and Pluijm (2006) (Kanis and others, 2005; Mukamal and others, 2004; Kurzthaler and others, 2005; Lima and others, 2009; Cawthon and others, 2006; Pluijm and others, 2006). Mukamal and others, (2004) reported a 25 per cent increase in falls in individuals who consumed ≥ 14 drinks a week in a sample of 5841 older people. Cawthon and others (2006) reported that a history of problem drinking (≥2 positive responses to CAGE questions) and heavy drinking (> 5 drinks on most days) was associated with greater risk of falling: RR 1.62 (1.33-1.97) and 1.50 (1.23-1.84), respectively. Binge drinking was not associated with falling at one year of follow-up, while recent light alcohol intake (≤ 13 drinks/week) was associated with an approximately 20 per cent lower risk of falling than no intake. Recent light alcohol use had a protective association with fall risk. Men with problem drinking tended to be less healthy than men without this problem. Lord and others (1993) found no association between alcohol intake and falls. O'Loughlin (1993) reported alcohol to be a protective factor against falls. Campbell and others (1989) found female abstainers had a high risk of falls. Contradictory reports across these studies may be due to decreased alcohol

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consumption in those with poor health and daily consumption of alcohol being a marker of good health. High risk drinkers may have died prematurely and not been drawn into samples. Major limitations of studies on the role of alcohol in falls in older persons are that alcohol intake is self-reported and not validated with a participant's completion of alcohol use diaries, liver function or other correlates of alcohol use. The reported amounts consumed are of dubious accuracy, and alcohol levels at the time of falling are unknown, making it difficult to attribute alcohol intake as a cause of the fall. While alcohol intake may be insufficient on its own to cause a fall, its interaction with medications such as benzodiazepines may certainly increase a risk of falling.

2.3.2.3 Physical activity/inactivity

Physical activity, or a lack thereof, has been found to increase a risk of falling. Physical activity is a part of normal life and is required to perform necessary activities, but increases opportunity to fall. A lack of activity with associated decrease in physical function, muscle weakness, poor balance and reduced bone mineral density has commonly been reported to increase a risk of falls and injurious falls (Biderman and others, 2002; Iinattiniemi, Jokelainen & Luukinen, 2009; Tinetti, Speechley & Ginter, 1988; Tinetti and others, 1995). However, some investigators have found no association between a lack of activity and falls (Bergland & Wyller, 2004; Covinsky and others, 2001; Graafmans and others, 1996; Luukinen and others, 1996; Pajala and others, 2006; Perracini & Ramos, 2002; Pluijm and others, 2006; Stel and others, 2003a; Teno, Kiel & Mor, 1990; Tromp and others, 2001). It has been argued that while physical activity increases exposure to falls, and may improve balance and muscle strength – and thus protect an individual from falling, a sedentary individual may reduce a risk of falling through reduced activity. Physical activity has been suggested to have a U-shaped association in which most inactive and most active individuals are at greatest risk of falling (Gregg, Pereira & Caspersen, 2000). An association between physical activity and falls has been equivocal partly due to varying study design, inclusion criteria, definition and

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measurement of physical activity, as well as control or lack thereof for confounders, which has led to contradictory findings reported in the literature.

2.3.2.4 Apparel, walking aids and body weight

Ill-fitting or inappropriate clothing and footwear (Koepsell and others, 2004; Tencer and others, 2004), use of a walking aid (Bootsma-van der Wiel and others, 2003; Chu, Chi & Chiu, 2005; Gassmann, Rupprecht & Freiberger, 2009; Graafmans and others, 1996; Luukinen and others, 1996; Reyes-Ortiz and others, 2004; Teno, Kiel & Mor, 1990; Tinetti, Speechley & Ginter, 1988; Tinetti and others, 1995) and body mass index (BMI) (Himes & Reynolds, 2012), have been reported as risk factors for falls. Walking aids may be a risk factor for falls if used inappropriately but are mostly a confounding factor for a fall as they are used by individuals with an increased propensity to fall. Obesity, and not underweight, has been reported to increase the risk of a fall compared to normal weight. Many falls occur during walking. The role of footwear in a risk of falling has been relatively under studied. Hazards linked to footwear include soles that are too thick which diminish an ability to sense the walk surface, treads that are too smooth and worn slippers which increase a likelihood of slips (Koepsell and others, 2004). High, narrow heels reduce the support base and predispose the wearer to instability and increased risk of a fall (Tencer and others, 2004). Despite knowledge of the risk of falls with ill fitting footwear, Dunn and others, (2004) reported that of 625 older persons interviewed, only 26 percent reported wearing sturdy shoes. Barriers to the use of sturdy shoes include foot problems, difficulty putting shoes on, cost, style and a lack of knowledge of their importance (Dunn and others, 1992). Poorly fitting clothing that is too long or is made of slippery material may contribute to tripping and slipping. Literature on clothing in this regard is scant in comparison to that of studies on footwear.

The literature on an association between body mass index (BMI) and risk of falling is inconclusive (Gassmann, Rupprecht & Freiberger, 2009; Hanlon and others, 2002; Pluijm and others, 2006; Stalenhoef and others, 2002; Tinetti, Speechley & Ginter,

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1988; Tinetti and others, 1995), but a high BMI has been reported to be protective against injurious falls (Vellas and others, 1998). Himes and others, (2012) reported the presence of chronic conditions and measured health problems (pain, dizziness and poor vision) only partially explained the greater risk of falling and limitation in activities of daily living following the fall in the obese. Only extreme obesity (BMI≥40 kg/m^2) was not associated with serious injury. Poor nutrition due to associated muscle weakness and reduced bone mineral density, and obesity with increased associated comorbidity and low physical activity would arguably be a risk factor for falls in comparison with intermediate BMI. A failure of studies to establish BMI and its association to fall risk highlights the complexity of attributing falls to a single causative factor. Both low (BMI< 18.5) and high (BMI >30) BMI may lead to decreased activity and reduced exposure to fall risk. The use of walking aids or assistive devices is a risk factor for falls in as much as balance and gait disorders, or muscle weakness that are present, but which complicates an understanding of the real cause of a fall (Letts and others, 2010).

2.3.3 Social and economic conditions

Low socio-economic status (SES) (here, a composite of low income, low education and poor housing) may predispose an individual to ill-health and lack of health care, and thereby constitute a risk factor for a fall. A poor living environment may additionally harbour hazards that contribute to falls. Studies on falls have tended not to collect standardised information on SES, and attempts to associate level of education, for example, and fall risk have had contradictory outcomes. In Brazil, Perracini and others, (2002) reported low education as a risk factor for falls, whereas Tinetti (1995), Tromp (2001) and Biderman (2002) found a high education level to be a risk factor. In Australia, Gill and others, (2002) found a high education level to be a protective factor and low income to increase a risk of falls. The majority of the studies (Chu, Chi & Chiu, 2005; Gassmann, Rupprecht & Freiberger, 2009; Hanlon and others, 2002; Heesch, Byles & Brown, 2008; Iinattiniemi, Jokelainen & Luukinen,

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2009; Pluijm and others, 2006; Snijder and others, 2006) have found no association between education level and falls.

Living arrangements, particularly living alone have been found to have a higher association with a risk of falls (Biderman and others, 2002; Bootsma-van der Wiel and others, 2003; Chu, Chi & Chiu, 2005; Gassmann, Rupprecht & Freiberger, 2009; Reyes-Ortiz and others, 2004; van Bemmel and others, 2005) than education level, where education is used as a single measure of SES. However, some studies have found no association between living alone and risk of falls (Bootsma-van der Wiel and others, 2003; Covinsky and others, 2001; Iinattiniemi, Jokelainen & Luukinen, 2009; Stalenhoef and others, 2002; Stel and others, 2003a; Teno, Kiel & Mor, 1990; Tromp and others, 1998). In a Hong Kong study, Leung and others, (2010) found that living alone was a protective factor against falling, the authors concluded that for Chinese older persons living alone does not mean social isolation, but having the resources and capacity to do so. Other studies in Hong Kong reported contradictory findings regarding fall risk and SES: Chu and others, (2005) found no association between occupation and fall risk, while Ho and others, (1996) found previous blue collar occupation was a protective factor. The role of SES in falls in older persons requires further study. There is a need moreover to use a standardised measure of SES to enable comparison of findings across studies.

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2.3.4 Environmental factors

Falls occur in a physical environment. Research on the role of the physical environment in the causation of falls has not been as robust as that for intrinsic causes of falls. In a review of 12 studies, Rubenstein (2006) reported that an environmental factor was the cause of 30 to 50 per cent of falls. The majority of studies that have included the environment as a risk factor for falls have focused on the indoor environment (Li and others, 2006). Studies that have examined outdoor environmental hazards as risk factors for falls have been both prospective (Carter and others, 2000; Cesari and others, 2002; Clemson, Cumming & Roland, 1996;

Fletcher & Hirdes, 2002; Gill, Williams & Tinetti, 2000; Nevitt and others, 1989; Northridge, Nevitt & Kelsey, 1996; Teno, Kiel & Mor, 1990; Tinetti, Speechley & Ginter, 1988; Tinetti, Speechley & Ginter, 1988) and retrospective (Carter and others, 2000; Cesari and others, 2002; Clemson, Cumming & Roland, 1996; Fletcher & Hirdes, 2002; Speechley and others, 2005), but in both cases the evidence is inconclusive. Some studies have positively linked the environment to falls (Carter and others, 1997; Carter and others, 2000; Cesari and others, 2002; Clemson, Cumming & Roland, 1996; Fletcher & Hirdes, 2002; Nevitt and others, 1989), while others have found no significant association (Gill, Williams & Tinetti, 2000; Northridge, Nevitt & Kelsey, 1996; Speechley and others, 2005; Studenski and others, 1994; Tinetti, Speechley & Ginter, 1988).

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Environmental hazards have been reported as causing falls in risk takers who tend to be relatively healthy (Li and others, 2006; Lord, Menz & Sherrington, 2006; Studenski and others, 1994). Differences in findings may be due to different methodologies used. Some of the studies (Northridge, Nevitt & Kelsey, 1996) have relied on self-reports of indoor hazards – thus relying on the older person's perception of the cause of the fall, and what is perceived to constitute a hazard. Others have specified the hazards investigated (Cesari and others, 2002; Fletcher & Hirdes, 2002; Studenski and others, 1994). Some prospective studies have itemised hazards for investigation (Clemson, Cumming & Roland, 1996; Gill, Williams & Tinetti, 2000). Retrospective studies have relied on recall of the fall and the hazard. In addition, varying sample size and number of environmental factors investigated have impacted the power of the studies to determine the significance of the factor under study.

2.3.5 Studies on risk factors for falls in developing countries

The majority of studies on risk factors for falls in developing countries have been retrospective (see Table 2.3). Only two studies, one in Brazil (Perracini & Ramos,

2002) and one in Hong Kong (Chu, Chi & Chiu, 2005), have investigated risk factors prospectively. Evidence of risk factors for a fall has also varied across studies in these regions, with most studies not adjusting for confounding factors such as age and gender. A majority of studies like those in developed countries reported that being female and of advanced age contributes to a higher risk of a fall. Other risk factors commonly identified in studies in developing regions include mobility problems, a history of falls, poor vision, medication use, an "unsafe" environment and chronic health problems such as heart disease, arthritis and diabetes. As in studies in developed regions, different combinations of risk factors have been associated with falls. However, none of the factors has differed substantially from risk factor evidence from developed regions (Tables 2.3–2.7), with the exception of the nature of environmental risks. In developing countries findings in this regard pertain to an increased risk of a fall due to a poorly maintained environment around the dwelling, for example roads (James, 2007; Poh-Chin and others, 2009). In both developed regions and developing regions, a measure of the significance of the risk factor has tended to be expressed in different parameters such as relative risk, odds ratio and incidence ratio, and multivariate analysis to control for multiple factors has not been carried out.

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2.3.6 Interaction of intrinsic and extrinsic risk factors in the causation of falls

It is accepted that multiple factors often combine to cause a fall. The relative contribution of intrinsic and extrinsic factors to falls will vary by age, gender, frailty and so on, and will largely determine the location of a fall (Rubenstein, 2006). In community environments, environmental demands and hazards may play a significant role in contributing to a fall, whereas in nursing homes, where residents are likely to be frail (and sedentary), and exposed to fewer environmental hazards and demands than community dwellers, intrinsic factors will play a greater role (Rubenstein & Josephson, 2002). Where a fall occurs will depend moreover on an individual's level of activity. Active individuals, typically younger than 75 years, are

likely to sustain falls outside the home. Impaired and frail persons older than 75 years are more likely to fall inside the home (Bath & Morgan, 1999). In the latter group falls occur commonly on a level surface during activities which require alteration in the centre of gravity, e.g. reaching, bending, transferring, standing and walking (Lord and others, 1993). In independent community dwelling older persons, approximately half of falls occur around the home (Berg and others, 1997).

Falls in older men tend to occur outdoors such as in a garden, or yard while older women tend to fall inside the house (Bath & Morgan, 1999; Luukinen and others, 1994; Vellas and others, 1998). A few investigators have reported a predominance of outdoor falls (Blake and others, 1988; Hill and others, 1999; Li and others, 2006; Shin and others, 2009). However, even in these studies it is acknowledged that recurrent falls tend to occur indoors (Blake and others, 1988; Morris and others, 2004). In nursing homes and hospitals most falls occur at the bedside or in the bathroom, usually when the individual changes posture, e.g. rises from the bed, transfers to a chair, bed or toilet, or enters and exits the bathroom (Rubenstein & Josephson, 2002; Tinetti and others, 1995). Environmental hazards that contribute to these falls include wet floors due to urinary incontinence, spillage, poor lighting, improper bed height and bed rails (Rubenstein & Josephson, 2002).

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Falls in community dwellers occur mainly during day time (80 per cent), as this is the period of maximum activity (Berg and others, 1997; Campbell and others, 1990; Luukinen and others, 1994; Vellas and others, 1998), while falls in institutionalised individuals occur mainly at night (Luukinen and others, 1994). Trips and slips are the cause of the majority of falls (Berg and others, 1997; Blake and others, 1988; Hill and others, 1999; Li and others, 2006; Lord and others, 1993; Shin and others, 2009), as opposed to legs giving way, fainting or dizziness. Falls that occur indoors may result in hip fracture due to falling sideways and being frail, whereas falls that occur outdoors are likely to result in distal forearm fracture, suggesting that the individual was mobile and active, and attempted to prevent the fall with an

outstretched arm (Jarnlo & Thorngren, 1993; Nevitt & Cummings, 1993; Nordell and others, 2000).

Although methodologies used and the findings of studies on falls have varied widely, a number of risk factors have been consistently identified as associated with a fall. Table 2.9 summarises common risk factors for falls in community dwelling older persons as determined in prospective studies. Falls therefore have multifactorial causation, and the impact of a fall on an older person will vary depending on his/her physical and mental ability.

Falls risk factors are a complex network of interrelated features: causal or causal pathway, reverse causal or confounded. For example, depression is listed as a risk factor for a fall, but falls, injuries, fear of falls and the consequent restriction of activity could cause depression, as may a stroke or Parkinson's disease. Intervention and programmes to prevent falls can address the individualised risk and effects of falls, but which may be difficult to institute.

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Table 2.9: Sources on specific risk factors for falls in community dwelling older people, by biological, behavioural, socio-economic and environmental factors, and by country

Risk factor	Source	Country
A. Biological factors		
Age	Tinetti, 1998; Tinetti, 1995; Nevitti, 1989; Teno, 1990; Northridge, 1996; Convinsky, 2001; Reyes-Ortiz, 2004; Hanlon 2002	USA
	Tromp, 1998; Stalenhoef 2002	The Netherlands
	Delbaere, 2006	Belgium
	Cesari, 2002	Italy
	Salva, 2004	Spain
	*Chu, 2005	Hong Kong
Gender	O' Loughlin, 1993	Canada
	Graafmans, 1996; Tromp, 1998;Tromp, 2001	The Netherlands
	Vellas, 1998; Friedman, 2002; Reyes-Ortiz, 2004	USA
	Gassman, 2008	Germany
	Luukinen, 1996	Finland
	Salva, 2004	Spain
	*Chu, 2005	Hong Kong
	Perracini, 2002	Brazil
Balance and gait disorder	Nevitt, 1989; Vellas, 1998; Convinsky, 2001	USA
	Graafmans, 1996; Bootsmans, 2003	The Netherlands
	Luukinen, 1996; Koski, 1998	Finland
	Biderman, 2002	Israel
	*Chu, 2005	Hong Kong
	Cesari, 2002	Italy
	O'Loughlin, 1993	Canada
Muscular weakness	Tinetti; 1988; Nevitti, 1989; Tinetti, 1995	USA
	Luukinen, 1995	Finland
	Graafmans, 1996; Tromp, 2001	The Netherlands
	Campbell, 1989	New Zealand
Dizziness and vertigo	Tinetti, 1995	USA
	Graafmans, 1996; Tromp, 2001; Bootsma, 2003; Stel 2003; Pluijm, 2006	The Netherlands
	Luukinen, 1996	Finland
	Gassman, 2009	Germany
Cognitive impairment	Tinetti, 1988; Tinetti, 1995; Stone, 2008	USA
	*Perracinni 2002	Brazil
	Graafmans, 1996; Stel, 2003; Van Bemmel, 2005;	The Netherlands
	*Chu, 2005	Hong Kong

* Studies in developing countries.

Table 2.9 (continued)

Risk factor	Source	Country
Depression	Tinetti, 1988; Tinetti, 1995; Reyes-Ortiz, 2004	USA
	Cesari, 2002	Italy
	Biderman, 2002	Israel
	Bergland, 2003	Norway
	Bootsman, 2003	The Netherlands
	Gassman, 2008	Germany
	Iinattiniemi,2009	Finland
Cardiovascular disease		
Orthostatic hypotension	Soteriades, 2002	USA
	Chu, 2005	Hong Kong
	Soteriades, 2002	USA
Arrythymias	Sheldon, 2006	Canada
Stroke	Tinetti, 1996; Stone, 2008	USA
	Graafman, 1996; Tromp, 1998; Van Schoor, 2002	The Netherlands
	Luukinen, 1996	Finland
	*Chu, 2005	Hong Kong
Parkinson's disease	Nevitt, 1989; Northridge, 1996; Friedman, 2002; Fink, 2005; Stone, 2008	USA
	*Chu, 2005	Hong Kong
Rheumatic disorder	Northridge, 1996; Hanlon, 2002; Reyes-Ortiz, 2002	USA
	Tromp, 1998; Tromp, 2001; Stel, 2003	The Netherlands
	*Perracini, 2002	Brazil
	*Chu, 2005	Hong Kong
Visual impairment	Nevitt, 1989; Tinetti, 1995; Reyes-Ortiz, 2004	USA
	Tromp, 1998; Stel, 2003; Bootsman, 2003; Pluijm, 2006	The Netherlands
	*Perracini, 2002	Brazil
	Bergland, 2003	Norway
	*Chu, 2005	Hong Kong
	Heesch, 2007	Australia
Urinary incontinence	Tinetti, 1988; Nevitti, 1989; Tinetti, 1995	USA
	Graafmans, 1996; Tromp, 1998; Tromp, 2001; Pluijm, 2006	The Netherlands
	Luukinen, 1996 Stel 2003	Finland
	Heesch, 2008	Australia
	Gassmann, 2009	Germany
Foot disorders	Menz, 2001; Menz,2006	Australia
	*Chaiwanichsiri, 2009	Thailand
Diabetes mellitus	Luukinen, 1996	Finland
	Hanlon, 2002; Swartz, 2002; Reyes-Ortiz, 2004	USA
Acute illness	Tinetti, 1986; Tinetti, 2003	USA
	O'Loughlin, 1993	Canada
Hearing impairment	Tinetti, 1995	USA
	Tromp, 1998; Tromp, 2001; Stel, 2003; Pluijm, 2006	The Netherlands

* Studies in developing countries.

Table 2.9 (continued)

Risk factor	Source	Country
Comorbid conditions	Tinetti, 1995; Covinsky, 2001; Friedman, 2002	USA
	Tromp, 1998; Pluijm, 2006	The Netherlands
	Perracinni, 2002	Brazil
	Bergland, 2003	Norway
	Heesch, 2008	Finland
Self-perceived health	Tinetti, 1995	USA
	*Perracinni, 2002	Brazil
	Biderman, 2002	Israel
	Stel, 2003	The Netherlands
	Gassman, 2009	Germany
	Iinattiemi, 2009	Finland
Pain	Nevitt, 1989; Arden, 1999; Leveille, 2002	USA
	Stel, 2003; Pluijm, 2006	The Netherlands
History of falls	Tinetti, 1988; Teno, 1990; Covinsky, 2001; Friedman, 2002; Orwoll, 2006	USA
	Graafmans, 1996; Tromp, 2001; Pluijm, 2006; Van der Velde, 2007	The Netherlands
	Pajala, 2006	Finland
	Clough-Gorr, 2008	Europe – England, Germany; Switzerland
	Iinattiniemi, 2009	Finland
	B. Behavioural factors	
Total medications	Luukinen, 1995	Finland
	Tinetti, 1995	USA
	Tromp, 1998; Tromp, 2001; Pluijm, 2006	The Netherlands
	Biderman, 2002	Israel
	Gerdham, 2005	Sweden
	Delbaere, 2006	Belgium
	Clough-Gorr, 2008	Europe – England; Germany; Switzerland
	Gassmann	Germany
Sedatives	Tinetti, 1988; Nevitt, 1989; Tinetti, 1995; Ensrud, 2002; Friedman, 2002; Hanlon, 2002; Stone, 2008	USA
	Luukinen, 1995	Finland
	Tromp, 2001; Bootsman, 2003	The Netherlands
Antihypertensive	Cauley, 1993; Tinetti, 1995	USA
	Tromp, 1998	The Netherlands
	*Chu, 2005	Hong Kong

* Studies in developing countries.

Table 2.9 (continued)

Risk factor	Source	Country
Antiepileptics	Cauley, 1993; Tinetti, 1995; Ensrud, 2002	USA
	Luukinen, 1995	Finland
	Tromp, 1998; Tromp, 2001	The Netherlands
Antidepressants	Liu, 1998; Kelley, 2003	Canada
	*Chaimowicz, 2000	Brazil
	Wang, 2001; Ensrud, 2002	USA
Antipsychotics	Mustard, 1997; Neutel, 2002	Canada
	Katz, 2004	USA
Other cardiovascular drugs	Graafmans, 1996	The Netherlands
	*Rozenfield, 2003	Brazil
	Bergland, 2004	Norway
Alcohol use	Kanis, 2005	Multicentral – The Netherlands, Australia, Canada
	Mukamal, 2004	USA
	Kurtzhaler, 2005	Austria
	Pluijm, 2006	The Netherlands
	Lima, 2009	Brazil
Physical activity	Tinetti, 1988; Tinetti, 1995	USA
	Biderman, 2002	Israel
	Iinattiniemi, 2009	Finland
Footwear	Tencer, 2004; Koepsell, 2004	USA
Use of a walking aid	Tinetti, 1988; Teno, 1990; Tinetti, 1995; Reyes-Ortiz, 2004	USA
	Graafmans, 1996; Bootsma, 2003	The Netherlands
	Luukinen, 1995	Finland
	*Chu, 2005	Hong Kong
	Gassmann, 2008	Germany
C. Socioeconomic factors		
Education level	*Perracinni, 2002	Brazil
	Tinetti, 1995	USA
	Tromp, 2001	The Netherlands
	Biderman, 2002	Israel
Living arrangement (living alone)	Bootsma, 2003; Van Bemmel, 2005	The Netherlands
	Reyes-Ortiz, 2004	USA
	*Chu, 2005	Hong Kong
	Biderman, 2002	Israel
	Gassmann, 2008	Germany
Occupation	*Ho 1996	Hong Kong
D. Environmental factors		
Environmental	Nevitt, 1989	USA
	Carter, 2000	Australia
	Cesari, 2002	Italy
	Clemson, 1996	Australia
	Fletcher, 2002	Canada

* Studies in developing countries.

2.4 Consequences of falls

Falls in older persons can affect their well-being significantly. The effects of falls can result in increased morbidity and/or mortality, reduced functioning, fear of falling and premature nursing home admission. The consequences of falls – for individuals, societies and economies – have been studied fairly extensively.

2.4.1 Morbidity and mortality

Falls are the most common cause of trauma in older persons and the fifth leading cause of death in this age group (Grimm & Mion, 2011) after cardiovascular disease, cancer, stroke and pulmonary disorders (Society and others, 2001). Although a major cause of trauma in older people (Nevitt, Cummings & Hudes, 1991; Tinetti and others, 1995; Tinetti, 2003), between 35 and 60 per cent result only in minor soft tissue injuries (lacerations, bruises and other soft tissue injury) (Campbell, Borrie & Spears, 1989; Campbell and others, 1990; Downton & Andrews, 1991; Hale, Delaney & McGaghie, 1992; Hale, Delaney & McGaghie, 1992; Lord and others, 1993; Nevitt and others, 1989; Nevitt and others, 1989; O'Loughlin and others, 1993) that do not require medical attention. Major soft tissue injuries (lacerations with sutures, sprains, dislocation) occur in 0.5 – 8.9% of injuries (Campbell, Borrie & Spears, 1989; Campbell and others, 1990; Downton & Andrews, 1991; Hale, Delaney & McGaghie, 1992; Lord and others, 1993; Nevitt and others, 1989; O'Loughlin and others, 1993; Tinetti, Speechley & Ginter, 1988) and fall related fractures vary from 2.5 to 12 per cent and hip fractures from 0.2 to 2.6 per cent (Campbell, Borrie & Spears, 1989; Campbell and others, 1990; Downton & Andrews, 1991; Hale, Delaney & McGaghie, 1992; Lord and others, 1993; Nevitt and others, 1989; O'Loughlin and others, 1993; Tinetti, Speechley & Ginter, 1988; Tinetti, Liu & Claus, 1993; Wild, Nayak & Isaacs, 1981a; Wild, Nayak & Isaacs, 1981b). Advanced age (> 80 years), poor physical health, gait and balance disorders, which are associated with frailty, influence whether a fall will cause an injury (Vellas and others,

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1998). Women are 1.54 more times likely than men to sustain injuries from a fall (Vellas and others, 1998), although the mortality rate has been found to be higher in men (Berg and others, 1997; Sattin, 1992; Spaniolas and others, 2010; Vellas and others, 1998), as well as similar for men and women after the age of 75 (Donald & Bulpitt, 1999; Gregg, Pereira & Caspersen, 2000; Gribbin and others, 2009; Rubenstein & Josephson, 2002). Mortality rates differ between single and multiple fallers, being higher in multiple fallers. Occasional falls result primarily from extrinsic factors, such as environmental hazards, while repeated falls are the result of intrinsic factors, such as socio-demographic factors, chronic disease and disability. Indeed, several risk factors for falls may be measures of poor health, while multiple falls may indicate underlying conditions that increase the risk of death. Both multiple and single falls have been shown moreover not to predict mortality when demographic, chronic condition and disability variables are controlled simultaneously (Dunn and others, 1992).

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Falls account for 10 per cent of emergency department visits and 6 per cent of hospital admissions (Sai and others, 2010; Tinetti, 2003). Fall associated hospital admissions lead to prolonged hospital stays (Davison and others, 2005; Public Health Agency of Canada. Division of Aging and Seniors, 2005). Maguire (Maguire, Taylor & Stout, 1986) reported that less than half of patients admitted following a fall were discharged at 28 days, compared with patients with cardiovascular, chest, gastrointestinal and other disorders, of whom three quarters were discharged at 28 days. Compared to older persons admitted for other indications, those admitted following a fall, particularly recurrent or injurious falls, are more likely to be discharged to long-term care than other age matched individuals (Donald & Bulpitt, 1999; Grimm & Mion, 2011; Tinetti & Williams, 1997).

A direct comparison of the incidence of injuries following a fall in developed countries and developing countries is not possible. Studies on fall related injuries, particularly fractures in developing countries, have been largely hospital based, and have

focused on trauma in the general population and not the older population. Even in studies conducted on an older population, age inclusion criteria in some studies was as low as 50 years (Adebajo, Cooper & Evans, 1991; Lau and others, 2001; Valizadeh, Mazloomzadeh & Azizi, 2008). Types of injuries sustained following a fall in developing countries do not differ much from studies in developed countries. However, an injury complication such as an infected chronic ulcer following a laceration from a fall has been found more frequently in hotter climates and in countries with poor healthcare facilities (James, 2007). Fractures are the most common reported type of injury for those seen in an emergency department or admitted to a hospital (Adebajo, Cooper & Evans, 1991; Fabrício, Rodrigues & Costa Junior, 2004; James, 2007; Johnson, 2006; Kalula and others, 2008; Kalula and others, 2006; Krishnaswamy & Usha, 2008).

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Overall, a significant proportion of older people who survive a fall will suffer resultant morbidity with greater functional decline and increased dependence (Chu, Chiu & Chi, 2006; Dunn and others, 1992; Tinetti, Liu & Claus, 1993; Tinetti & Williams, 1998). Falls that do not cause serious injury may still have serious psychological sequelae for an older person, who may fear falling again, which leads to dependence and self-protective immobility (Tinetti, Speechley & Ginter, 1988; Vellas and others, 1997).

2.4.2 Fear of falling

Avoidance of activity due to fear of falling is common in older persons. In community dwelling older populations the prevalence rate of fear of falling ranges from 20 to 73 per cent; rates of 40 to 73 per cent have been found in recent fallers and 20 to 46 per cent in those not reporting a recent fall (Maki, 1997; Nevitt and others, 1989; Tinetti, Speechley & Ginter, 1988; Walker & Howland, 1991). Inability to get up from the floor following a fall and loss of confidence contribute significantly to fear of falling (Tinetti, Liu & Claus, 1993; Tinetti and others, 1994b).

Fear of falling often leads to physical (Cumming and others, 2000; Delbaere and others, 2006; Friedman and others, 2002), psychological (Arfken and others, 1994) and social (Suzuki and others, 2002; Tinetti and others, 1994b) changes in older individuals. Functional consequences resulting from fear of falling are reduced participation in and/or avoidance of certain activities (Howland and others, 1998; Murphy, Williams & Gill, 2002; Tinetti and others, 1994b). Social consequences include a reduced social activity (Suzuki and others, 2002; Tinetti and others, 1994b) resulting in social isolation. Psychological factors include depression leading to diminished quality of life (Arfken and others, 1994; Cumming and others, 2000; Murphy, Williams & Gill, 2002). Fear of falling and activity avoidance lead to further functional decline, with increased risk of falling and poor quality of life (Legters, 2002). It may be argued that falls and fear of falling are not directly related, but result from common underlying risk factors which include balance disturbance, cognitive status and visual problems that increase a risk of both outcomes (Howland and others, 1998; Lord, Clark & Webster, 1991). The shared risk factors expose such individuals to a cascade effect of functional decline, deconditioning and gait changes, and social isolation with an increased risk of more falls (Friedman and others, 2002; Maki, 1997). It is essential therefore that preventive strategies be targeted at such individuals (Friedman and others, 2002). Independent correlates of severe degrees of fear of falling and severe avoidance of activity due to fear of falling are: female gender, limitations in activities of daily living, a history of falls and age (Arfken and others, 1994; Friedman and others, 2002; Kempen and others, 2009; Murphy, Dubin & Gill, 2003), as well as intake of ≥ 4 medications and poor general health (Friedman and others, 2002) – all risk factors for falls. Falls and fear of falling predict one another. Fear of falling is therefore not merely an acute outcome of a fall, but recognition of being at risk of falling and adverse consequences of a fall (Cumming and others, 2000).

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The literature shows variation in the prevalence and risk factors for fear of falls. Different study outcomes are due to methodological differences such as sample size, which has ranged from 18 to 2497 persons (Scheffer and others, 2008); a lack of a standard classification for fear of falling and its consequences; and different assessment instruments. Variation in constructs used to measure fear of falling further complicate comparisons. Some studies use a dichotomous (yes/no) response to a single item to assess fear of falling, while others use more sensitive measures (self-efficacy, fear of falling and activity related measures) such as the Fall Efficacy Scale (FES) (Tinetti, Richman & Powell, 1990) and the Activity Specific Balance and Confidence Scale (ABC) (Powell & Myers, 1995). The majority of the studies have been cross-sectional and no conclusions can be drawn on causality. Prospective studies, although preferable, have shown substantial losses to follow-up. Subjects lost to follow up have tended to be older, to have greater functional impairment, and to have more cognitive problems and lower quality of life (Brouwer and others, 2003; Brouwer, Musselman & Culham, 2004; Delbaere and others, 2004; Murphy, Williams & Gill, 2002; Murphy, Dubin & Gill, 2003; Tinetti, Richman & Powell, 1990; Vellas and others, 1997; Vellas and others, 1998)). Some studies have included only persons with a previous history of a fall (Nevitt and others, 1989).

Despite such shortcomings in the studies, there is support for a high prevalence of fear of falling in older persons and multi-factorial associated factors. More prospective studies with adequate follow-up time are needed to study the natural course of fear of falling and its relation to falls and the efficacy of intervention (Scheffer and others, 2008). Measurement of fear of falling needs to be standardised and standardised instruments used for its measurement. Attention needs to be paid to physical and psychological consequences of falling, rather than falling *per se,* when investigating the impact of falls on function (Dunn and others, 1992; Wolinsky, Johnson & Fitzgerald, 1992).

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2.4.3 Costs of managing falls

A fall that results in injury is costly in terms of the impact on an individual's functional independence, or death, and health service utilisation (King & Tinetti, 1995). Multiple healthcare resources are utilised in the management of falls in older persons, and management costs of fatal and non-fatal falls are high (Stevens and others, 2006). Regardless of the healthcare system, studies in developed countries have highlighted the economic burden caused by fall related injuries (Carroll, Slattum & Cox, 2005; Gannon, O'Shea & Hudson, 2007; Hendrie and others, 2004; Shumway-Cook and others, 2009). Direct costs (hospitalisation, office based medical visits and home healthcare) from fall related medical conditions in older persons in the United States, for example, was earlier estimated at between \$6 and \$8 billion dollars per year in 2002 dollars (Carroll, Slattum & Cox, 2005). The mean cost per injured older person in the US was \$2039 in 1997 and \$2591 in 2002 (Carroll, Slattum & Cox, 2005). Another estimate of the cost of fall related injuries in the US was \$19.2 billion (in year 2000 dollars), with \$0.2 billion for fatal and \$19 billion for non-fatal falls (Stevens and others, 2006). In Western Australia, the cost of fall injury in older persons to the health system was \$86.4 million in 2001/2002 and accounted for 1.5 per cent of health expenditure for the region (Hendrie and others, 2004). In Ireland, it was €402 million and 0.32 per cent of Gross Domestic Product (GDP) (Gannon, O'Shea & Hudson, 2007). In a recent study in Australia, comparing health costs in older adults reporting no falls (\$7049) and those reporting one fall, total aggregate costs (\$ 9113) were reported as higher by \$2,000 (29%) in adults reporting one fall and among those reporting recurrent falls (\$12 647), \$5,600 (79%), and the total cost for fallers with injuries (\$13 507) were \$4,100 (44%) higher compared to those without injuries (\$9 387) (Shumway-Cook and others, 2009). The estimated cost of hospitalisation in 1999 was £981 million for the United Kingdom (Scuffham, Chaplin & Legood, 2003). Similarly high costs have been reported in Canada and Ireland (Gannon, O'Shea & Hudson, 2007).

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The highest proportion of the costs is expended on inpatient care and provider costs (Gannon, O'Shea & Hudson, 2007; Scuffham, Chaplin & Legood, 2003; Shumway-Cook and others, 2009). The total economic burden of falls will be significantly higher, as the estimates do not include non-medical, intangible and indirect costs. The cost of managing a fall increases with advancing age (Scott and others, 2011; Scuffham, Chaplin & Legood, 2003; Stevens and others, 2006). The young older population is managed in an Emergency Department (ED) and discharged, while the rate of hospitalisation of individuals aged ≥ 80 years who fall is high. The cost of treating falls in older people in an ED in 2005 in the US was $6.3 billion with $451 million for patients who were treated and released, and $5.8 billion for those hospitalised (Stevens and others, 2006). In tandem with gender differences in frequency of falls and injury rate, medical costs for injury in both groups were higher in women than men (Stevens and others, 2006).

The greatest part of management costs for falls is for a minority of serious injuries resulting from falls. However, hip fractures account for the majority of costs of hospitalisation (Cotter and others, 2006; Gannon, O'Shea & Hudson, 2007; Harris & Centre for Health Program Evaluation, 1998; Scott and others, 2011). An Australian study (Tiedemann and others, 2008b) monitored community dwelling older persons for falls and reported that hospital costs constituted 67 per cent of the total, even though only 4 per cent required hospitalisation, 3 per cent due to ED services, and 30 per cent from non-hospital based services such as medical and allied health care, pharmaceutical and diagnostic investigations. Although all studies report relatively high costs associated with falls, great variation is found in the costs. Indirect costs such as care from family and friends, transportation and loss of earning, quality of life are commonly not included in studies that estimate the cost of falls (Gannon, O'Shea & Hudson, 2007; Stevens and others, 2006). In addition to variation in cost items, the definition of a fall and fall related injuries, clinical outcomes that are reported (e.g. hip fracture, emergency department visits), unit of costing (per day, per week, per

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person, per fall etc), and period of follow-up during which total cost is summed up have also varied across studies (Davis and others, 2010).

A search of the literature on management costs of falls in developing countries yielded only one study (James, 2007): a retrospective epidemiological review of patient folders. Costing was done by listing procedures performed as recorded in the medical records. The costs reported from hospital records were higher than those from a community clinic, but would have been under estimated as not all relevant information would have been recorded, or indeed a fall may not have been recorded as the cause for seeking medical care.

However, with an increase in the number of "oldest old" people (> 85 years) globally, and as estimated in the US in 2020, the annual direct and indirect costs of fall related injuries are expected to reach $54.9 billion (Stevens and others, 2006). Other costs that extend beyond medical costs, which include but are not limited to loss of earnings, disability, and emotional distress on family and other associates, home adjustments and payments for long-term care, are not included (Stevens and others, 2006). This burden of healthcare costs from falls has similarly been articulated in Australia. If the current situation continues, it is estimated the country will need 2,500 additional beds permanently allocated to fall injury treatment and 3,320 additional nursing home places by 2051 (Moller, 2003).

Hence, successful evidence based fall prevention programmes and interventions are indicated, that are acceptable to the diverse population of older people. A reduction in the incidence of falls will lead to a reduction in the consequences of a fall for an individual and his/her carers, and a reduced economic burden on the individual, family, society and government, and resource savings.

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2.5 Intervention to prevent falls

While research in the 1980s focused on identifying risk factors for falls, a focus in the previous and current decades has been on fall prevention intervention. The literature shows that falls in older people are caused, in many circumstances, by identifiable and some modifiable risk factors; by implication, falls may therefore be prevented or reduced through intervention. The literature on fall prevention has burgeoned in recent years. Intervention targeted at risk factors has been shown to be effective in several published studies and reviews, including the Cochrane collaboration systematic reviews (Chang and others, 2004; Gillespie, 2004; Gillespie and others, 2009; Gillespie and others, 2003; Kannus and others, 2005; Sherrington and others, 2008).

Intervention to prevent falls has typically included multi-factorial fall risk assessment and management, exercises, environmental modification and education – defined by Gillespie and others (2009) and Chang (2004) as follows:

1) Multi-factorial fall risk assessment and management programmes are characterised by a post-fall assessment or a systematic risk assessment in individuals at risk of falling, and where falls were managed or referred for treatment, in order to reduce risk of a fall.
2) Exercise programmes include general as well as specific physical activities such as walking, cycling (Buchner and others, 1997; Brown & Holloszy, 1993), aerobic exercises and other endurance training exercises, as well as exercises targeted at balance, gait and strength, such as Tai Chi.
3) Environmental modification programmes include home visits by a professional who scrutinises the environment for known hazards for falls, and recommends or assists with implementation of the recommendations.
4) Education interventions range from distribution of pamphlets or posters directed at individuals, groups or communities, to more intensive face-to-face counselling about risk factors.

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Evidence presented in this review focuses on intervention to prevent or reduce falls in older people living in the community. Results shown mainly emanate from randomised controlled trials (Harbour & Miller, 2001).

The most comprehensive review to date on intervention to reduce falls in community dwelling older people is the most recent Cochrane Collaboration review of Gillespie and others (2009), which includes 111 trials involving 55,303 participants. The majority of the studies reviewed were individually randomised, with a few studies cluster randomised by community physician practices, retirement villages or senior centres. Of the 111 trials included, only seven were conducted in developing countries: Chile (1), China (1), Taiwan (3) and Thailand (2). A further search of the literature did not yield additional publications from developing countries. An array of combinations of intervention to prevent or reduce falls has been investigated, but the intervention is largely grouped as those that involve single, multiple or multi-factorial factors.

2.5.1 Single intervention

A single intervention is delivered to all participants in a study, and the intervention has mainly included exercise, vitamin D supplementation with or without calcium, surgical procedures, nutritional supplementation and environmental modification.

2.5.1.1 Physical exercises

Studies that examined the effect of physical exercise on risk of falls include reports where the exercise was unsupervised, such as walking, as in studies of Pereira (Pereira et al. 1998) and Resnick, (Resnick 2002). The majority of these studies have involved some supervision, either through telephonic reminders to encourage adherence, or supervision at the inception of the programme (Gillespie and others, 2009). In the majority of cases, however, intervention targeted groups (Ballard and others, 2004; Barnett and others, 2003; Buchner and others, 1997; Bunout and

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others, 2005; Carter and others, 2002;Lord, Menz & Tiedemann, 2003; Lord and others, 1995; Luukinen and others, 2007; Means, Rodell & O'Sullivan, 2005; Menz, Morris & Lord, 2005; Rubenstein & Josephson, 2000; Suzuki and others, 2004; Weerdesteyn and others, 2006), although in a few cases trials were carried out with individuals (Campbell and others, 1997; Campbell and others, 1999; Lin and others, 2007). The majority of the studies included exercises aimed at gait and balance training, strength and resistance training, and flexibility (Ashburn and others, 2007; Ballard and others, 2004; Barnett and others, 2003; Campbell and others, 1997; Campbell and others, 1999; Cerny and others, 1998; Day and others, 2002; Hauer and others, 2001; Li and others, 2005; Lin and others, 2007; Lord, Menz & Tiedemann, 2003; Lord and others, 1995; Means, Rodell & O'Sullivan, 2005; Morgan and others, 2004; Robertson and others, 2001; Skelton and others, 2005; Suzuki and others, 2004). Some studies offered Tai Chi (strength and balance training exercises) (Li and others, 2005; Voukelatos and others, 2007; Wolf and others, 1996; Wolf and others, 2003; Woo and others, 2007).

Pooled analyses demonstrated that exercise intervention is effective in reducing both rate and risk of falling (Gillespie and others, 2009). However, no difference was found in effectiveness between those with or without known risk factors. Exercise categories shown to be most effective have been multiple component group exercises which reduce both rate of fall (Rate ratio (RaR) 0.78, 95% CI 0.71 – 0.86) and number of fallers (Risk ratio (RR) 0.83, 95% CI 0.72 – 0.97). Tai Chi as a group exercise has also demonstrated a reduction in rate of falls (RaR 0.63, 95% CI 0.52 – 0.78), and a reduction in the number of fallers (RR 0.65, 95% CI 0.51-0.82). Multiple component individual home-based exercises have shown a reduction in rate of falls (RR 0.66, 95% CI 0.53 – 0.82) and in number of fallers (RR 0.77, 95% CI 0.61 – 0.97) (Gillespie and others, 2009).

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The role of exercise aimed at preventing falls in nursing home residents is inconclusive (Faber and others, 2006; Rosendahl and others, 2008; Sakamoto and others, 2006; Shimada and others, 2004); indeed, exercise may increase a risk of falling (Schoenfelder, 2000) in frail older persons (Barreca and others, 2004; Faber and others, 2006). It has been recommended that the rate of falls before and after institution of an intervention in these settings should be closely monitored (Cameron and others, 2010).

Methodological quality and diverse study populations contribute to inconsistent findings of these studies. Despite differences in inclusion criteria – and thus study participants, study design and type of exercise, there is agreement on the effect of exercise programmes in reducing the rate and risk of falling. However, more research is required with sufficiently powered studies to determine the optional type, duration, frequency and intensity of exercise programmes that is most effective in the older population (Gardner, Robertson & Campbell, 2000).

2.5.1.2 Vitamin D supplementation

A number of studies have explored the effect of vitamin D supplementation with calcium supplementation (Bischoff-Ferrari and others, 2004; Dhesi and others, 2004; Dukas and others, 2004; Harwood and others, 2004; Latham and others, 2003; Pfeifer and others, 2009; Porthouse and others, 2005; Sato and others, 1999; Smith and others, 2007; Trivedi, Doll & Khaw, 2003) or without calcium supplementation (Gallagher and others, 2001) in the prevention of falls in older people. Vitamin D supplementation has shown significant reduction in both rate (RR 0.57, 95% CI 0.37 – 0.89) and risk of falls (RR 0.65, CI 0.46 – 0.91), but only in individuals selected on the basis of low vitamin D level (Pfeifer and others, 2009; Porthouse and others, 2005).

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Although vitamin D may be effective in selected individuals, evidence is limited, based on only a few studies. In addition, an associated increased risk of hypercalcaemia exists with vitamin D supplementation (Dukas and others, 2004; Dukas, Schacht & Stahelin, 2005; Gallagher and others, 2001).

In contrast to the finding of inconclusive benefit of vitamin D supplementation in community dwelling older persons, the intervention has been shown to be effective in nursing home residents (Broe and others, 2007; Flicker and others, 2003; Law and others, 2006) – not surprisingly, with a characteristic high incidence of low vitamin D levels in these populations (Flicker and others, 2003).

2.5.1.3 Other medication withdrawal or modification

Psychotropic mediation withdrawal was shown to be effective in a placebo-controlled trial (Campbell and others, 1999), resulting in a reduction in rate of falls (RR 0.34, 95% CI 0.16 – 0.74), but no significant reduction in the number of fallers. Hormone Replacement Therapy (HRT) (Gallagher and others, 2001; Greenspan, Resnick & Parker, 2005) has been found not to have an effect on fall prevention, as was neither an intervention involving medication review and modification (Meredith and others, 2002). However, a study involving education of family physicians in prescribing and self assessment of medication use by their patients, as well as medication review and modification (Pit and others, 2007) was found to be effective in reducing the number of fallers (RR 0.61, 95% CI 0.41-0.91).

2.5.1.4 Surgery

Cardiac pacing in fallers with carotid sinus sensitivity (Kenny and others, 2001) was found to improve the rate of falls (RaR 0.42, 95% CI 0.23 – 0.75), but to have no effect on the number of people sustaining a facture. Expedited cataract surgery reduced the rate of falling by 34 per cent in an intervention group compared with controls awaiting surgery, but had no significant effect on the number of fallers. However, surgery on the second eye showed no effect (Foss and others, 2006).

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Contrary to these findings, an increase in rate and risk of falls was associated with correction of visual impairment in a study by Cumming (Cumming and others, 2007). It was suggested that changes in eyeglass prescription may adversely affect frail older people who may require time to adjust to a new prescription.

2.5.1.5 Nutrition therapy

A study with 46 participants (Gray-Donald, Payette & Boutier, 1995) that reviewed the efficacy of a 12-week period of high-energy, high-nutrition dietary supplementation in older people with a recent history of weight loss or with low body mass index failed to show an effect on fall risk.

2.5.1.6 Environmental intervention

The role of home safety environmental intervention alone has been investigated in a variety studies (Campbell and others, 2005; Cumming and others, 1999; Day and others, 2002; Lannin and others, 2007; Lin and others, 2007; Pardessus and others, 2002; Stevens, Holman & Bennett, 2001). The study of Campbell and others (2005) only included participants with severe visual impairment. Home safety intervention has not shown significance in reducing the rate or risk falling. However, in his study on severe visually impaired participants, Campbell and others (2005) reported a reduction in the rate of falls (RaR 0.59, 95% CI 0.42–0.83) with 41 per cent fewer falls, in those who received the home safety intervention compared to those who did not.

2.5.1.7 Hip protectors

Hip protectors may be effective in preventing hip fracture in frail older persons in nursing home settings, reducing the risk of fracture by 60 per cent (Kannus and others, 2000). However, their effectiveness has not been proven in community dwelling older persons (Rubenstein & Josephson, 2006). The most common problem with hip protectors is user compliance. In a study by Kannus and others, (2000), 31 per cent of the participants refused to wear hip protectors. Despite their refusal, the

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study reported that to prevent one hip fracture, only 41 persons need to use the protector for one year or eight persons for five years (Kannus and others, 2000).

2.5.2 Multiple intervention

Studies that included two or more major categories of single intervention discussed above are as follows: Some of these studies included an exercise component with another intervention such as vitamin D supplementation (Campbell and others, 2005); education and risk assessment (Shumway-Cook and others, 2007); a three-part study of varying combination of exercise with education, home safety and visual assessment (Day and others, 2002); home safety, education and clinical assessment in varying combinations (Steinberg and others, 2000); education and home safety (Clemson and others, 2004); fall prevention education (individualised) (Hill and others, 2008); nutritional supplement, and vitamin D and calcium (Swanenburg and others, 2007); and a study that excluded exercise but combined education as well as a free geriatric clinic assessment (Assantachai and others, 2002) and home safety with medical review (Carter and others, 1997). Multiple interventions, which vary from study to study, have shown inconsistent outcomes. A majority have shown no reduction in falls. Only Clemson and others, (2004) and Swanenburg (2007) have demonstrated a reduction in the rate of falls, but not in the number of fallers. Day and others, (2002) reported a reduction in the number of fallers, but not the rate of falls. However, Swanenburg (2007) points out that these results should be treated with caution as the study sample had only ten participants in each part of the intervention and control groups.

2.5.3 Multi-factorial intervention

Multi-factorial intervention consists of more than one main category, but a combination of which is individualised to an older person based on results of a risk assessment conducted by a team of health professionals (Gillespie and others,

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2009). The health professional either provides an intervention or recommendations on prevention, or a referral for management of risk factors. Several studies have implemented such interventions and as a group generally reports benefit in the intervention group compared to controls. However, significant reduction in the rate of falls was demonstrated in less than a third of these studies (Carpenter & Demopoulos, 1990; Close and others, 1999; Davison and others, 2005; Hogan and others, 2001; Hornbrook and others, 1994; Nikolaus & Bach, 2003; Tinetti and others, 1994a; Wyman and others, 2007). Gillespie and others, (2009) pooled data from 15 RCT for rate of falls, 26 RCT for number of falls and 7 RCT from risk of fracture to show no significant reduction in the number of fallers (RR 0.95 95% CI 0.88-1.02) or risk of fracture (RR 0.70, 95% CI 0.47 to 1.04), but a significant reduction in the rate of falls (RaR 0.75, 95% CI 0.65 to 0.86). On rare occasions, cognitive behaviour therapy has been included as part of a multi-factorial intervention strategy (Clemson and others, 2004; Coleman and others, 1999; Reinsch and others, 1992).

2.5.4 Intervention to prevent falls in developing countries

As with research on the epidemiology of falls, few studies have been conducted to test the effectiveness of fall intervention in developing countries; none have been tested in Africa. Of the 111 RCT included in the Cochrane review of interventions for preventing falls in older people living in the community, only seven were conducted in a developing country. Interventions in these studies included the following: In Chile, a community-based weight-bearing resistance training programme (Bunout and others, 2005); in China, Tai Chi and resistance exercise (Woo and others, 2007); in Taiwan, effectiveness of home visits on fall prevention (Huang & Acton, 2004), effectiveness of a discharge planning intervention in hospitalised elderly with hip fracture due to falling (Huang, 2005), and home-based exercise training and home safety assessment and modification (Lin and others, 2007); and in Thailand, the effect of education, a nurse visit and rehabilitation (Jitapunkul, 1998), and

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education with free access to a geriatric clinic (Assantachai and others, 2002). For studies in nursing care facilities and hospitals, the 2010 Cochrane review (Cameron and others, 2010) included 41 RCT, but only one study from a developing country – Korea. The study examines the effects of Tai Chi group exercises (Choi, Moon & Song, 2005).

In tandem with studies in developed countries, outcomes of the interventions were mixed, with interventions in some studies reporting significant effect (Assantachai and others, 2002; Huang & Acton, 2004; Lin and others, 2007; Woo and others, 2007), and in others, with no significant difference (Bunout and others, 2005; Choi, Moon & Song, 2005; Huang & Acton, 2004; Huang, 2005; Jitapunkul, 1998).

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2.5.5 Cost effectiveness of fall intervention programmes

Effective intervention should both reduce a hazardous outcome and be cost effective. It should also promote participants' adherence to the programme, and encourage buy-in from the community, society and government. Thus far, only a few studies on falls prevention intervention in community dwelling older persons have evaluated the cost effectiveness of the programmes. Potential cost servings were demonstrated in some of the studies (Buchner and others, 1997; Cumming and others, 1999; Harwood and others, 2005; Tinetti and others, 1994a). Cost savings were demonstrated for a home safety programme, as in a study by Cummings (1999), when delivered to high risk participants, particularly with previous falls (Salkeld and others, 2000). The Otago exercise programme (a home based strength and balance retraining programme) implemented in a study by Campbell (1997) showed savings through the prevention of fall related hospital admissions. Cost effectiveness was established for a multi-factorial intervention programme in a study by Tinetti (Tinetti and others, 1994a), and reported in a study of individuals with ≥ 4 of eight targeted risk factors, in terms of falls prevented and medical attention

required (Rizzo and others, 1996), as well as in the Harwood (2005) study on expedited cataract surgery (Sach and others, 2007).

In some studies interventions were found to be more costly than controls: Benefits of Tai Chi classes (1 hour a week for 16 weeks) (Voukelatos and others, 2007) and home visits by a nurse four times a week for three years (van Rossum and others, 1993), were inconclusive (Campbell and others, 2005; Coleman and others, 1999; Hendriks and others, 2008). Comparison of cost savings between studies is difficult due to differences in methodology, study duration, cost items and health systems. Adherence to the intervention may affect outcome and hence cost. Some studies have not grouped the cost according to study allocation, making comparisons difficult.

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Despite the diverse nature and contexts of the interventions, there is general agreement in the literature that fall prevention intervention is effective if targeted at high risk groups (known fallers), other than an unselected group of older people (Gillespie and others, 2009). A key challenge with fall prevention programmes for older persons is adherence. It is insufficient for an intervention to be efficient but unacceptable to recipients, as it will result in a high dropout rate. Guidelines of the National Institute for Clinical Excellence (2004) (National Collaborating Centre for Nursing and Supportive Care (UK), 2004), recommend that certain approaches should be adopted in order to encourage older people's participation in falls prevention programmes. Professionals should encourage a positive approach which emphasises healthy ageing rather than falls prevention; discuss which changes a person is willing to make to prevent falls; provide information that is relevant and in the recipients' preferred language; and address potential barriers such as fear of falls and low self-efficacy; and encourage the negotiated and planned level of activity with participants.

The effectiveness of intervention to reduce falls in older people has been the focus of a number of recent reviews. A UK study using a multifactorial intervention followed by a single occupational therapy home visit showed a 20 per cent reduction in falls in the intervention group compared to the control group (Close and others, 1999). A multiple risk factor intervention study with home visits showed a 12 per cent difference in fall rate between the control and intervention groups at one year follow-up (Tinetti and others, 1994a). The Frailty and Injuries: Co-operative Studies of Intervention Techniques (FICSIT) project combined various forms of exercise with other intervention. A meta-analysis of these studies showed that the exercise group had a 10 per cent lower risk of falling (Province and others, 1995)

A meta-analysis by Hill-Westmoreland, 2002 of 12 studies on fall prevention intervention that met the inclusion criteria concluded that an estimated overall effect size of 0.0779 on fall reduction from these studies translated into a 4 per cent decrease (from 52% to 48%) in the rate of falls for individuals who were in treatment groups receiving various fall prevention interventions (Hill-Westmoreland, Soeken & Spellbring, 2002). Exercise as a sole intervention has been found to be not statistically significant in reducing falls (Hill-Westmoreland, Soeken & Spellbring, 2002). Only specific types of exercise, those that use strength and balance training, Tai Chi and endurance exercise training have been reported to lower fall rate (Wolf and others, 1996, Campbell and others, 1999). However, exercise and risk modification programmes and programmes involving interdisciplinary comprehensive risk assessment and management were statistically significant. The most significant reduction on proportion of falls was demonstrated in community-based than in institution-based interventions (Hill-Westmoreland, Soeken & Spellbring, 2002). An explanation for the difference in the effect of intervention could be that individuals resident in the community generally tend to be less frail than those who reside in institution (Vu, Weintraub & Rubenstein, 2005).

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Interventions in high quality studies have demonstrated a significant reduction in proportion of falls, whereas low quality studies have not. Effects of fall prevention intervention are greatest when outcome is measured for long-term effect: in this case, 12 months after the intervention had been initiated, other than 4 months or less (Hill-Westmoreland, Soeken & Spellbring, 2002). More tightly controlled studies were more effective at fall prevention. Effect of fall prevention interventions on the proportion of falls were reported to be small (Hill-Westmoreland, Soeken & Spellbring, 2002). A recent systematic review and meta-analysis conducted on randomized controlled trials of fall prevention programmes conducted between 2000-2009 concluded that fall prevention programmes are effective in overall reduction of fall rates of 9 per cent with a reduction of 10 per cent in multi-factorial interventions, 9 per cent in community settings and 12 per cent in initial intervention efforts with subsequent follow-up (Choi & Hector, 2012). In general, fall prevention programmes have shown limited ability to reduce the risk of falls, with a relative risk reduction ranging from as low as 9 per cent to 30 per cent. Additional, appropriately properly designed studies are required to demonstrate the effectiveness of fall prevention interventions.

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2.6 Summary of the literature review

The review of literature on falls in older persons focused primarily on studies of community dwelling individuals. The greater part of the body of literature in the area of falls in older people emanates from developed countries. Where indicated, comparisons were made with evidence from developing countries. A major difference in knowledge on falls in the two broad regions is the abundant evidence in the developed regions relative to the sparse evidence in developing regions. A major gap in knowledge on falls in older persons in the latter regions lies in epidemiology, particularly in SSA, including South Africa. The present study will seek to address this gap, in part, as well as gaps in knowledge on risk factors for, and consequences

of a fall (summarised in sub-sections below) with a view to informing falls prevention intervention.

2.6.1 Incidence and prevalence of falls

Evidence from developed countries has established that falls are common in older persons, with 24 to 60 percent at risk of falling at least once a year. Prevalence and incidence rates vary within and between countries. The variation can be explained by heterogeneity and methodological differences in the studies, but environmental and cultural factors may play a role. The few studies in developing countries consistently report lower rates compared to those in developed countries. Reasons for this difference call for further investigation. A comparative lack of attention given to falls in developing countries limits understanding of the extent of the problem and leads to neglect in health planning and policy.

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2.6.2 Risk factors for falls

Evidence from developed countries clearly shows that falls result from multiple causative factors, some of which are modifiable and preventable. Over 400 different risk factors for falls have been proposed in the literature, with different combinations of risk factors being investigated in different studies. However, review studies on risk factor analyses for falls indicate that key risk factors can be identified, such as balance and gait disorders, and previous falls. These risk factors suggest that a multitude of underlying physiological and pathological changes are most commonly reported, with environmental and behavioural factors acting as a trigger for slips and trips. Hence, the location where a fall occurs is largely determined by an individual's physical and mental abilities. No major differences in risk factors for falls are evident between developed and developing regions, although studies in the latter regions are sparse and mainly retrospective. A gap in knowledge, and therefore areas in

need of exploration, is the influence of specific cultural, environmental and socio-economic factors on risk factors for falls in developing regions.

2.6.3 Consequences of falls

A fall in an older person can be a life changing event with physical, psychological and emotional consequences that impact ability to live independently. Fear of falls an important risk factor and a notable consequence of falls. Tangible and intangible costs of falls impact individuals, family, community and society. Determination and comparison of costs of falls in different communities remains a challenge for investigators in developed countries. The cost of falls and their impact on health services in developing countries need exploration, but are beyond the focus of this thesis.

2.6.4 Intervention to prevent falls

Consequences of falls in older persons, and risk factors' amenability to modification and prevention have led to the establishment, in some countries, of fall prevention strategies and programmes. Although programmes have been established in developed countries, their efficacy and cost effectiveness are not well known. Most convincing evidence supports multifactorial and unifactorial intervention such as exercise programmes targeted at high risk fallers, rather than random groups of older persons. Developing countries, in SSA in particular, generally lack fall prevention and health promotion programmes for older persons. Such deficiency has been recognised internationally and the WHO has emphasised an urgent need for research in this area.

Overall, the review of the relevant literature has demonstrated disparate knowledge in all areas of falls in older persons, between developed and developing countries. As population ageing evolves rapidly in developing regions, and falls as a disorder

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associated with ageing become more common, investigation and management of falls in these regions is called for urgently

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Chapter 3

Study methods

3.1 Introduction

This chapter describes the research design, the sampling strategy and selection criteria, the measurement tools used, the study procedure, statistical analysis of the data and ethical considerations. The study set out to establish the prevalence and associated risk factors for falls in older persons. Establishment of an association between a risk factor and a heath outcome requires a temporal relationship between the two. While a prospective study design with regular data collection would be preferable for such a study, the present study focused on the establishment of a baseline to reflect the existing situation regarding the significance of falls in the local older population. For this purpose, a cross-sectional survey design with follow-up at 12 months was deemed appropriate. To strengthen an association between risk factors and falls, the survey subjects were reassessed approximately 12 months after initial assessment. The results of the baseline and follow-up surveys could help to identify factors for consideration and inclusion in a prospective study. The execution of the study is described below.

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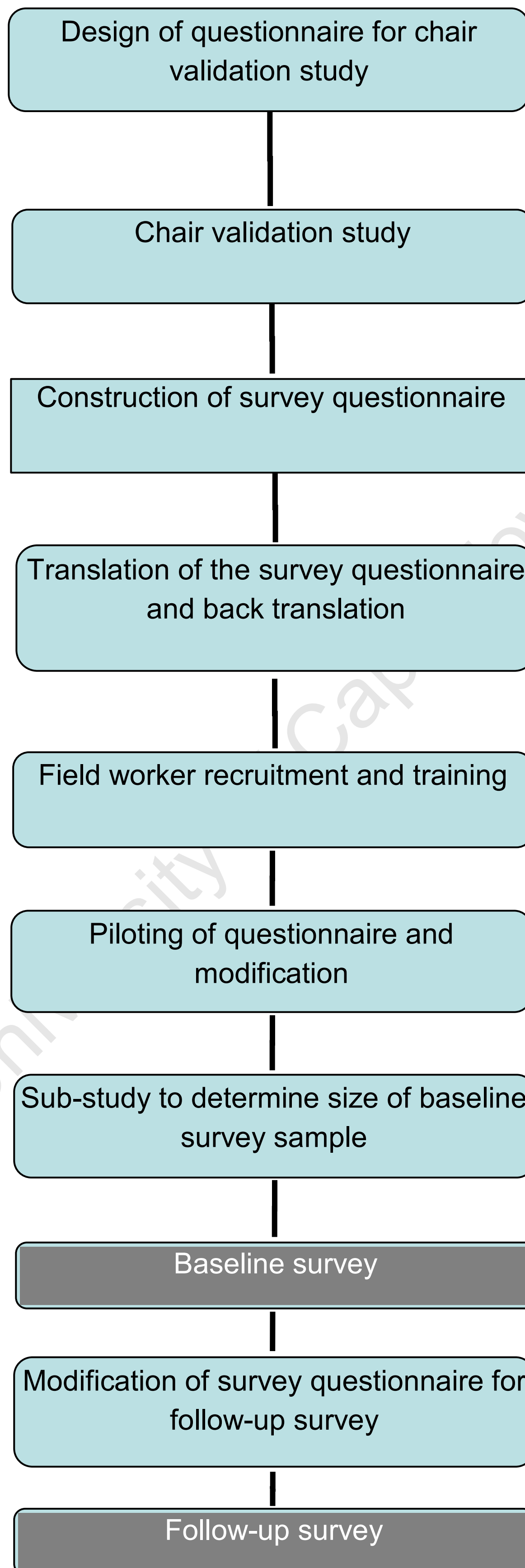
3.2 Research design

The research design for the study comprised a cross-sectional descriptive/analytic survey and a one-year follow-up survey. The study design sought to test an association between exposures (risk factors) and a health outcome (a fall). The methodological stages are shown diagrammatically in Figure 3.1 and are described in sub-sections below.

Figure 3.1: Diagrammatic presentation of the study stages



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3.2.1 Stages of the investigation

The stages in which the study was conducted are set out below.

3.2.1.1 Chair validation study.

A study was first conducted to validate a chair upon which subjects would sit and stand up in the assessment of their lower limb strength and balance, and according to time taken and ability to stand up from the chair and walk a measured distance. A standardised chair could not be used for this purpose (Siggeirsdóttir and others, 2002) for practical reasons (the assessments were made in the subjects' dwelling and not at central venue), and use of a substitute chair had to be validated first. The chair validation study, for which a questionnaire was specially designed, was conducted prior to the baseline survey.

3.2.1.2 Construction of the survey questionnaire

A survey questionnaire was constructed for the baseline and the follow-up surveys, pre-piloted, and translated and back-translated prior to administration in the baseline survey.

3.2.1.3 Recruitment and training of fieldworkers.

Field workers were recruited and trained in data collection: specifically, how to administer the questionnaire and how to use other measurement instruments. Before starting data collection, they piloted the questionnaires in the suburbs in which the study would be carried out.

3.2.1.4 Sub-study to calculate sample size

A sub-study was conducted to inform the calculation of the required sample size for the baseline survey.

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3.2.1.5 The baseline survey

The baseline survey was conducted over a period of 11 months from January 2009 to November 2009. Information was gathered on history of falls in the previous 12 months (fall prevalence) and the presence of risk factors known to be associated with falls (as reported in the literature). Physical assessments were performed to record measurements that might distinguish fallers and non-fallers. The term “fallers” is used in this context to depict a propensity to fall during a given activity or situation.

3.2.1.6 The follow-up survey.

The follow-up survey was conducted 12 months after the baseline survey. This survey assessed fall incidence/prevalence; compared an association between fall occurrence and associated risk factors for falls further; and performed physical assessments and measurements for fall risk assessment, as in the baseline survey.

3.2.2 Study area

The study was conducted in purposively selected suburbs of the Cape Town Metropolitan Area in the Western Cape Province. The Western Cape Province lies in the south west region of South Africa (see Figure 3.2). In 2011, the province had a population of 5 287 863, of which 6.1 per cent were aged 65 years and over (Statistics South Africa, 2011). The City of Cape Town is the capital of the province and has a population of approximately 3 497 097. The City of Cape Town Metropolitan municipality governs the City of Cape Town and its suburbs (City of Cape Town, 2011). A suburb refers here to a residential area.

The Cape Town Metropolitan Area was deemed a suitable site for the study. It has a multi-ethnic older population living in a variety of socio-economic conditions. The proportion of the population aged 60 years and over in the total population, 8 per cent, is higher than the national average of 7 per cent (Statistics South Africa, 2010).

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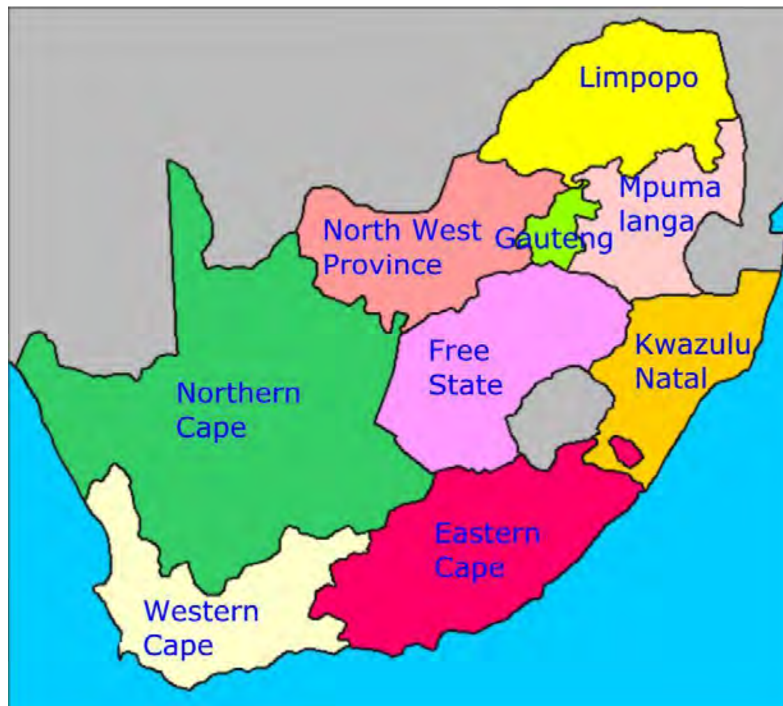
Figure 3.2: Map of South Africa, showing the Western Cape Province



Source: http://www.southafrica.to/provinces/RSA_by_provinces.jpg&imgrefurl= ved=1t:429,r:1,s:0.

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3.2.3 Study population

The selection of the suburbs and the sampling technique used in the study were as follows: A list of suburbs in the Cape Town Metropolitan municipality located in the catchment area of a tertiary referral health centre, Groote Schuur Hospital, was compiled. The suburbs were then grouped according to the proportion of the major ethnic group of the population. Under apartheid South African society was classified in four ethnic groups: Black Africans, persons of mixed race (coloureds), Indians and whites. This classification has been retained by the South African statistics office (Statistics South Africa, 2010). Most residential areas retain much of their previous racial profile.

The proportion of persons age 65 years and older was calculated for each suburb using the 2001 census data – the most recent national census data available for South Africa. One suburb with a high proportion (≥ 5.2%) of older persons from three

predominant ethnic groupings in the province (Black Africans, coloureds and whites) was selected as a study area. The basis of this selection was to achieve a study sample broadly representative of the population of the Cape Town Metropolitan municipality. Few Indians reside in the Western Cape and do not reside in specific suburbs; Indians were sampled within the suburbs selected but not according to a quota for the study. (The Indian/Asian population constitutes 2.6 per cent of the total South African population; Indians/Asians constitutes <1% of the older population of the Western Cape Province).

Three suburbs (see Figure 3.3) were selected as a sampling frame for the study: Plumstead (which has a majority white population), Wynberg Central (with a majority coloured population) and Gugulethu (with a majority black African population). In 2001 Plumstead had a total population of 18,660 with 2,864 persons (15%) aged 65 years and over; Wynberg had a population 12,821 with 1410 persons (11%) aged 65 years and over; and Gugulethu had a population of 61,113 with 3,419 persons (5.6%) in that age group (Statistics South Africa., 2003).

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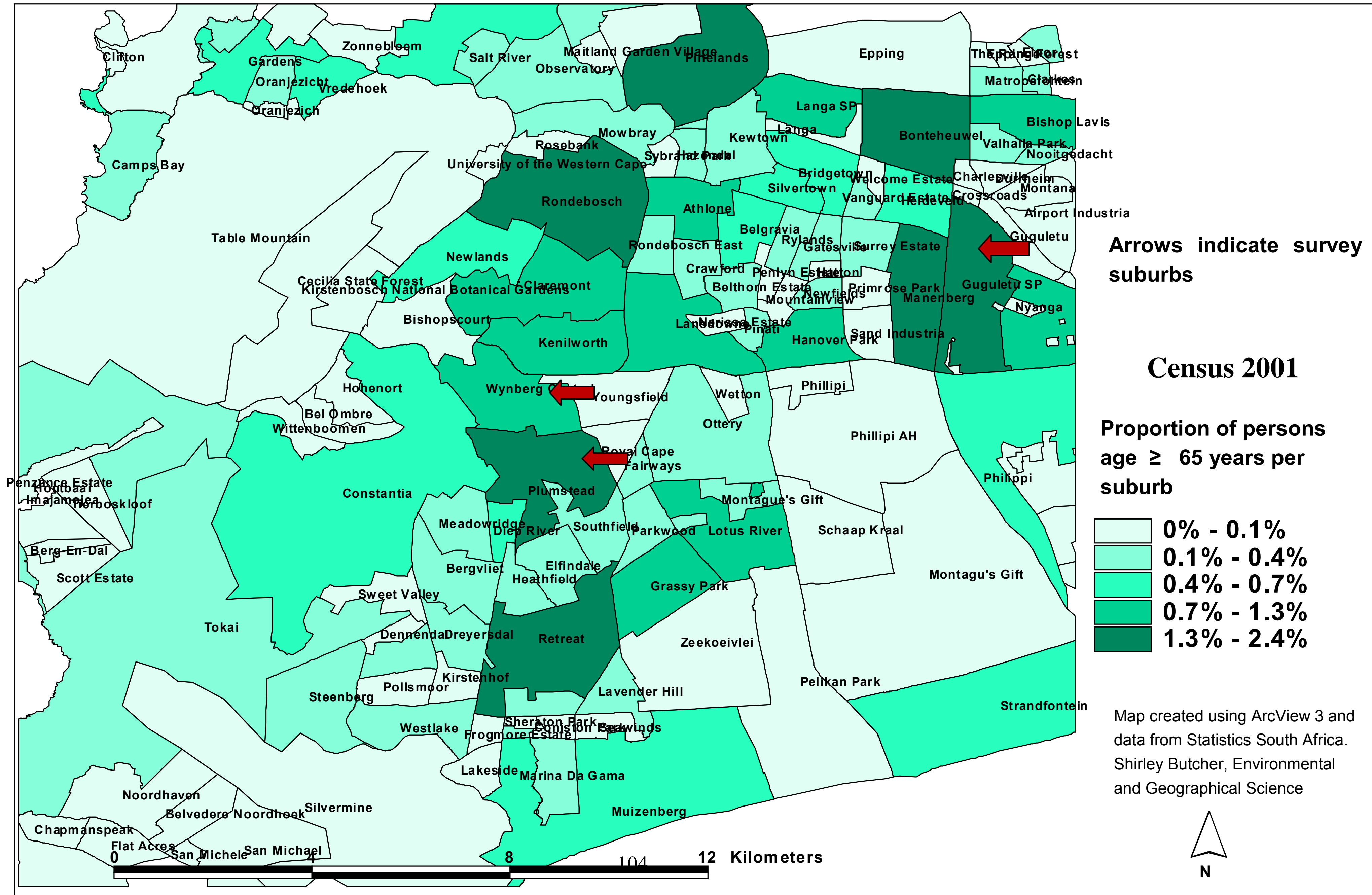
3.2.4 Sampling strategy

For confidentiality and security reasons, South Africa's Census Office does not provide names and addresses of citizens, which would indicate their suburb of residence. A sampling frame for research purposes cannot be generated from such a database. A multi-stage sampling method had to be used therefore, based on the Census Office's division of suburbs into smaller units referred to as Enumeration Areas (EAs). The intention of the Census Office is that each EA can be managed by a single enumerator, and every household in an EA can be visited within the time frame provided.

EAs were selected randomly for data collection for the study. Within an EA, a street was randomly selected as a starting point. Households on both sides of the street were sampled, commencing on the left side of the street, with a field worker visiting

Figure 3.3: Map of the Cape Town Metropolitan Area, showing suburbs in which the study was conducted.



households on that side and then the right side until all households in the sampling frame in a street had been visited. The field worker then moved on to the next street, again starting on the left.

As the proportion of older persons in the study suburbs was low in relation to the total population, from 5 to 15 per cent of the total older population, every household in the EA was visited in order to increase the probability of finding a subject who fitted the study criteria. Where an older resident who was approached declined to participate in the study, or where no occupants were found at a household after two visits, no further visits were made to the household. All refusals of older household occupants were recorded. The same sampling rule as for a street was applied in multi-household dwellings (blocks of flats); each flat was visited. Where more than one older person was found in a household, the oldest member who consented to be interviewed was selected for the sample. A decision to recruit an older member of the household was made in order to increase the number of male participants in the study. For the population age 65 years and over, the proportion of men in the Western Cape is 43.2 per cent. In most couples, the male spouse tends to be older than the female spouse. Fifty-two persons who met the study criteria refused to participate in the study. They gave reasons for refusal as a lack of interest in participation, being too busy, or already being in consultation with a general practitioner and seeing no need to discuss their health condition with another person.

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Criteria for the inclusion of study participants in the sample were as follows:

- Age 65 years or older
- Resident in one of the three suburbs in the sampling frame
- Able to walk independently, with or without a walking aid
- Ability to give informed consent to participate in the study.

Criteria for the exclusion of individuals from the sample were as follows:

- Resident in a care facility

- Being wheelchair bound or bed bound
- Not resident in a suburb within the sampling frame
- Inability to consent to participate in the study.
- Advanced dementia

3.2.5 Sub-study to determine sample size

A sub-study to determine the prevalence of falls and to calculate the sample size for the survey was conducted over a four-week period, from October to November 2008. The same sampling technique described for the baseline survey (section 3.2.4) was used for the sub-study. The sub-study was conducted among randomly selected, non-institutionalised subjects age 65 years and over resident in one of the three study suburbs (Gugulethu, Plumstead and Wynberg). Face to face interviews and all physical measurements were conducted according to the protocol for the survey. Data were collected using a questionnaire (Annexure 1), discussed under section 3.3.2.

A total of 105 subjects participated in the sub-study. Mean age for the subjects was 75.7 (SD 6.99) years. Seventy five (71%) were female. Twenty five (23.8 %) reported having fallen at least once, and eight (7.6%) reported having fallen more than twice in the previous 12-month period. With a fall prevalence of 23.8 per cent in this sample and a level of significance of 5 per cent, i.e. an acceptable margin of error on either side of the proportion of 5 per cent, and at 80 per cent power, the required sample size for the baseline survey was calculated as 280 (Dean, Sullivan & Soe M.M. 2011). To allow for comparisons between study populations from the three suburbs and ethnic groups, a sample of 280 was required from each suburb, with a total sample of 840.

The sample size was calculated using the formula:

$n = \frac{p(1-p)z^2}{d^2}$ where,

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n = sample size
p = expected population prevalence or proportion
d = precision required on either side of the proportion, the acceptable margin of error on either side of the proportion. For this study, d = 0.05
z = z statistic for the level of confidence. The chosen level of confidence was 95% and the z value (cut-off value of the Normal distribution) for this level of confidence is 1.96.

3.3 Instrumentation

Two questionnaires were designed for the study: A questionnaire for the chair validation study (Annexure 2) and one for the baseline survey (Annexure 1). The baseline survey questionnaire was modified for the follow-up study (Annexure 3). All questionnaires were piloted by field workers. Each questionnaire was piloted on five older persons who fitted the sample criteria and lived in one of the suburbs in the sampling frame. The questionnaires were piloted to test the appropriateness of items and to correct ambiguities, or to adjust the arrangement of items. Following piloting and modification, questionnaires B and C were translated from English into isiXhosa (the language spoken by a majority of the black African population in the Western Cape Province), and each questionnaire was back translated into English by two independent translators.

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3.3.1 Chair validation study questionnaire

The design of the chair validation study questionnaire (Annexure 2) provided for the collection of information on the subjects 1) socio-demographic characteristics, including age, gender, marital status and living arrangements; 2) chronic medical conditions, including arthritis, cardiovascular disease, chronic lung disease, diabetes and Parkinson’s disease; 3) mobility status and the use of walking aids; 4) history of falls in the previous 12 months; and 5) time taken to complete the timed Up and Go Test using a standard chair and the test chair.

3.3.2 Baseline survey questionnaire

A structured questionnaire which included a small number of open ended items was designed for the baseline survey. This questionnaire was also used for the sub-study conducted to calculate the sample size for the baseline survey. Variables for which data were collected were grouped in five domains: 1) Socio-demographic characteristics; 2) housing and environmental factors; 3) history of falls; 4) physical and mental health status; and 5) functional status and performance measures and biomarkers. The content of the five domains of the questionnaire was as follows:

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3.3.2.1 Socio-demographic information

Socio-demographic information included: age, gender, marital status, living arrangement, race (ethnicity), education, previous occupation, the older person's main source of income and the socio-economic status (SES) of the household, based on a score on an 8-item index of household items. The items, which had to be in working order, were electricity, a telephone or cellular phone, an electric or gas stove/burner, a television set, a radio or a hi-fi set, a refrigerator or deep freezer, a washing machine and a car

3.3.2.2 Housing and environment

Housing and environment information included duration of residence in the dwelling and suburb; housing circumstances – type of dwelling, i.e. formal or informal housing; number of co-residents; housing structure and main material of the floors; number of rooms, excluding the toilet and bathroom, used for sleeping; the main source of drinking water; the type of toilet facility; and the availability of electricity.

3.3.2.3 Falls

History of falls/recurrent fall/s in the past year and past 3 months inquired about the circumstances of the fall/s; events and symptoms associated with the fall/s; and types of injuries sustained, and medical attention sought and received. Specific items

in the questionnaire pertained to the occurrence of falls in the previous 12 months: the number of falls; whether the falls were reported; duration (months/weeks) since the last fall; location of the fall; the time of day of the fall; factors and symptoms associated with the fall; and circumstances surrounding the fall including activity at the time of fall. The questions aimed to determine the extent to which biological/intrinsic, behavioural, social and economic, and environmental factors contributed to the fall. Other questions inquired about whether there was any change in normal daily activities as a result of the fall. If a subject reported more than one fall, an enquiry was made of injuries sustained in any of the falls. In addition, all subjects were asked about fear of falling, with a "yes" or "no" answer, and to identify indoor and outdoor obstacles in their environment that might predispose them to fall.

3.3.2.4 Physical and mental health status

Information on subjects' general health was measured with the use of 1) a five-point self-rated health status scale ("Very good," "Good," "Average," "Poor" or "Very poor") and 2) perceived change in general health compared to a year ago. Level of mobility was measured with the use of a five-point scale on self-assessed mobility ("Can get around freely and independently," "Can get around but with difficulty," "Can get around but only with a cane," "Can get around but only with a frame" or "Cannot get around without the help of another person").

Overall health status was measured with the use of the Medical Outcomes Study Short Form – 36 (SF-36) health survey (Ware Jr, 2000). The SF-36 is a multipurpose generic measure of health status, and does not target a specific age, disease or treatment group. The SF-36 questionnaire comprises 36 questions and eight scales grouped in two components: 1) A physical component (physical function, role of physical function in limiting activity, bodily pain and general health perception; and 2) a mental component (mental health, role of emotion in limiting activity, social function and vitality (energy and fatigue) perception).

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To increase the sensitivity of responses to health status questions, the responses were graded: Responses were slightly modified to suit their application in the study population and to improve discrimination between answers. In the pilot study of the baseline questionnaire some respondents had difficulty in differentiating between response options “A good bit of the time” and “Some of the time”, and these responses were collapsed into one – “A good bit of the time” – and only this response was used. The response “Some of the time” in the original SF–36 was therefore omitted from the vitality responses, leaving “All of the time”, “Most of the time”, “A good bit of the time”, “A little of the time” and ”None of the time” as response options. Responses to the question on general health were also modified: five original responses were collapsed into four, to read “Very good”, “Good”, “Fair” and “Poor.” These modifications to the questions should not significantly affect the scoring. The scoring for each question ranges from 0-100 as recommended by the simplified scoring of the Rand 36-Item Health survey, which is identical to the MOS SF-36 (Rand 36-Item Health Survey 1.0). The total score for the subscales represent an average for all items in the subscale for which the subject gave a response. A high score defines a favourable health outcome. The responses will be scored as follows: the scoring range of 0-100 will change from (0, 20, 40, 60, 80, 100) for 6 graded responses to (0, 25, 50, 75, 100) for 5; (0, 33, 66, 100) for 4; (0, 50, 100) for 3; and (0, 100) for 2 responses respectively. Hence, there should not be a major change in the average score from the modifications to the questions.

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3.3.2.5 Mental health status

The Short Orientation Memory Concentration Test (SOMCT) (Katzman and others, 1983), also known as the 6 Item Cognitive Impairment Test (6 CIT), was used to screen for cognitive impairment. The six items include orientation: the year, month and time; attention – counting backwards from 20 to 1; saying months of the year backwards; and delayed recall of a learned address. Scores for the 6 CIT range from 0 to 28 with high scores signifying cognitive impairment. Using a cut off score of 7/8, the 6 CIT has sensitivity and specificity for early dementia of 78 % and 100 %,

respectively, in comparison to the the Mini-Mental State Examination (MMSE). The MMSE is a commonly used test for screening cognitive function (Folstein, Folstein & McHugh, 1975) at a conventional cut-off of 23/24. The MMSE has sensitivity of only 51% and specificity of 100% (Brooke & Bullock, 1999). The Short Orientation Memory Concentration Test was selected for use in this study because it has been validated a Xhosa speaking population similar to participants in this study (Brodrick, 2002).

The Geriatric Depression Scale (short form) (GDS) was used to screen for depression. The GDS was developed as a questionnaire measure of symptoms of depression (Yesavage and others, 1983). The original version has 30 questions and the shorter version 15. The scale is quick and simple to use. Scoring is with simple yes/no responses to depressive symptoms. Scores range from 0-15. A total score of 0-4 is normal, while a score of 5-10 points is suggestive of depression warranting follow-up assessment. Scores of >10 almost always indicate depression (Almeida & Almeida, 1999).

3.3.2.6 Chronic medical conditions

The presence of chronic medical conditions was based on self-report. A list of chronic medical conditions was compiled, derived from self-reported conditions for which significant association with decline in functional status has been reported in community-dwelling older persons (Stuck and others, 1999). The conditions included hypertension, stroke, Parkinson’s disease, diabetes, memory loss, depression, arthritis, chronic lung disease, ischaemic heart disease, peripheral vascular disease, heart failure, foot problems, dizziness or vertigo and cancer (including type). Subjects were asked if they had been told by a doctor or nurse they had this condition, and whether the condition/s was being treated with drug therapy.

Other conditions included in the list, but which were not necessarily being treated by a health professional, were self-reported visual or hearing deficit, and urinary

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incontinence. Vision was assessed based on self-reported ability to recognise a face at 4 metres (across the road) or to see objects at arm's length. Hearing was assessed based on self-reported ability to hear a direct conversation and an ability to follow group conversation. Urinary incontinence was assessed by the question "Do you ever lose control of your urine?"

A list of medications being taken by subjects and duration of their use (months or years) for the reported health conditions was recorded. Unless the containers had been discarded, the medications were recorded using their dispensing packaging. Included in the list of medications being taken were over-the-counter (OTC) medications, and herbal and traditional preparations. The Anatomical Therapeutic Chemical classification was used to categorise drugs (WHO Collaborating Centre for Drug Statistics Methodology, Norwegian Institute of Public Health, 2011).

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3.3.2.7 Health-related behaviour

Life-style habits were recorded as follows: Tobacco use was recorded as "Current", "Previous" or "Never". If current, the use was quantified: The number of cigarettes, and/or other forms of tobacco and snuff taken daily. Alcohol use was recorded as "Current", "Previous" or "Never". If current, use was recorded as the number of units of alcohol consumed per week. (One unit of alcohol was defined as one glass of wine, one (25 ml) measure of spirits, or half (284 ml) a pint of beer.

3.3.2.8 Anthropometrics, performance tests and biomarkers

Blood pressure and pulse, weight, height, and waist and hip circumference were measured in all subjects. Where a measurement was not recorded, field workers gave reasons in writing for the failure to record the measurement. The main reason for the failure to record these measurements was a participant's inability to stand. Immobility was an exclusion criterion for the study and no participants were immobile.

Blood pressure and pulse

Blood pressure and pulse were recorded by a trained field worker using Rossmax D150 automatic wrist blood pressure monitor. Blood pressure and pulse were recorded after five minutes in supine position and after standing for three minutes. Orthostatic hypotension was defined as a drop of ≥ 20 mmHg in systolic blood pressure and/or a drop of ≥ 10 mmHg in diastolic blood pressure from supine to standing blood pressure readings (Caird, Andrews & Kennedy, 1973; Dey, Stout & Kenny, 1997).

Height and weight

Height. Height was measured as follows: Standing height was measured with the subject barefoot, standing straight on a horizontal surface (floor) with the back against a wall, the head placed in the Frankfurt horizontal plane and the hands hanging by the sides. A flat and stiff measuring ruler was placed on a subject's head and a mark made where the ruler touched the wall. Using a tape measure, the vertical distance from the mark on the wall to the floor was recorded in centimetres to the nearest 0.5 centimetre. The use of a stadiometer was preferable to measure standing height, but due to budgetary constraints, was not feasible for the study.

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Weight. Body weight was measured in kilograms (kg) with a TANITA HA-521 Dial Bathroom Scale with a capacity of 130 kg. Measurements were recorded to the nearest 0.5 kg. The scale was placed on a horizontal, even surface and the dial adjusted to the "0" mark before each measurement. Wearing indoor clothing and barefoot, the subject was instructed to stand with feet equally apart on the scale platform. Body mass index (BMI) (weight (kg)/height (m^2)) was calculated. Overweight is defined as a BMI 25–29.9 kg/m^2 and obesity as a BMI ≥30 kg/m^2; underweight is defined as a BMI of <18 kg/m^2.

Waist and hip circumference

Waist circumference was recorded around the narrowest point viewed from the front of a subject, after exhaling. Hip circumference was measured at the point where the buttocks are maximally extended when viewed from the side. Waist/hip ratio is waist circumference in centimetres/hip circumference in centimetres. Abdominal obesity is defined as a ratio of >0.85 in women and 0.95 in men.

Muscle strength measurement

Muscle strength was measured as follows:

Hand grip strength. Upper limb strength was measured using handgrip. Grip strength in kilograms was measured with a portable, simple and quick to use Hydraulic Hand Dynamometer (Jamar 5030J, 1 Sammons Preston Rolyan, Bolingbrook, Illinois, USA) (AbleData, 2010). Prior to testing, subjects were asked whether they have had surgery to their hand or wrist in the past three months, or experienced arthritis or pain, and to indicate their dominant hand. Those with surgery, arthritis or pain were excluded from testing. The subject sat with the elbow held at 90 degrees, the palm facing in (as in shaking hands), and was asked to press the elbow against the body, grip the handle and squeeze as hard as possible when instructed to squeeze. Verbal encouragement was given to elicit maximal performance from the subjects. The test was performed three times in each hand with brief pauses between each reading. The average of the readings of the highest value for the right and left hand was used for the analysis.

Grip strength and tests of lower body muscle strength and balance have been proven to be a strong predictor of physical function and disability (Giampaoli and others, 1999; Rantanen and others, 1999), length of hospital stay (Kerr and others, 2006) and mortality (Laukkanen, Heikkinen & Kauppinen, 1995).

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Lower limb balance and strength. Lower limb balance and strength were measured as follows:

- **One legged flamingo stand (Unipedal stance).** A subject was asked to stand near a wall; to look straight ahead; to fold his/her arms across the chest; and to raise either leg off the floor to ankle height with one foot kept flat on the floor. The subject was then asked to maintain this posture for as long as possible. Recording of the time a subject could maintain this posture started when the subject lifted the foot, and stopped after the subject had maintained the posture for ≥ 30 seconds, or if there was loss of balance. Decreased unipedal stance time is associated with an increased risk to falls (Studenski, Duncan & Chandler, 1991).

- **Timed Get-up and Go Test.** The procedure followed in the study for the timed Up and Go (TUG) test followed that described by Podsiadlo and Richardson (1991). The performance of the TUG test is detailed in section 3.4.3. The timed "Up and Go" (TUG) Test (Podsiadlo & Richardson, 1991) measures the time taken for a person to arise from a standard armchair, walk 3 meters, turn 180°, walk back to the chair and sit down. The score is viewed as correlating with basic functional capacity, and may be used to follow functional change over time as well as to evaluate outcome of intervention, such as rehabilitation (Podsiadlo & Richardson, 1991; Sousa & Sampaio, 2005; Steffen, Hacker & Mollinger, 2002). Podsiadlo and Richardson (1991) found that subjects who completed the test in ≤ 20 seconds tended to be independent, while those who completed it in over 30 seconds needed assistance with activities of daily living (ADLs) and transfer tasks, and required an assistive device for mobility.

- **Chair stands (Sit-to-stand test).** To test for ability to rise from a chair, the subject was asked to sit in the straight backed chair placed on firm ground against a wall. The subject was asked to stand with arms folded across the chest.

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If this was done successfully the subject was asked to stand up and sit down five times as quickly as possible. Time from the initial sitting position to the end of the fifth stand was recorded in seconds. Quartiles of performance used to define scores were as follows: if < 11.1 seconds 4 points; 11.2 – 13.6 seconds 3 points; 13.7 – 16.6 seconds 2 points; > 16.7 seconds 1 point; unable to do test 0 points (Guralnik and others, 1995). The test is interpreted as normal if completed in 11 seconds or less.

The chair "Sit to stand" test is used in older individuals to test several functional components which contribute to overall performance, including muscle strength, balance, co-ordination, joint range of motion and exercise tolerance and psychological status (Lord and others, 2002). Mean time for completion increases with age and disability.

3.3.3 Follow-up survey questionnaire

The structure of the follow-up survey questionnaire (Annexure 3) was the same as that for the baseline survey questionnaire, with certain modification and additions. Major modification pertained to physical performance: an assessment of performance of basic activities of daily living (ADLs) (Katz and others, 1970) and instrumental activities of daily living (IADLs) (Lawton & Brody, 1969) was added. The ADLs and IADLs were added to complement the physical assessments. The ability to perform basic ADLs and IADLs is related to physical agility and a propensity to fall. Second, the test for lower body strength and balance evaluation, the "one-legged stand" was substituted with the "feet together" stand (Gardner and others, 2001; Rossiter-Fornoff and others, 1995), and the "near tandem stand" (Lord, Sherrington & Menz, 2007). In the follow up survey, subjects performed the "feet together" and "semi-tandem stance" tests as a test of lower limb balance, following on an observation in the baseline survey that several subjects had difficulty in performing the "one leg stand" test. Other modification was the removal of open

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ended questions on environmental obstacles that may predispose subjects to falls: the questions were asked only in the baseline survey and not in the follow-up survey.

3.3.3.1 Basic activities of daily living

The Katz Index of independence in activities of daily living (Katz and others, 1970) was used to assess ability to perform basic ADLs. The Katz Index is viewed as an excellent tool to evaluate health status and changes in health status in older persons through functional assessment (Wallace & Shelkey, 2007). The index ranks adequacy of performance in six functions of daily living: Bathing, dressing, toileting, transferring, continence and feeding. Clients are scored yes/no for independence in each of the six functions. A score of 6 indicates full function, while scores of 4 indicate moderate impairment, and of 2 or less, severe functional impairment. Assessment of mobility was omitted in this test as it was assessed under health information (sub-section 3.3.2.4)

3.3.3.2 The Lawton Instrumental Activities of Daily Living (IADL) scale

The Katz Index to assess performance of ADLs, although sensitive to changes in declining health status, does not assess performance of more advanced activities of daily living. Lawton and Brody (1969) developed another scale to assess performance of instrumental activities of daily living (IADLs) as a measure of independent living skills (Lawton & Brody, 1969). Eight domains are assessed which include housekeeping, shopping, managing finances, ability to use the telephone, food preparation, laundering, use of public transport and responsibility for own medications. The instrument is useful in assessing older people in community settings. The scale has been widely used in both clinical practice and research.

A summary score of the scale ranges from 0 (low function and dependent) to 8 (high function, independent). In the present study a ninth activity, “collecting pension,” was added; the majority of the subjects were social pensioners and are required to queue at pay points to collect their monthly pension money. An additional category, “Does

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not do this activity," was added, as in traditional African society men do not prepare food, keep house or do laundry.

3.3.3.3 "Feet together" test

The "feet together" test and the "near tandem stand" test were used to assess standing balance. For the "feet together" test a subject was asked to stand bare foot with feet together and eyes open. If required, the interviewer helped the person to assume the position. Timing started when the subject indicated he/she was ready to begin the test unaided. The subjects were encouraged to maintain this position for at least 10 seconds. Timing stopped if the subject moved his/her feet from the proper position, or touched either the wall or the interviewer for support. If the subject could not assume the position, the test failed at this stage.

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3.3.3.4 "Near tandem" stand test

The "near tandem" test is a modification of the tandem stand test (Lord and others, 1999; Tiedemann, Lord & Sherrington, 2010). The latter test has limited value as a screening test in older persons as many older persons find it difficult to perform. The "near tandem" test is a measure of lateral stability, essential for maintaining balance and preventing sideway falls. The test is simple to perform. Initially, the normal cut off score was 30 seconds, but following a recent validation study, a cut off point of 10 seconds has been recommended (Tiedemann, Lord & Sherrington, 2010). In performing the near tandem stand, the subject was asked to stand with feet parallel, and to position the feet so that the big toe is close to the heel of the other foot and to keep the big toe and heel 2.5 cm (1 inch) apart. When stable, the subject was asked to close his/her eyes. Timing started when the subject closed the eyes.

3.4 Chair validation study

Lower limb strength and balance are determinants of a risk of falling. The testing of lower limb strength and balance requires a chair. For the study, a chair with

specifications as determined in previous studies was required to perform these tests. As the present study was community based, and all measurements were conducted in subjects' dwellings, field workers were required to carry measuring instruments when visiting subjects. For this reason, a portable chair was required, that could be easily carried by the field workers. A standard 46 cm sitting height office chair recommended for the test of lower limb strength (Siggeirsdóttir and others, 2002) was not suitable for carrying on public transport. As it could not be known whether the use of a collapsible and therefore portable chair, as opposed to a "standard" chair, would affect the outcome of the tests such as the Timed Up and Go (TUG) test, a chair validation study was conducted in an older population with the characteristics of the survey population, to assess whether the chair type would influence the outcome of the TUG test.

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3.4.1 Sample

The cross-sectional chair validation study was conducted in older persons (N=118, mean age 77 years (SD 7.1, range 62-99 years)) recruited at multipurpose senior centres at sites in the Cape Town Metropole: Site 1: A retirement complex for independent living residents (n=55); site 2: An assisted living and frail care facility (n=25); and site 3: A home for the aged with semi-dependent living and a frail care facility (n=38). Ninety-eight subjects (83 %) were female. All subjects were able to walk independently, with or without a walking aid, and could understand simple verbal instructions. Participants in the chair validation study were not included in the baseline survey.

3.4.2 Instrument

The "standard" chair (chair A) used in other studies had firm cushions covered with synthetic PVC and a high straight backrest; a chair width of 51 centimetres (cm), seating depth of 45 cm, back rest height of 40 cm, armrest height of 71.5 cm and a

total chair height of 96 cm. The alternative (collapsible) chair (chair B) used in the present study had an aluminium frame, a firmly fitted canvas seat and back, a low and straight backrest, and padded armrests; a chair width of 50 centimetres (cm), seating depth of 42 cm, seat canvas width of 35 cm, back rest canvas width of 18 cm, armrest height 62 cm, a total chair height of 81 cm and a weight of 4 Kg. Both chairs have a standard 46 cm seat height (Figure 3.4).

3.4.3 Test procedure

Testing was performed by a trained occupational therapist and a research assistant at each of the three sites. The floor at all sites was level. At site 1, the floor had a linoleum cover, while at sites 2 and 3, the floor was carpeted. Test times were recorded on a specially constructed questionnaire (Annexure 2), described in section 3.3.1.

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The test was performed as follows: Chairs A and B were placed side by side, and a line drawn in front of the chairs' legs and another line drawn at a 30 cm distance in front of that line; a third line was drawn 3 metres in front of the chairs. The subjects were instructed to sit in a chair, with their back against the chair and their arms on the armrests. Wearing regular footwear, they were asked to place their feet between the two lines in front of the chair (to standardise their sitting posture prior to testing). At the word 'Go,' they were required to stand upright and to walk to the 3 metre line. Once they had crossed the line, they were required to turn round and walk back to the chair and sit down.

A stop watch was started on the word 'Go' and stopped when a subject returned to the starting position. A subject could use any walking aid that was customary for him or her. No physical assistance was given to the subjects. A pre-test was conducted using chair A (standard chair) to familiarise subjects with the test. Afterwards, the subjects were tested alternately using chair A or chair B first, and times recorded for

performance on both chairs were compared. Time was recorded to 1/100 of a second.

To assess for a difference in the scoring of the test, the standard chair (chair A) was used in a sub-sample of 55 subjects recruited at site 1. The occupational therapist and the research assistant simultaneously timed the 55 subjects performing the test. The raters were blinded to the results recorded by the other.

3.4.4 Statistical analysis

Baseline clinical and socio-demographic characteristics, and time measurements of the three groups were compared using the χ^2 test and the Wilcoxon signed rank test, whichever was appropriate. A p-value of < 0.05 was considered significant. Non-parametric tests were used due to the non-normality of the variables studied.

Time difference to complete the TUG test in the standard chair (chair A) and test chair (chair B) was calculated for each subject. A time difference of two seconds in performing the test in the two chairs by a subject was deemed acceptable. A binary variable was created using a difference of ≤ 2 seconds. A stepwise multivariate regression analysis was performed with a time difference to complete the TUG test on the two chairs of ≤ 2 seconds as a binary dependent variable. Variables considered for inclusion in the model were self-reported medical conditions, customary use of a walking aid, and self-reported difficulty with mobility, gender, age, marital status, use of a walking aid during testing, observed difficulty in mobility during testing, and a history of falls. Data were analysed using SPSS version 16 (2008).

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Figure 3.4: Standard chair (chair A) and test chair (chair B)

Chair A

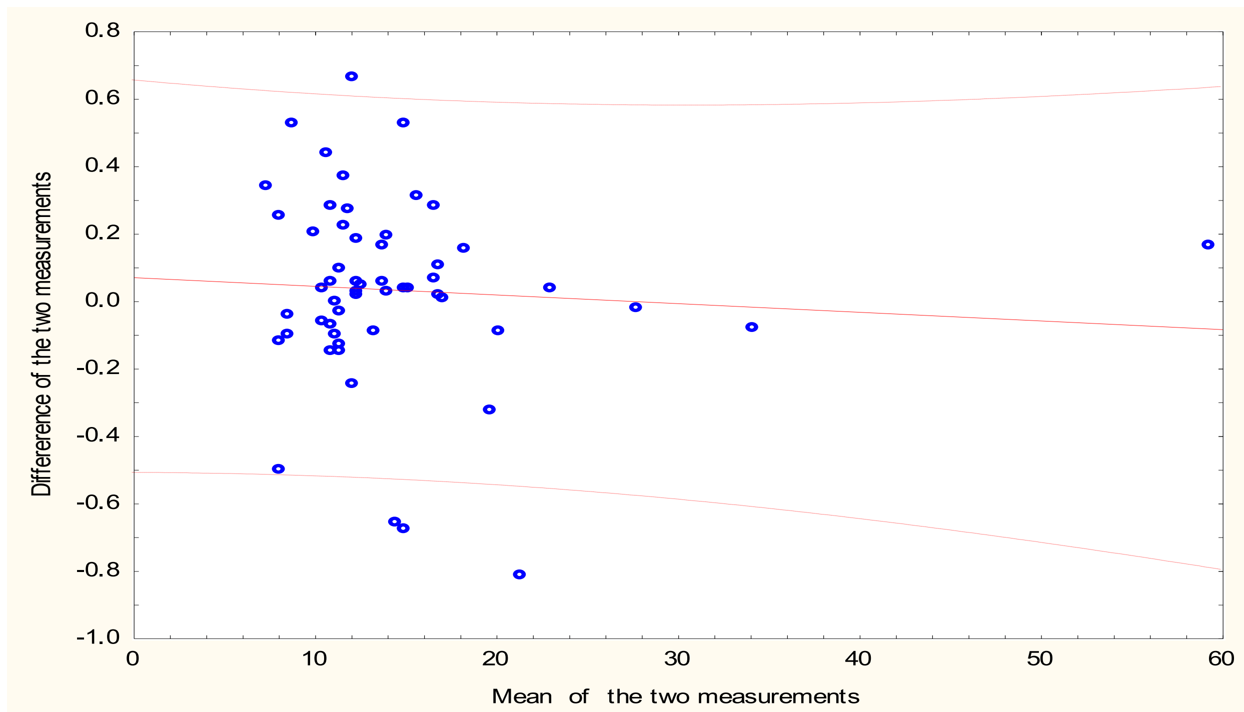
Chair B: Front view

Chair B: Side view

3.4.5 Results

All 118 subjects completed the test. Twenty two (18.6%) used a walking aid to perform the test. Thirty seven (31.4%) reported having fallen in the previous 12 months, with 11 (9.3%) reporting two or more falls. The subjects were observed and none faltered on rising from the test chair or sitting, and the chair stability was satisfactory. Time taken to complete the test did not differ by chair type [median (inter-quartile range, IQR) = 12.3 (9.53-15.9) and 12.6 (9.7-16.6)] seconds for chair A and chair B, respectively (p-value=0.87). Subjects who used a walking aid and/or

Figure 3.5: Bland-Altman plot for rater scores of the Up and Go test on the standard chair



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reported poor mobility took longer to complete the test, but this was true for both chairs.

No significant difference was found between time scores recorded by the two raters: median (IQR) = 12.4 (10.9-15.9) and 12.3 (11-15.6) seconds for the occupational therapist and for the research assistant, respectively (Wilcoxon matched pairs test, p=0.144). A Bland Altman plot (Figure 3.5) shows the mean of the measurements by the two raters against the difference between the two measurements. The points are distributed above and below the zero line suggesting no consistent bias between the measurements (Myles & Cui, 2007)..

It was concluded from this study that the use of a portable canvas chair with standardised specifications offers an acceptable alternative to the use of a

"standard" chair in assessments of fall risk using the TUG test. The chair could be used without influencing the score in field settings where field workers are reliant on public transport and cannot travel with a standard chair (Kalula and others, 2010).

3.5 Recruitment and training of the field workers

Field workers were recruited through recommendation by other researchers and by advertising in suburbs where the study would be conducted. They were recruited on the basis of their familiarity with the geography and population of the suburbs that constituted the sampling frame, as well as fluency in the language of residents of the suburb in which they would work. An educational level of at least 12 years of schooling was required.

Six field workers were recruited. They were all fluent in at least two languages of the study population: English and Afrikaans (4 interviewers), and English and isiXhosa (2 interviewers). Training of the field workers was conducted over five days by two researchers (the candidate and a researcher whose mother tongue is isiXhosa, and who is fluent in English and Afrikaans). The field workers were trained in obtaining informed consent from subjects, building rapport with them, techniques for interviewing older persons, administration of the questionnaires, and the use of the physical assessment instruments. They were also trained in how to introduce and explain the study and its purpose to subjects, or potential subjects.

Training of the field workers in anthropometrical measurements was given by the candidate, a physician. The field workers practised interviewing and recording measurements through role play in mock interviews with one another.

The six field workers then piloted the questionnaire on five older persons with broad characteristics of the survey population in each of the three suburbs (Gugulethu, Plumstead and Wynberg). Following the training and piloting of the questionnaire,

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two field workers who were conversant with interviewing and physical measurement techniques (one fluent in English and Afrikaans and one in English and isiXhosa) were recruited for the baseline survey. The other four field workers were discharged with counselling, because of assessed inability to conduct interviews and perform physical assessments satisfactorily. Re-training of the two field workers was given prior to the commencement of the follow-up survey.

3.6 Data collection

3.6.1 Baseline survey

The baseline survey was conducted in the three study suburbs over an 11-month period, from mid-January 2009 to November 2009. Data were collected in face to face interviews by the field workers who administered the questionnaire (Annexure 1), in the sequence of domains and items in the questionnaire. Functional assessments were carried out in the same interview following the administration of the questionnaire. The duration of the interviews ranged from approximately 60 to 90 minutes.

In general, the field workers reported that the subjects understood and responded to questions well. In some cases, they reported repeated interruptions from other household members, particularly young children. Every effort was made to interview a subject privately, but which was not always possible. Some subjects insisted that a family member be present during the interview. In some instances the small size of the dwelling and the presence of young children in the household prevented a field worker from ensuring that privacy was maintained. Household members' interjections in the interview were controlled as far as possible, and on all occasions, the subject's response, and not that of another person, was recorded. Information on the occurrences of falls was self-reported.

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Data collection was closely supervised by the candidate, who also checked completed questionnaires for inconsistencies and errors. If any omissions of information or errors were detected, a field worker had to return to the subject to rectify the omission or error. Weekly face to face feedback sessions were conducted with the interviewers. Random telephone calls to subjects were conducted by the candidate and constituted a 10 per cent back-check on all completed questionnaires. Back-checks were done to confirm that an interview had been conducted and data were valid. The candidate did not reassess these subjects, but a few logical inconsistencies in assessments were noted and had to be corrected by interviewers. Where necessary, a field worker was required to conduct an assessment again.

A total of 844 subjects were recruited for the baseline survey: Gugulethu: n=289, Plumstead: n=188 and Wynberg: n=367. The proportion of older persons aged ≥ 65 years living in the three sample suburbs were obtained from earlier census data which may have inaccuracies. For security reasons the Census Office does not provide specifics of age for a particular area of a suburb or for a household. No sampling frame could be created for data collection in any of the suburbs. Thus, systematic sampling was performed in order to achieve the most representative sample possible.

The main challenge to field workers in recruiting the sample and subsequent interviewing was gaining access to households. Due to safety concerns, numerous households, particularly in Plumstead with a predominant white population, are reluctant to allow a stranger, in this case a field worker, into their dwelling. Despite following the same sampling strategy employed in Gugulethu and Wynberg, the response rate in Plumstead was poor; only 188 subjects (67% of the required sample) were recruited after visiting 310 households. As a result, the population of older persons in Plumstead was under sampled, while that of Wynberg was over sampled. It was not possible to determine how many of the households had a member eligible for inclusion in the sample, as some occupants refused to answer

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any questions, other than indicate via an intercom system that “they were not interested in any study.” Of the 52 refusals that met the age inclusion criterion, 37 (71%) were in Plumstead.

3.6.2 Follow-up survey

The study subjects were revisited approximately 12 months after the baseline survey and interviewed again, using a modified questionnaire as described in section 3.4 (Annexure 3). For subject data comparison, the same subject survey identity number used for the baseline survey was used for each subject in the follow-up survey. The same interviewer who collected baseline data interviewed the subject at follow up. Written consent was again obtained from the subjects who indicated willingness to participate in the follow-up survey. Mortality status data were collected, as reported by household members, where subjects had died prior to follow-up. No inquiry was made as to the cause of death due to the unreliability of such information from lay sources and the inaccessibility of death certification. Death certificates must be accessed from the Home Office. For a death certificate to be retrieved, a national identity document number for the deceased has to be submitted to the Home Office. No identification document number for a subject was recorded during interviews. Subjects who had relocated from their original address and could not be traced, or had moved to another suburb, were recorded as lost to follow up. Subjects who refused to participate in the follow up study were documented as refusals. Due to wide-ranging literacy levels and variable availability of a telephone, neither written nor telephonic reporting of fall occurrences and outcomes were collected between the baseline and follow-up surveys.

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3.7 Data capture and statistical analysis

All responses apart from responses to open ended questions were coded. Data codes and open ended responses were entered into a Microsoft Access 2003 database by a data capturer. The candidate checked all entries against the relevant

questionnaire, and corrected any errors and omissions. The data were then transferred to an Excel database and rechecked for errors, omissions and any outliers.

Data were analysed using IBM Statistics (SPSS statistics) 19 (SPSS Inc., Chicago Illinois). Frequency distributions were run to check that all variables were in the acceptable range, and outlying values were checked and corrected as indicated. The prevalence of falls was calculated with a 95 per cent confidence interval. A relationship between falls, and (potential) predictors of a fall and recurrent falls was determined through logistic regression analysis. For continuous variables, data were tested for normality of distribution using the Shapiro-Wilks test. Parametric tests for normally distributed data and non-parametric tests for non-normally distributed data were used for analyses. Odds ratios were used as a measure of effect referring to a unit increment in that variable. Odds ratios and 95% confidence intervals (CIs) were estimated for categorical variables. A risk model for any fall and multiple falls (≥ 2 falls) in a 12-month period was obtained through binary or multinomial logistic regression analyses with a two-tailed p-value < 0.05 to define statistical significance. Longitudinal analyses were performed including subjects lost to follow-up.

3.8 Ethical considerations

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Approval to conduct the study was obtained from the Ethics and Research Committee of the Faculty of Health Sciences at the University of Cape Town (Reference number: 126/2008) (Annexure 5). Permission to conduct the study in Gugulethu was obtained from local community leaders. It is the norm in South Africa for researchers in suburbs with a large black African population, such as Gugulethu, to seek permission from community leaders to carry out activities in their suburb, and to state the purpose of the activities and how outcomes will benefit that community. Community leaders then inform their constituency of the study, which helps to publicise the activity and improves field workers' access to the community. It was

explained to the community leaders that falls are a risk for older persons, and that the study was seeking to establish the prevalence of and risk factors for falls. The information obtained would be used to inform the design of falls prevention protocols, which could be implemented to help older populations in communities such as their community. In Plumstead and Wynberg, fliers describing the study were placed on notice boards at places of worship and in household letter boxes.

Written informed consent (Annexure 4) in a subject's preferred language was obtained from each subject prior to recruitment: for the study, for the sub-study, for the baseline survey and for the follow-up survey. Where physical assessment recordings, such as blood pressure recordings, were obviously out of acceptable range, the field worker advised the participant to consult his/her general practitioner. Where possible, telephone advice on the management of the medical condition was given to the subject by the candidate.

Subjects' anonymity was assured through the use of unique reference numbers, and no names or other identifying information were used, in data entry and analysis. Personal details used for communication with the subjects were known only to the field workers and the candidate. Original records with subjects' personal details will be kept under lock and key in a safe place for a period of five years, and then destroyed.

Feedback sessions on the findings of the study and how falls may be prevented are planned with groups of study participants and interested older persons in the communities in which the surveys were conducted. The sessions will take the form of workshops. Study participants will be invited, and informed of the date and purpose of the workshops, either telephonically, or by written advertisement placed in their letter box. In Gugulethu, it will be communicated through community leaders. Workshops will be conducted in English in the suburbs of Plumstead and Wynberg, and in isiXhosa in Gugulethu. The feedback information will be disseminated in a

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simplified format. Information pamphlets in English and isiXhosa presenting main study findings and future plans for falls intervention programmes will be distributed to workshop attendees.

3.9 Summary of the study procedure and realised samples

Study participants were assessed at baseline and as many as possible again at follow-up. A prospective study is the gold standard for establishing the incidence of falls and associated risk factors. In general, research designs for studies in this area, in addition to a survey, recommend obtaining complementary data from participants through their completion of a falls diary, telephone follow-up and assessment of any reported falls by researchers. This approach minimises the chance of recall bias and under-reporting of falls. However, low literacy levels in the study population, and a lack of universal access to a telephone facility made it impractical to use the gold standard research design. Given these challenges, and in order to robustly establish an association between falls and risk factors, the study sample was reassessed in a follow-up survey after a period of approximately 12 months. Self-reported information on falls that had occurred in the interim was recorded.

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The study procedure, or stages of the study and the realised samples for each sub-study are shown graphically in Figure 3.6. Eight hundred and ninety six households with older persons aged ≥ 65 years old were visited. Of these, 844 older residents in the households agreed to participate in the study and were recruited for the sample. Fifty-two older persons (males 50%, females 50%) in the original 896 houses visited refused to participate in the study at baseline recruitment. Their age distribution could not be determined as no other information was recorded for them. A further 15 had agreed to participate but were excluded due to immobility. Of the 844 subjects recruited, 7 were later rejected for not meeting all study criteria. Eight hundred and thirty seven subjects in the baseline survey and 632 in the follow-up survey constituted samples for data collection and analysis. Two hundred and five subjects

could not be followed up: 50 had died, 78 refused to participate, 56 had relocated and 21 were too ill to be interviewed.

Data collected in the baseline and follow-up surveys are analysed in Chapter 4.

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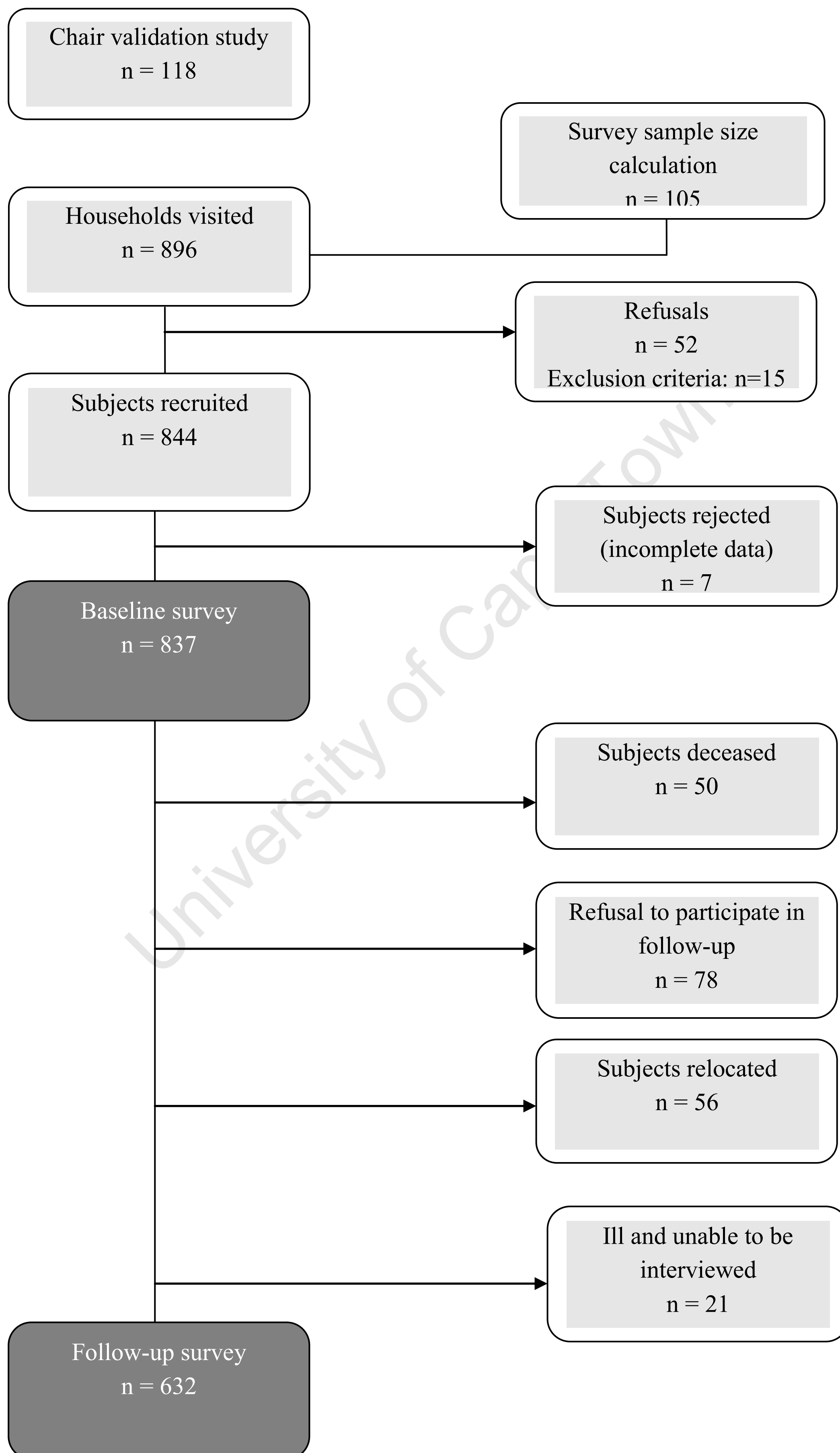
Figure 3.6: Study procedure and sample recruitment



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Chapter 4

Analysis of the data

4.1 Introduction

The collection of data for the empirical study in structured interviews and through physical assessments was described in Chapter 3 (Study methods). An analysis of the data is undertaken and outcomes of the analyses are presented in Chapter 4. The outcomes are then discussed broadly.

4.2 Findings

Results of analyses of data collected in the baseline and the follow-up surveys are presented in seven parts: 1) Socio-demographic characteristics; 2) prevalence of falls; 3) circumstances surrounding a fall; 4) consequences of the fall; 5) risk factors for the fall; 6) environmental factors contributing to a fall as reported by study participants; and 7) results of independent predictors of falls in logistic regression analyses. To provide for an efficient comparison of findings of analyses of data from the baseline and follow-up surveys, where applicable, results of analyses of the two datasets are shown in the same table.

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4.2.1 Socio-demographic characteristics of the samples

Table 4.1 shows a distribution of the socio-demographic characteristics of the two samples (baseline survey and follow-up survey samples), by suburb and gender. As indicated in Chapter 3, 43.7 per cent of subjects resided in Wynberg, which suburb has a high proportion of coloured older persons. Females made up 81.6 per cent of the Gugulethu, 77 per cent of the Plumstead and 72 per cent of the Wynberg sub-samples.

Table 4.1: Baseline survey sample, by suburb and gender (frequencies and percentage distribution) *

Suburb	Gender				Total	
	Males		Females			
	n	%	n	%	n	%
Gugulethu	52	24.6	231	36.1	283	33.7
Plumstead	43	21.8	145	22.7	188	22.5
Wynberg	102	51.8	264	41.3	366	43.7
Total	197	100	640	100	837	100

* Percentages in this and subsequent tables may not add up to 100% due to rounding off.

Table 4.2 shows characteristics of both the baseline survey sample (n=837) and the follow-up survey sample (n=632). Women constituted 76.5 per cent of the baseline sample and 77.2 per cent of the follow-up sample. The mean age and standard deviation (SD) of the two samples was 74 years (± 6.4) and 75 years (± 6.2) for the baseline and follow-up samples, respectively. No substantial differences were found between the baseline sample and the follow-up sample, and the proportions of subjects in five-year age groups were not significantly different (Table 4.2).

The age distribution, marital status, level of education and previous occupational category of the samples are shown in Table 4.2. In both samples, almost half the subjects were coloured. Twenty-eight per cent had a primary level of education (< 8 years); 5 per cent had received no formal schooling. Less than 15 per cent lived alone; the majority co-resided with family members. Three fifths of the subjects were widowed. The majority received the means-tested social pension (77.8%); 21.6 per cent of pensioners received additional income support from family members, adult children in particular.

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Table 4.2: Descriptive characteristics of the baseline and follow-up survey samples (frequencies and percentage distribution)

Characteristic	Baseline survey n = 837	Follow-up survey n = 632
Age (years) (mean (SD))	74 (6.4)	75 (6.2)
Age group (years) (N (%))		
65-69	230 (27.5)	135 (21.4)
70-74	229 (27.4)	194 (30.7)
75-79	204 (24.4)	159 (25.2)
≥80	174 (20.8)	144 (22.8)
Female (N (%))	640 (76.5)	488 (77.2)
Marital status (N (%))		
Married	262 (31.3)	180 (28.5)
Widowed	483 (57.7)	393 (62.2)
Divorced/separated	36 (4.3)	23 (3.6)
Never married	56 (6.7)	36 (5.7)
Lives alone (N (%))	144 (13.6)	99 (15.7)
Residents per household (median (IQR))	3 (2-6)	3 (2-5)
Ethnic group (N (%))		
Black African	283 (33.8)	180 (28.5)
Coloured	392 (46.8)	331 (52.4)
Indian	22 (2.6)	13 (2.1)
White	140 (16.7)	108 (17.1)
Level of education (N (%))		
No schooling	45 (5.4)	20 (3.2)
Primary schooling	241 (28.8)	198 (31.3)
Secondary schooling	499 (59.6)	369 (58.4)
Post school qualification	52 (6.2)	45 (7.1)
Occupation category (N (%))		
Unskilled	309 (36.9)	214 (33.9)
Skilled/Services	436 (52.1)	342 (54.1)
Professional/management	92 (11.0)	76 (12.0)
Housing		
Formal	830 (99.2)	625 (98.9)
Informal	7 (0.8)	7 (1.1)
Toilet indoors	627 (74.9)	460 (72.8)
Toilet outdoors	210 (25.1)	172 (27.2)
Piped water (N (%))		
Indoors	814 (97.3)	612 (96.8)
Outdoors only	23 (2.7)	20 (3.2)
Receipt of a social pension (yes)	651 (77.8)	443 (70.1)

Table 4.2 (continued)

Characteristic	Baseline survey	Follow-up survey
Self-reported health status (N (%))		
Very good, Good	401 (47.9)	348 (55.1)
Average	358 (42.8)	244 (38.6)
Poor, Very poor	78 (9.3)	40 (6.3)
Perceived health compared to a year ago (N (%))		
Better	184 (22.0)	146 (23.1)
Same	562 (67.1)	425 (67.2)
Worse	91 (10.9)	61 (9.7)
Self-rated mobility (N (%))		
Independent	698 (83.4)	520 (82.3)
Impaired	139 (16.6)	112 (17.7)
Use of walking aid	106 (12.7)	77 (9.2)
Medical conditions (self-reported) (N (%))		
Hypertension	571 (68.3)	438 (69.3)
Arthritis	501 (59.9)	387 (61.2)
Cardiovascular disease	394 (47.1)	254 (40.2)
Foot problems	217 (25.9)	177 (28.0)
Diabetes	215 (25.7)	193 (30.5)
Dizziness, vertigo	163 (19.5	128 (20.3)
Chronic lung disease	93 (11.1)	49 (7.8)
Depression	88 (10.5)	39 (6.2)
Stroke	67 (8.0)	37 (5.9)
Poor memory	63 (7.5)	19 (3.0)
Cancer	45 (5.4)	43 (6.8)
Parkinson's disease	23 (2.7)	13 (2.1)
Number of comorbidities (median, IQR)	3 (2-4)	3 (2-4)
Medication use		
Total drug intake (median (IQR))	4 (2-6)	4 (2-6)
Poor urine control (N (%))	191 (22.8)	159 (25.2)
Impaired hearing	248 (29.6)	152 (24.1)
Vision (N (%))		
Far: poor	74 (8.8)	43 (6.8)
Near: poor	59 (7.0)	33 (5.2)
Tobacco use (N (%))		
Current	100 (11.9)	79 (12.5)
Previous	199 (23.8)	151 (23.9)
Never	538 (64.3)	402 (63.6)
Alcohol consumption (N (%))		
Current	117 (14.0)	97 (15.3)
Previous	84 (10.0)	47 (7.4)
Never	635 (75.9)	488 (77.2)

About one per cent of subjects lived in informal housing (e.g. a shack). A quarter of subjects' households had an outside toilet (25%) and a minority accessed water from an outside tap (3%). Approximately 10 per cent of subjects reported poor health and the same proportion perceived their health to be worse than a year ago; fewer than half reported their health as good or very good, while about two thirds perceived their health had not changed over the past year. Almost one in five (17%) subjects reported poor mobility and 13 per cent used a walking aid. More black Africans than other subjects rated their health as poor (OR 7.25, 95% CI 2.90–18.15, p=0.001), but their self-rated mobility was no different from that of subjects in other ethnic groups (OR 1.19, 95% CI 0.68–2.11, p=0.54).

Certain chronic diseases and biomedical markers were common in both baseline and follow-up samples. At baseline, about two thirds (68%) reported having hypertension; 59 per cent reported arthritis; 47 per cent reported cardiovascular disease; and about a quarter in each case reported diabetes and foot disorders. The median number of comorbid conditions was three (interquartile range 2-4 (range 0-9)). The median number of medications used was four (range 0-17 and 0-11 in the baseline and follow-up samples, respectively). Poor vision was reported in less than 10 per cent and hearing impairment in just over a quarter of subjects. The majority reported they had never used tobacco nor consumed alcohol; under reporting regarding consumption of alcohol was likely.

Table 4.3 summarises results of physical measurements and assessments recorded at baseline and follow-up. The one leg stand test was performed only at baseline, while the feet together stand test and the near tandem stand test were performed only at follow-up. There were no major differences in the measurements or physical performance of the samples at baseline and follow-up. High diastolic blood pressure ≥ 90 mmHg was recorded in 42 per cent. High systolic blood pressure (≥ 140 mmHg) was recorded in 60 per cent. Body mass index (BMI) of ≥ 30 was recorded in 18 per

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Table 4.3: Physical measurements and assessments of the baseline and follow-up samples

Measurement	Baseline survey	Follow-up survey
Depression scale score (GDS) (median and IQR)	2 (1-4)	2 (1-4)
Cognitive test score (SOMCT)	4 (2-10)	4 (2-10)
Blood pressure		
Systolic blood pressure (≥ 140 mmHg) (N & %)	500 (59.8)	377 (59.6)
Diastolic blood pressure (≥ 90 mmHg) (N & %)	353 (42.2)	265 (42.0)
Systolic blood pressure mmHg (median (IQR))	142 (130-154)	145 (132-155)
Diastolic blood pressure mmHg (median (IQR))	88 (80-95)	89 (78-97
BMI (median, (IQR)) (N & %)	28 (24-31)	28 (24-32)
BMI ≥ 30 (obese)	316 (37.8)	249 (39.4)
BMI 19-29	495 (59.1)	371 (58.7)
BMI ≤ 18	22 (2.6)	9 (1.4)
Unknown	4 (0.5)	3 (0.5)
Waist hip ratio (median, (IQR))	0.90 (0.84-0.94)	0.91 (0.86-0.96)
Men ≥ 0.95 (N & %)	88 (53.0)	89 (61.8)
Women ≥ 0.85 (N & %)	402 (70.3)	354 (72.5)
Grip strength (kg), (median, (IQR))	15 (10.5-20)	10 (6-16)
Up & Go test (seconds) (median (IQR))	15 (11-20)	15 (12-21)
Chair stands (seconds)	15 (11-20)	14 ((11-20)
One leg stand (median, (IQR)) in seconds		
Eyes open	8 (3-20)	—
Eyes shut	3 (1-6)	—
One leg stand	(N & %)	
≥ 30 eyes open	137 (16.4)	—
≥ 30 sec eyes shut	8 (1.0)	—
Feet together stand (median, (IQR)) in seconds	—	30 (18-30)
Semi tandem stand (median, (IQR)) in seconds	—	16.8 (9.3-30)
Timed Up & Go (time to complete)	(N & %)	(N & %)
< 10 sec	118 (14.1)	54 (8.5)
> 20 sec	235 (28.1)	200 (31.6)
Unable to perform	15 (1.8)	21 (3.3)
Chair stands (time to complete)	(N & %)	(N & %)
< 11 seconds	140 (16.7)	89 (14.1)
> 16.7 sec	352 (42.1)	241 (38.2)
Unable to perform	80 (9.6)	90 (14.3)
Feet together		(N & %)
≥ 10 seconds	—	555 (87.8)
> 10 seconds	—	77 (12.2)
Semi tandem		(N & %)
≥ 30 seconds	—	415 (65.8)
< 30 seconds	—	216 (34.2)

GDS= Geriatric Depression Scale; IQR = inter-quartile range; SOMCT = Short Orientation Memory Concentration Test.

cent of the participants, and the waist/hip ratio of ≥ 0.95 for men and ≥0.85 for women was recorded in more than half the men (53%) and more than three quarters (70%) of the women in the baseline sample; these proportions were even higher at follow-up.

4.2.1.1 Characteristics of the sample according to history of follow-up

There were some differences in the baseline characteristics of the subjects who were followed up and those who were lost to follow-up. Subjects lost to follow-up were: older than those who were followed up – median age and interquartile range (IQR) 76 years (71-81) and 73 years (69-78) respectively, (OR 1.06, 95% CI (1.03–1.09)) (Table 4.4); likely to have poor self-rated health, poor vision and difficulty in mobility; reported higher rates of chronic disease (hypertension, Parkinson's disease, diabetes, memory loss, and lung disease); had a high Geriatric Depression Scale score and a high (SOMCT) cognitive test score; had lower hand grip strength, difficulty standing on one leg and increased time to complete the Up and Go test; and a high proportion were black Africans (OR 1.80, 95% CI 1.14 – 2.85). They were likely to reside in Gugulethu than in Plumstead OR 0.46, (0.30 – 0.70) or Wynberg (OR 0.36, (0.25 – 0.52) ((Tables 4.4 and 4.5).

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At follow-up, 50 subjects in the baseline survey were reported to have died: 35 (70%) were non-fallers and 15 (30%) had reported a fall at baseline. The proportion of deaths was 5.7 per cent in those with no previous history of falls, 6.7 per cent in those with a history of a fall and 8.5 per cent in those with a history of recurrent falls. The differences in proportions of those who died in the sub-groups according to fall history were not statistically significant (non-fallers versus single fallers, OR 1.08, 95% CI 0.43 – 2.74, p=0.56; non-fallers versus recurrent fallers, OR 1.94, 95% CI 0.75 – 5.01, p=0.29). However, subjects who died during the period to follow-up were older, likely to have reported poor mobility and poor urine control, had been current or previous smokers and had reported a higher number of co-morbid diseases, particularly lung disease, cancer and foot disorders, and had been on a higher

Table 4.4: Characteristics of subjects at baseline by follow-up history (frequencies and percentage distribution and level of significance)

Variable	Baseline survey sample		
	Followed up N = 632	Lost to follow-up N = 205	OR (95%CI)
Age in years (median, IQR)	73 (69 – 78)	76 (71 – 81)	1.06 (1.03 – 1.09)*
Age group (years)			
65 – 69	192 (30.4)	38 (18.5)	1
70 – 74	180 (28.5)	49 (23.9)	1.37 (0.86 – 2.20)
75 – 79	147 (23.3)	57 (27.8)	1.96 (1.23 – 3.11)*
80^+	113 (17.9)	61 (29.8)	2.73 (1.71 – 4.35)*
Gender			
Male	147 (23.5)	50 (24.4)	1
Female	485 (76.7)	155 (75.6)	0.94 (0.65 – 1.36)
Self-rated health			
Good/Very good	340 (53.8)	61 (29.8	1
Average	250 (39.6)	108 (52.7)	4.18 (2.03 – 8.60)*
Poor/very poor	42 (6.6)	36 (17.6)	8.29 (3.66 – 18.77)*
Perceived health compared to a year ago			
Better	127 (20.1)	57 (27.8)	1
Same	443 (70.1)	119 (58.0)	0.60 (0.41 – 0.87)*
Worse	62 (9.8)	29 (14.1)	1.04 (0.61 – 1.79)
Self-rated mobility			
Independent	548 (86.7)	150 (73.2)	1
With difficulty	84 (13.3)	55 (26.8)	2.39 (1.63 – 3.51)*
Previous falls			
No fall	462 (73.1)	154 (75.1)	
Single fall	100 (15.8)	29 (14.1)	0.87 (0.55 – 1.37)
Recurrent fall	70 (11.1)	22 (10.7)	0.94 (0.56 – 1.57)
Marital status			
Married	200 (31.6)	62 (30.2)	1
Widowed	356 (56.3)	127 (62.0)	1.51 (0.81 – 1.63)
Divorced	29 (4.6)	7 (3.4)	0.78 (0.32 – 1.86)
Never Married	47 (7.4)	9 (4.4)	0.62 (0.29 – 1.33)
Race			
White	107 (16.7)	33 (16.1)	1
Black African	182 (28.8)	101 (49.3)	1.80 (1.14 – 2.85)*
Coloured	327 (51.7)	65 (31.7)	0.64 (0.40 – 1.03)
Indian	16 (2.5)	6 (2.9)	1.22 (0.44 – 3.36)
Residence			
Gugulethu	180 (28.5)	103 (50.2)	1
Plumstead	149 (23.6)	39 (19.0)	0.46 (0.30 – 0.70)*
Wynberg	303 (47.9)	63 (30.7)	0.36 (0.25 – 0.52)*

Table 4.4 (continued)

Variable	Followed up	Lost to follow-up	OR (95%CI)
Medical conditions (self-reported)[1]			
Hypertension	215 (34.0) 417 (66.1)	51 (24.9) 154 (75.1)	1 1.56 (1.09 – 2.22)*
Stroke	582 (92.1) 50 (7.9)	188 (91.7) 17 (9.3)	1 1.05 (0.59 – 1.87)
Parkinson's disease	621 (98.3) 11 (1.7)	193 (94.1) 12 (5.9)	1 3.51 (1.52 – 8.08)*
Diabetes	442 (69.9) 190 (30.1)	121 (59.0) 84 (41.0)	1 1.50 (1.06 – 2.13)*
Memory loss	596 (94.3) 36 (5.7)	178 (86.8) 27 (13.2)	1 2.51 (1.48 – 4.25)*
Depression	567 (89.7) 65 (10.3)	182 (88.8) 23 (11.2)	1 1.10 (0.67 – 1.82)
Arthritis	246 (39.0) 385 (61.0)	89 (43.4) 116 (56.6)	1 0.84 (0.61 – 1.15)
Lung disease	569 (90.2) 62 (9.8)	173 (84.8) 31 (15.2)	1 1.64 (1.03 – 2.60)*
Cardiovascular disease	325 (51.4) 307 (48.6)	118 (57.6) 87 (42.4)	1 0.78 (0.57 – 1.07)
Foot disorders	459 (72.6) 173 (27.4)	161 (78.5) 44 (21.5)	1 0.72 (0.50 – 1.06)
Dizziness/vertigo	505 (80.0) 126 (20.0)	168 (82.0) 37 (18.0)	1 0.88 (0.59 – 1.33)
Cancer	597 (94.6) 34 (5.4)	194 (94.6) 11 (5.4)	1 1.00 (0.50 – 2.01)
Number of comorbidities (median IQR)	3 (2 – 4)	3 (2 – 4)	1.02 (0.93 – 1.12)
Hearing Good Poor	 445 (70.4) 248 (29.6)	 144 (70.2) 61 (29.8)	 1 1.01 (0.71 – 1.42)
Vision Good Very poor Poor	 520 (82.3) 108 (17.1) 4 (0.6)	 136 (66.3) 56 (27.3) 13 (6.3)	 1 1.95 (1.04 – 3.67)* 5.29 (1.65 – 6.92)*
Urine control Good Poor	 483 (76.4) 149 (23.6)	 163 (79.5) 42 (20.5)	 1 0.83 – (0.57 – 1.23)

[1] The reference group are those who did not report having the medical condition * Significant association.

number of drugs than those lost to follow-up but not reported to have died (Tables 4.6 and 4.7).

Table 4.5: Association of baseline physical assessments and measurements by history of follow-up

Variable	Baseline survey sample		
	Followed-up N = 632	Lost to follow-up N = 205	OR (95% CI)
Geriatric Depression Scale score (median, IQR)	2 (1 – 4)	2 (1 – 5)	1.10 (1.05 – 1.16)*
Cognitive score (SOMCT)	4 (0 – 8)	8 (4 – 14)	1.09 (1.06 – 1.12*)
Alcohol (U/Wk) (median, IQR), range	0 (0 – 0)	0 (0 – 0)	0.83 (0.61 – 1.12)
Systolic BP supine (mmHg)	143 (131 – 156)	144 (133 – 155)	1.00 (0.99 – 1.01)
Diastolic BP supine (mmHg)	87 (78 – 97)	89 (80 – 98)	1.00 (0.99 – 1.01)
Pulse rate supine (bpm)	70 (62 – 80)	72 (65 – 81)	1.01 (1.00 – 1.02)*
Systolic BP standing (mmHg)	142 (130 – 154)	145 (132 – 155)	1.00 (0.99 – 1.01)
Diastolic BP standing (mmHg)	87 (79 – 95)	88 (81 – 96)	1.00 (0.99 – 1.01)
Pulse standing (bpm)	73 (65 – 85)	74 (67 – 84)	1.00 (0.99 – 1.01)
Hand grip (Kg) (median, IQR)	16 (11 – 21)	12 (10 – 18)	0.95 (0.94 – 0.97)*
One leg stand eyes open (seconds)	9 (4 – 23)	4 (1 – 10)	0.94 (0.93 – 0.96)*
One leg stand eyes shut (seconds)	3 (2 – 6)	2 (1 – 4)	0.91 (0.87 – 0.95)*
Up & Go test (seconds)	14 (11 – 20)	19 (13 – 22)	1.03 (1.02 – 1.05)*
Chair stands (seconds)	14 (11 – 20)	18 (12 – 20)	1.01 (0.99 – 1.04)
Comorbid disease (median, IQR)	3 (2 – 4)	3 (2 – 4)	1.02 (0.93 – 1.12)
Total drugs (Median, IQR)	4 (2 – 6)	4 (2 – 5)	0.95 (0.89 – 1.00)*

SOMCT = Short Orientation Memory Concentration Test; BP = Blood Pressure; bpm = beats per minute; Kg = Kilogram; IQR= interquartile range; U/Wk = units/week; * significant association.

Figure 4.1a: Frequency of falls reported by baseline and follow-up samples

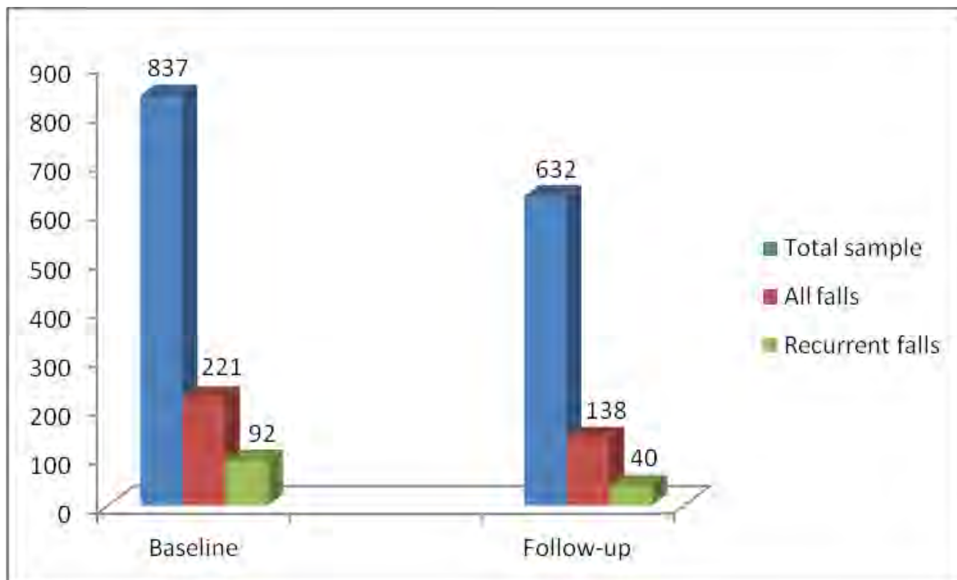
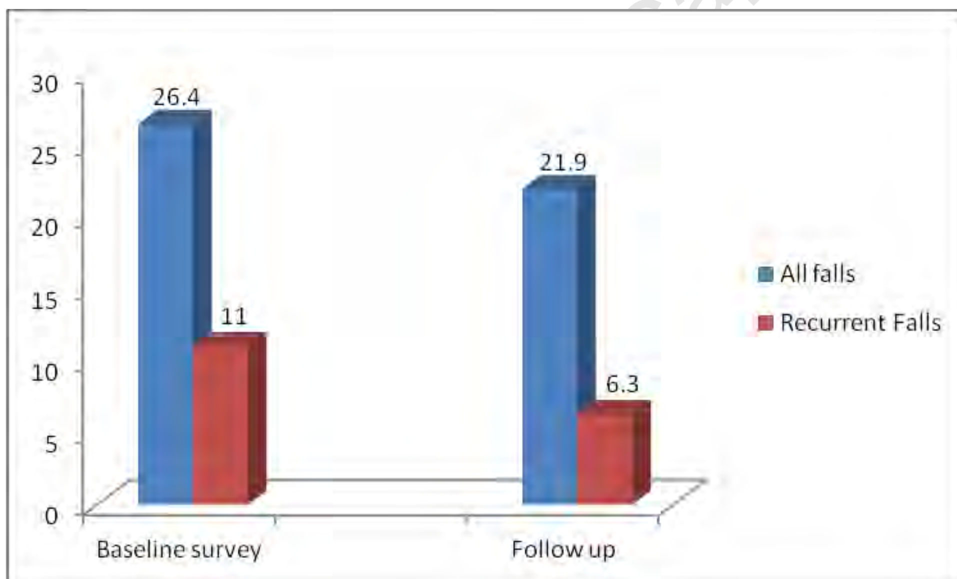


Figure 4.1b: Prevalence of falls as reported by baseline and follow-up samples



4.2.2 Prevalence of falls

In the baseline sample, 221 (26.4%) subjects reported they had fallen in the previous year (95% confidence interval (CI) 23.5-29.5%) (Figures 4.1a and 4.1b). A total of 421 falls were reported by the 221 participants. Fallers therefore reported an average of 1.9 falls per person, while 3.2 falls were reported per recurrent faller (292

falls in 92 participants, prevalence rate (PR) 11%; 95% CI, 9-13%). Fairly similar to the baseline sample, 138 (21.8%) subjects in the follow-up sample reported at least one fall during the year following baseline (PR 21.8%; 95% CI 18.9-25.3%): A total of 224 falls were reported (1.6 falls per faller). The overall incidence rate of falls on follow-up was 367/1000 person years. The incidence rate for men and women was 236.1/1000 and 405.7/1000 person years, respectively. The difference in incidence rate between men and women was statistically significant, (p=0.002). Recurrent fallers at follow-up reported 3.3 falls per faller (133 falls reported by 40 participants, prevalence rate 6.3%; 95% CI, 4.6-8.3%). Women reported more recurrent falls than men. Of the 40 subjects who reported falls, only 7 (17.5%) were men. The prevalence rate of falls in the baseline and follow-up samples was therefore 26.4 per cent and 21.8 per cent, respectively.

Of the 138 respondents who reported having fallen in the year following baseline, 75 (54.3%) were incident fallers: that is, they had not fallen prior to baseline and 63 (45.7%) had reported falling prior to baseline. There was a difference in the prevalence rate of recurrent falls (≥ 2 falls) – 92 (11%) in the baseline sample and 40 (6.3 %) at follow-up, p = 0.001 (see Figure 4.1). There was no difference in age between non-fallers and fallers at baseline: median age and interquartile range (IQR) 74 (69-78) and 74 (69-79) years, respectively, OR 1.01, 95% CI 0.98–1.03, p = 0.75 (Table 4.11), and between non-fallers and recurrent fallers: 74 (69-78) and 74 (70-81), respectively, OR 1.03, 95% CI 0.99 – 1.06, p= 0.16 (Table 4.12). Similarly, there was no difference in age between non-fallers and fallers in the follow-up sample: median age and IQR 76 (69-81) and 76 (69-78) years, respectively, OR 1.02, 95% CI 0.99–1.05, p = 0.73 (Table 4.11); and between non-fallers and recurrent fallers: 76 (69-81) and 75 (69-78) respectively, OR 1.03, 95% CI 0.98–1.09, p= 0.40 (table 4.12). Gender did not influence the likelihood of a fall at baseline or follow-up, but the female gender was associated with increased risk of recurrent falls at baseline. However, ethnicity was significantly associated with prevalence of falls. Percentages in different ethnic groups reporting falls were: whites 42.9 per cent, coloureds 34.4

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Figure 4.2a: Fall history in baseline sample, by ethnic group (percentages)

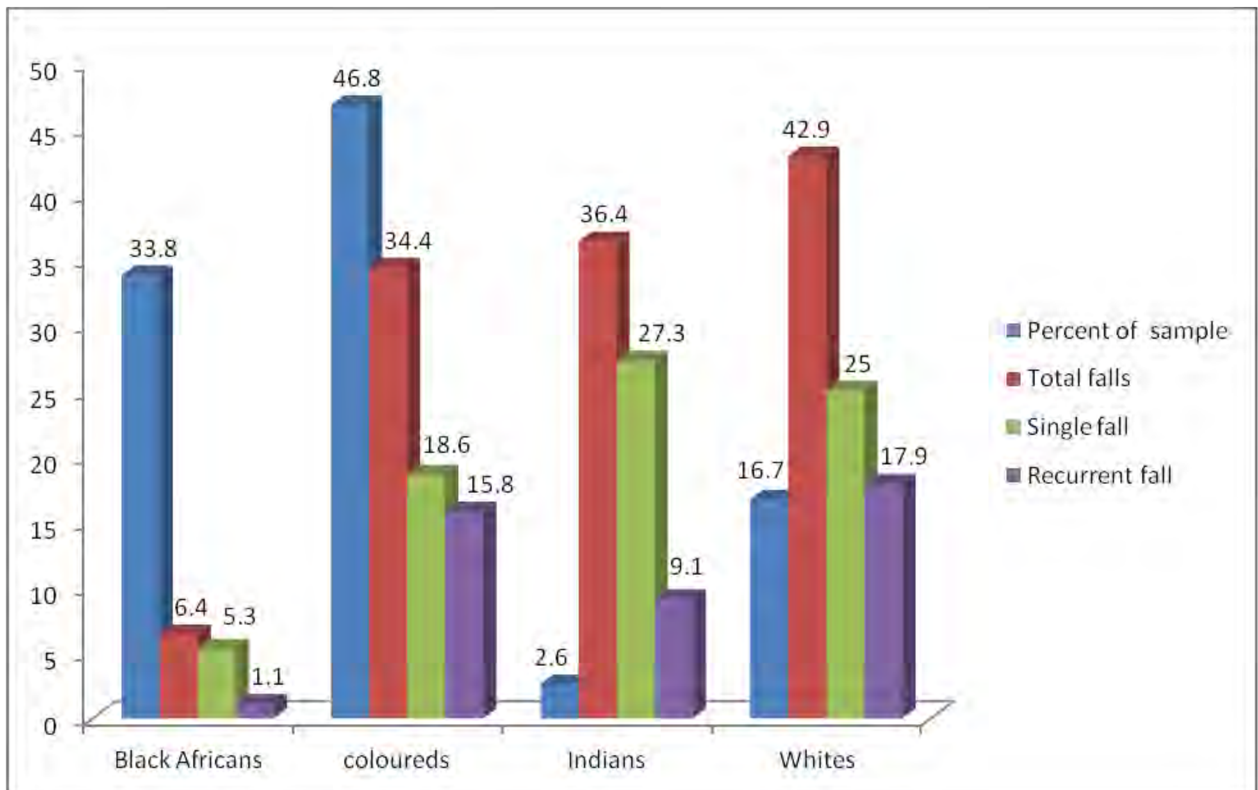
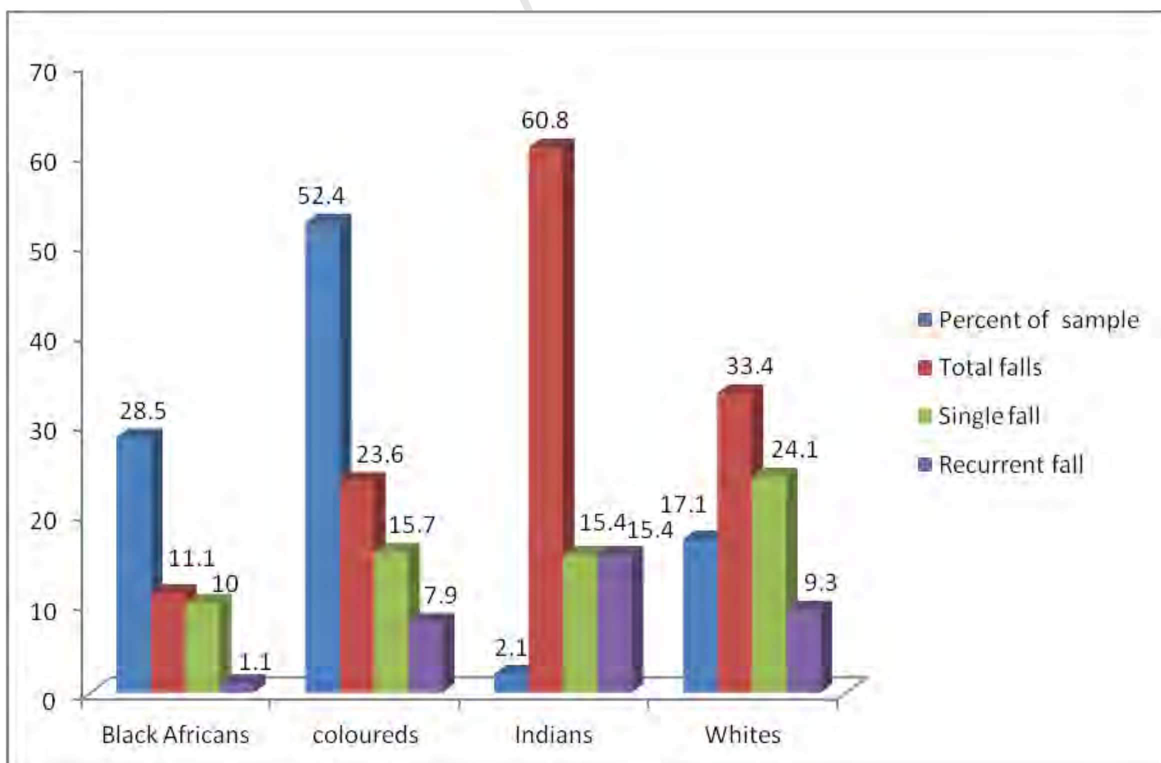


Figure 4.2b: Fall history in follow-up sample, by ethnic group (percentages)



per cent and black Africans 6.4 per cent (p=0.0005). The number of Indian subjects (22) was too small for interpretation, but 8 (36.4%) reported a fall. (Figures 4.2a and 4.2b).

4.2.3 Circumstances of the fall

Factors associated with falls did not differ significantly between those at baseline and those at follow-up. Results shown in Table 4.8 are for the baseline sample. Falls in men occurred mainly outdoors, while those in women occurred mainly indoors (length of time spent outdoors by subjects was not recorded). Of falls that occurred in men outdoors, slightly over half occurred away from home. In women, outdoor falls occurred largely around the dwelling (in the yard), although these differences between male and female subjects were not statistically significant. In both genders, falls indoors occurred mainly in the bedroom and kitchen.

Table 4.9 lists factors and symptoms associated with the fall and the time of day at which a fall occurred. Trips or slips were the most commonly reported factor contributing to a fall, accounting for over half of falls. Dizziness or vertigo was the commonest symptom reported as having preceded a fall, implicated in almost a quarter of the falls. The majority of falls occurred during the morning and afternoon, which are times of maximum activity; very few falls occurred during the night.

4.2.4 Consequences of the fall

Consequences of a fall included fallers' inability to get up from the floor or ground, articulation of fear of falling, impact of the fall on daily activities and injuries sustained as a result of the fall. Table 4.10 summarises consequences of falls for subjects who fell.

Fewer than half of fallers were able to get up unassisted after a fall. A similar proportion reported they were helped up immediately by someone who witnessed the fall. More than one in ten fallers remained on the floor until someone came to

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their assistance. Almost three quarters (72%) reported suffering an injury from the fall, but fewer than half sought medical help (Table 4.10). Types of injury commonly reported were bruises (> 60%) and lacerations (25%). Of fallers with injuries, 14 per cent reported having sustained a fracture at baseline and 6 per cent at follow up. About a quarter of the fractures were of the hip. When interviewed, more than a third of fallers reported not having recovered completely from injuries relating to the fall; a third reported having either given up or changed certain physical activities after the fall (Table 4.10). Almost two thirds of both fallers and non-fallers reported subsequent fear of falling. (Table 4.10 only shows responses of fallers.)

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4.2.5 Risk factors for falls

Risk factors for falls determined in analyses of the data are shown in three areas of the classification used in Chapter 2: biological, behavioural and socio-economic. Apart from noting the presence of mats/rugs or stairs/steps in the dwelling which may have contributed to a fall, no assessment of environmental risk factors for falls was undertaken. Subjects reported falls retrospectively, which would make it difficult to link specific details of an environmental factor at the time of the interview to the fall episode. However, information was collected on the activity in which a subject engaged at the time of the fall. In the analyses, certain closely related categories for a variable have been combined (collapsed) to prevent the effects of low numbers in a cell count on the results. For example, self-rated health status categories (Poor and Very poor ratings) were combined in a single category: “Poor.” The term “fallers” or “recurrent fallers” is used in reporting the results; the terms are used to indicate a propensity to fall during a given activity or situation. In the analyses, a Poisson distribution linked to a general mixture model would have been preferable in presenting the number of falls as an outcome as this would have made better use of the data and increased the power of the study. However, a logistic regression model with falls dichotomized at ≥ 2 was used because the number of participants with recurrent falls was too small for such analyses (Figures 4.3a and 4.3b).

Table 4.6: Baseline sample characteristics, by history of follow-up (no death versus death report): (frequencies and percentage distribution)

Variable	Baseline survey sample		
	Lost to follow-up – no death reported n = 155	Lost to follow-up due to death n = 50	OR (95% CI)
Age in years (median, IQR)	74 (70 – 78)	81 (76 – 86)	1.15 (1.00 – 1.21)*
Age group (years)			
65 – 69	33 (21.3)	5 (10.0)	1
70 – 74	45 (29.0)	4 (8.0)	0.59 (0.15 – 2.35)
75 – 79	46 (29.7)	11 (22.0)	1.58 (0.50 – 4.97)
80^+	31 (20.0)	30 (60.0)	6.39 (2.20 – 18.55)*
Gender			
Male	34 (21.9)	16 (32.0)	1
Female	121 (78.1)	34 (68.0)	0.60 (0.29 – 1.21)
Self-rated health			
Good/Very good	48 (31.0)	13 (26.0)	1
Average/Poor/Very good	107 (69.0)	37 (74.0)	1.28 (0.62 – 2.62)
Perceived health compared to a year ago			
Better	48 (31.0)	9 (18.0)	1
Same	86 (55.5)	33 (66.0)	2.05 (0.90 – 4.63)
Worse	21 (13.5)	8 (16.0)	2.03 (0.69 – 5.99)
Self-rated mobility			
Independent	120 (77.4)	30 (60.0)	1
Difficulty	35 (22.6)	20 (40.0)	2.29 (1.16 – 4.51)*
History of previous falls			
No fall	119 (76.8)	35 (70.0)	1
Single fall	22 (14.2)	7 (14.0)	1.08 (0.43 – 2.74)
Multiple fall	14 (9.0)	8 (16.0)	1.94 (0.75 – 5.01)
Medical conditions (self-reported			
Hypertension	36 (23.2)	15 (30.0)	1
	119 (76.8)	35 (70.0)	0.71 (0.35 – 1.44)
Stroke	145 (93.5)	43 (86.0)	1
	10 (6.5)	7 (14.0)	2.36 (0.85 – 6.57)
Parkinson's disease	147 (94.8)	46 (92.0)	1
	8 (5.2)	4 (8.0)	1.60 (0.46 – 5.55)
Diabetes	105 (67.7)	34 (69.4)	1
	50 (32.3)	15 (30.6)	0.93 (0.46 – 1.85)
Memory loss	135 (87.1)	43 (86.0)	1
	20 (12.9)	7 (14.0)	1.10 (0.43 – 2.78)
Depression	138 (89.0)	44 (88.0)	1
	17 (11.0)	6 (12.0)	1.11 (0.41 – 2.98)

Table 4.6 (continued)

Variable	Lost to follow-up − no death reported	Lost to follow-up due to death	OR (95% CI)
Arthritis	66 (42.6)	23 (46.0)	1
	89 (57.4)	27 (54.0)	0.87 (0.46 – 1.65)
Lung disease	135 (87.7)	38 (76.0)	1
	19 (12.3)	12 (24.0)	2.24 (1.00 – 5.03)*
Cardiovascular disease	100 (64.5)	18 (36.0)	1
	55 (35.5)	32 (64.0)	3.23 (1.66 – 6.28)*
Foot disorders	123 (79.4)	38 (76.0)	1
	32 (20.6)	12 (24.0)	1.21 (0.57 – 2.59)
Dizziness/vertigo	129 (83.4)	39 (78.0)	1
	26 (16.8)	11 (22.0)	1.40 (0.63 – 3.09)
Cancer	150 (96.8)	44 (88.0)	1
	5 (3.2)	6 (12.0)	4.09 (1.19–14.04)*
Number of comorbidities (median, IQR)	3 (2 – 4)	4 (3 – 5)	1.22 (1.02 – 1.45)*
Hearing			
Good	113 (72.9)	31 (62.0)	1
Poor	42 (27.1)	19 (38.0)	1.65 (0.84 – 3.23)
Vision			
Good	140 (90.3)	42 (84.0)	1
Poor	15 (9.7)	8 (16.0)	0.59 (0.07 – 5.05)
Urine control			
Good	130 (83.9)	33 (66.0)	1
Poor	25 (16.1)	17 (34.0)	2.68 (1.30 – 5.53)*
Alcohol use			
No	138 (89.0)	44 (88.0)	1
Yes	17 (11.0)	6 (12.0)	1.57 (0.79 – 3.16)
Tobacco use			
Never	1.14 (73.5)	26 (52.0)	1
Current	11 (7.1)	9 (18.0)	3.59 (1.35 – 9.54)*
Previous	30 (19.4)	15 (30.0)	2.19 (1.03 – 4.65)*

Table 4.7: Physical assessments and measurements, by loss to follow-up (death and no death): (baseline survey)

Variable	Baseline survey sample		
	Lost to follow-up – No death reported	Lost to follow-up – Death reported	OR (95% CI)
	N = 155		
Geriatric Depression Score (median, IQR)	2 (1 – 4)	4 (1.5 – 6)	1.08 (0.99 – 1.17)
Cognitive score (SOMCT)	8 (4 – 14)	8 (3 – 14)	1.01 (0.97 – 1.06)
Alcohol use (U/Wk) (median, IQR)	0 (0 – 0)	0 (0 – 0)	1.22 (0.12 – 1.45)
Systolic BP supine (mmHg)	145 (133 – 158)	140 (133 – 152)	0.99 (0.98 – 1.01)
Diastolic BP supine (mmHg)	89 (80 – 96)	89 (79 – 102)	1.01 (0.99 – 1.04)
Pulse rate supine (bpm)	72 (67 – 81)	73 (62 – 85)	1.01 (0.99 – 1.03)
Systolic BP standing (mmHg)	145 (133 – 155)	141 (124 – 152)	0.99 (0.97 – 1.00)
Diastolic BP standing (mmHg)	88 (81 – 95)	88 (80 – 98)	1.00 (0.97 – 1.03)
Pulse standing (bpm)	73 (67 – 83)	74 (66 – 85)	1.01 (0.99 – 1.03)
Hand grip (Kg) (median, IQR)	12 (10 – 18)	11 (6 – 18)	0.96 (0.92 – 1.01)
One leg stand eyes open (seconds)	4 (2 – 9.5)	3 (0 – 10.5)	0.98 (0.94 – 1.02)
One leg stand eyes shut (seconds)	2 (1 – 4.5)	2 (0 – 4)	0.95 (0.86 – 1.04)
Up & Go test (seconds)	20 (13 – 22)	19 (12.5 – 26)	1.01 (0.98 – 1.05)
Chair stands (seconds)	18 (13 – 20)	17 (0.00 – 23.5)	0.99 (0.95 – 1.02)
Comorbid disease (Median, IQR)	3 (2 – 4)	4 (3 – 5)	1.22 (1.02 – 1.45)*
Number of drugs (Median, IQR)	4 (2 – 5)	4 (3 – 6)	1.15 (1.01 – 1.32)*
Number of previous falls	0 (0.0 – 0.0)	0 (0.0 –1)	1.04 (0.89 – 1.23)

SOMCT = Short Orientation Memory Concentration Test; PB = Blood Pressure; bpm = beats per minute; Kg = Kilogram; IQR= interquartile range; U/Wk = units/week; *significant association

Table 4.8: Sites (indoors, outdoors) where falls occurred in baseline sample, by gender (frequencies and percentage distribution)

Site	Gender		OR (95% CI)
	Men n=44	Women n=175	
Outdoors	30 (68.2)	87 (49.7)	1
Indoors	14 (31.8)	88 (50.3)	2.17 (1.08 – 4.37)*
Outdoors			
Around dwelling	13 (43.3)	45 (51.7)	1
Away from dwelling	17 (56.7)	42 (48.3)	0.71 (0.31 – 1.65)
Indoors			
Kitchen	4 (28.6)	24 (26.7)	1
Bedroom	5 (35.7)	30 (33.3)	1.00 (0.24 – 4.14)
Bathroom	1 (7.1)	9 (10.0)	1.50 (0.15 – 15.28)
Stairs	1 (7.1)	1 (1.1)	0.17 (0.01 – 3.24)
Living room	1 (7.1)	16 (17.8)	2.67 (0.27 – 26.09)
Other place	2 (14.3)	10 (11.1)	0.83 (0.13 – 5.30)

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4.2.5.1 Biological risk factors for falls

Table 4.11 gives results of univariate analyses of biological risk factors and their association with falls. A greater number of biological risk factors for falls were associated with a fall at baseline than at follow-up. A difference in the sample size (837 at baseline and 632 at follow-up) would account for differences in the association; the smaller sample increases the chance of a type II error, i.e., the result showing no association when an association does exist. Risk factors significantly associated with a fall both at baseline and follow-up include self-reported health status, self-perceived health worse than one year ago, the number of comorbid conditions, and certain underlying medical conditions (depression, cardiovascular disease, foot problems (ulcers, bunions, callouses), dizziness/vertigo, and poor urine control). History of previous falls was significantly associated with falls at follow-up. Variables not associated with a fall at either baseline or follow up included age, age group, gender, and certain medical conditions (arthritis and lung disease). Univariate predictors for recurrent falls both at baseline and follow up were perceived health compared to a year ago, difficulty with mobility, the total number of comorbid conditions and self-reported health conditions (stroke, depression, cardiovascular

Table 4.9: Factors associated with a fall, symptoms preceding the fall and time of day of the fall (baseline and follow-up survey samples, frequencies and percentage distribution)

Factor, symptom, time	Survey sample	
	Baseline	Follow-up
Factor contributing to the fall	**n=219**	**n= 137**
Tripped/slipped	111 (50.7)	86 (62.3)
Weak legs	56 (25.5)	41 (29.9)
Blacked out	32 (14.5)	21 (15.4)
Changed position	16 (7.3)	6 (4.5)
Knocked over	4 (1.8)	2 (1.5)
Symptoms preceding the fall	**n=219**	**n=136**
Dizziness or vertigo	52 (23.7)	28 (20.4)
Light-headedness	43 (15.5)	14 (10.3)
Palpitations	16 (7.3)	10 (7.4)
Loss of consciousness	10 (4.6)	10 (7.4)
Time of fall	**n=220**	**n=138**
Morning	87 (39.5)	65 (47.1)
Afternoon	82 (37.3)	43 (31.2)
Evening	37 (16.8)	22 (15.9)
Night	7 (3.2)	8 (5.8)
Unsure	7 (3.2)	1 (0.7)

n= total number of fallers responding to this factor.

disease, foot disorders, dizziness), hearing impairment and poor urine control. No association was found between age, history of hypertension, poor memory, arthritis, visual impairment and recurrent falls. Age group and gender, Parkinson's disease, lung disease and cancer were significantly associated with recurrent falls, but only at baseline (see Table 4.12).

Table 4.10: Consequences of the fall (baseline survey sample) (frequencies and percentage distribution)

Consequence	Survey sample	
	Baseline	Follow-up
Ability to get up after the fall	**n=220**	**n=136**
Able to get up	100 (45.5)	57 (41.3)
Helped up immediately	75 (34.1)	64 (46.4)
Remained on floor until someone came	36 (16.4)	15 (10.9)
Injury from the fall	**n=215**	**n=132**
Yes	151 (70.2)	96 (72.7)
No	63 (29.3)	35 (26.5)
Unsure	1 (0.5)	1 (0.8)
Type of injury (“yes” responses**)**		
Bruising	109 (67.7)	63 (58.9)
Lacerations	41 (25.6)	27 (25.2)
Head injury	18 (11.3)	14 (13.1)
Fracture – all	23 (14.4)	6 (5.7)
–hip*	6 (26.1)	2 (20.0)
–arm*	3 (13.0)	1 (16.7)
–wrist*	7 (30.4)	–
–ribs*	6 (26.1)	2 (22.2)
–spine*	1 (4.3)	–
–clavicle*	–	1 (16.7)
Sought medical attention	**n=206**	**n=129**
Yes	87 (42.2)	49 (38)
Recovery from effects of fall	**n=206**	**n=132**
Has not fully recovered	86 (41.7)	56 (39.4)
Has fully recovered	111 (53.9)	80 (60.6)
Unsure	9 (4.4)	–
Impact on activities	**n=209**	**n=134**
Has given up or changed some activities	72 (34.4)	40 (29.9)
No change in daily activities	137 (65.6)	94 (70.1)
Fear of falling	**n = 219**	**n=138**
Yes	118 (53.9)	83 (60.1)

n= Total number of fallers responding to a characteristic. * Percentage of fracture type is % of all fractures and not % of the whole sample.

Figure 4.3a: Number of subjects and the frequency of falls reported at baseline

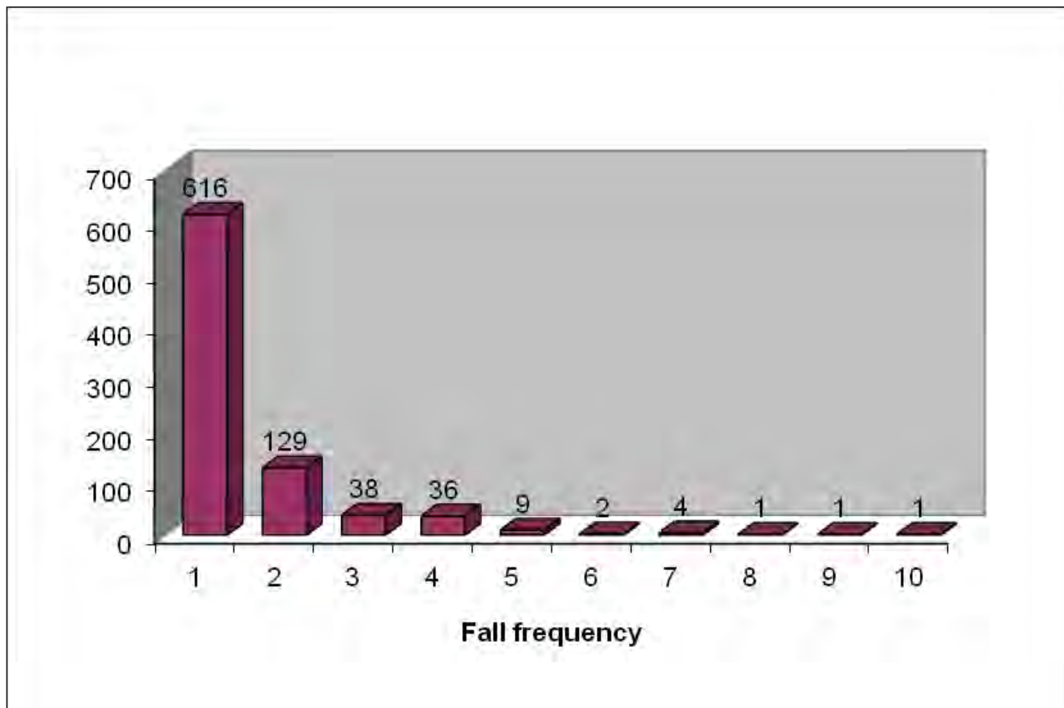

Figure 4.3b: Number of subjects and the frequency of falls in the follow-up survey sample

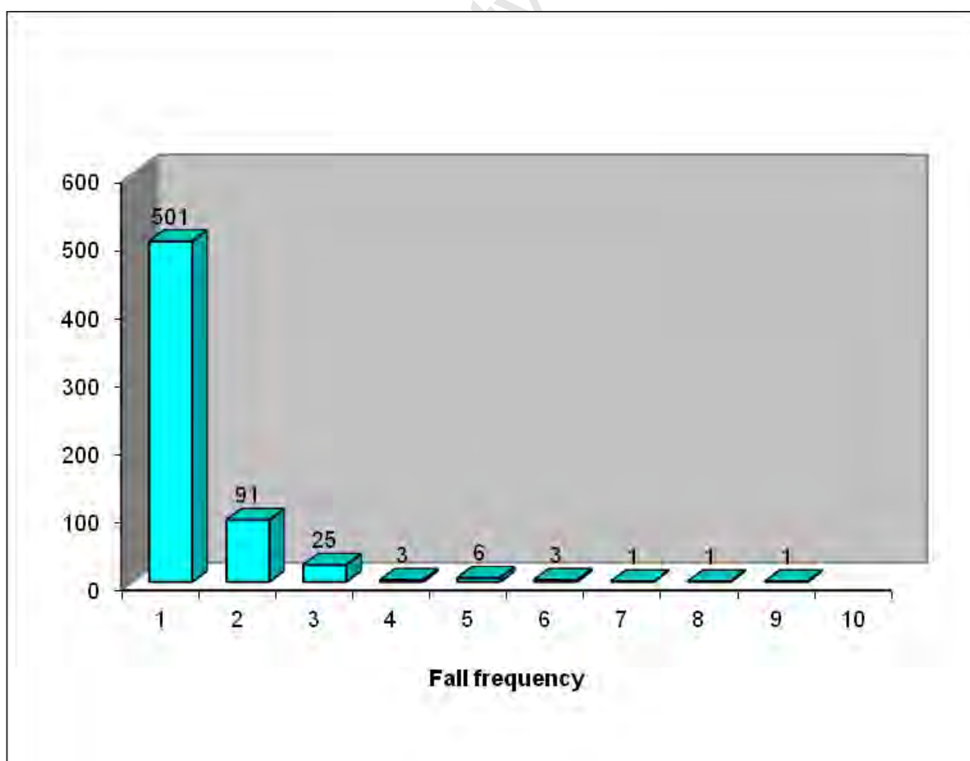

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Table 4.11: Biological predictors of falls, by fallers and non-fallers: results of univariate analyses (baseline and follow-up surveys) (percentages)

Variable	Survey sample					
	Baseline			Follow-up		
	Non fallers n=616	Fallers n=221	OR (95% CI)	Non-fallers n = 493	Fallers n= 139	OR (95% CI)
Age in years (median (IQR))	74 (69-78)	74 (69-79)	1.01 (0.98 – 1.03)	76 (69-81)	76 (69-78)	1.02 (0.99 – 1.05)
Age group (years)						
65-69	26.9	29.0	1	20.5	24.5	1
70-74	28.2	24.9	0.82 (0.54 – 1.25)	32.3	25.2	0.65 (0.38 – 1.11)
75-79	25.2	21.3	0.78 (0.50 – 1.20)	25.2	25.2	0.81 (0.47 – 1.39)
80+	19.3	24.9	1.20 (0.78 – 1.84)	22.1	25.2	0.95 (0.55 – 1.64)
Gender						
Male	24.1	20.4	1	24.3	17.3	1
Female	75.3	79.6	1.28 (0.88 – 1.86)	75.7	82.7	1.52 (0.94 – 2.47)
Self-rated health						
Good/Very good	45.1	55.7	1	52.5	64.0	1
Average/Poor/Very poor	54.9	44.3	1.53 (1.12 – 2.08)*	47.5	36.0	1.58 (1.07 – 2.34)*
Perceived health compared to a year ago						
Better	25.8	11.3	1	23.7	20.9	1
Same	67.2	67.0	1 2.27 (1.43 – 3.61)*	68.8	61.9	1.01 (0.63 – 1.61)
Worse	7.0	10.9	7.10 (3.94 – 12.80)*	7.5	17.3	2.62 (1.36 – 5.04)*
Self-rated mobility						
Independent	87.0	73.3	1	82.6	81.6	1
Impaired	13.0	26.7	2.44 (1.67 – 3.57)*	17.4	18.7	11.10 (0.68 – 1.79)

Table 4.11 (continued)

Variable	Non-faller	Faller	OR (95% CI)	Non-faller	Faller	OR (95% CI)
Medical conditions (self-reported						
	29.5	37.7	1	31.2	28.8	1
Hypertension	70.5	62.3	0.68 (0.50 – 0.94)*	68.8	71.2	1.12 (0.74 – 1.70)
	93.8	86.9	1	94.5	92.8	1
Stroke	6.2	13.1	2.30 (1.38 – 3.83)*	5.5	7.2	1.34 (0.63 – 2.84)
	98.7	93.2	1	98.4	96.4	1
Parkinson's disease	1.3	6.8	5.53 (2.31 – 13.24)*	1.6	3.6	2.26 (0.73 – 7.03)
	73.7	76.5	1	67.2	77.5	1
Diabetes	26.3	23.5	0.85 (0.60 – 1.22)	32.8	22.5	0.59 (0.38 – 0.92)*
	93.0	91.0	1	97.8	94.2	1
Memory loss	7.0	9.0	1.33 (0.76 – 2.31)	2.2	5.8	2.68 (1.05 – 6.79)*
	91.9	82.8	1	95.1	89.2	1
Depression	8.1	17.2	2.35 (1.49 – 3.70)*	4.9	10.8	2.36 (1.20 – 4.64)*
	41.6	35.7	1	38.9	38.1	1
Arthritis	58.4	64.3	1.29 (0.94 – 1.77)	61.1	61.9	1.03 (0.70 – 1.52)
	89.8	86.4	1	92.1	92.8	1
Lung disease	10.2	13.6	1.38 (0.87 – 2.19)	7.9	7.2	0.90 (0.44 – 1.86)
	58.1	38.5	1	63.9	45.3	1
Cardiovascular disease	41.9	61.5	2.22 (1.62 – 3.04)*	36.1	54.7	2.13 (1.46 – 3.12)*
	79.1	60.2	1	75.5	59.7	1
Foot disorders	20.9	39.8	2.50 (1.79 – 3.48)*	24.5	40.3	2.07 (1.40 – 3.08)*
	85.4	67.0	1	83.2	67.6	1
Dizziness	14.6	33.0	2.88 (2.01 – 4.13)*	16.8	32.4	2.36 (1.54 – 3.62)*
	95.6	91.9	1	93.7	91.4	1
Cancer	4.4	8.1	1.93 (1.04 – 3.59)*	6.3	8.6	1.41 (0.70 – 2.82)

Table 4.11 (continued)

Variable	Non-faller	Faller	OR (95% CI)	Non-faller	Faller	OR (95% CI)
Number of comorbidities (median, IQR)	3 (2-4)	4 (3-6)	1.38 (1.25 – 1.51)*	3 (2-4)	3 (2-5)	1.19 (1.08 – 1.31)*
Hearing						
Good	73.1	62.9	1	77.7	69.8	1
Poor	26.9	37.1	1.60 (1.15 – 2.21)*	22.3	30.2	1.56 (0.99 – 2.29)
Vision						
Good	91.9	95.9	1	94.7	94.9	1
Poor	8.1	4.1	0.48 (0.23 – 0.99)*	5.3	5.1	0.95 (0.40 – 2.24)
Urine control						
Good	81.5	65.2	1	78.5	61.9	1
Poor	18.5	34.5	2.35 (1.67 – 3.32)*	21.5	38.1	2.25 (1.56 – 3.37)*
	–	–	–	78.5	54.0	1
Previous fall				21.5	46.0	3.11 (2.09 – 4.63)*

*significant association.

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Biological risk factors included outcomes of physical assessments which examined for muscle weakness, gait and balance, and the presence of medical conditions such as hypertension and possible depression or cognitive impairment. Results of the measurements and assessments, and the level of association with the occurrence of a fall in the two survey samples are shown in Tables 4.13 and 4.14. It should be noted that the one leg stance was assessed at baseline and not at follow-up, while the feet together stance and near tandem stance were assessed at follow up only. Physical assessments and measurements recorded at baseline and follow-up significantly associated with a fall in univariate analysis were: Geriatric Depression Scale score, supine systolic and diastolic blood pressures, hand grip strength and timed five chair stands. Cognitive score had no association with falls. Physical assessments and measurements that were significantly associated with recurrent falls both at baseline and follow-up include supine systolic and diastolic blood pressures, hand grip strength and the timed chair stands. The timed Up & Go test and the Geriatric Depression Scale score were associated with recurrent falls at follow-up but not at baseline. The near tandem stand was associated with recurrent falls at follow-up but not the feet together stand test. The SOMT Cognitive test score was not associated with falls at either baseline or follow-up. The one leg stance test used only at baseline was not associated with recurrent falls, nor was the feet together test at follow-up (Table 4.14).

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4.2.5.2 Behavioural risk factors

Behavioural risk factors analysed for significance as predictors of falls were fear of falling, medication use, life-style habits (alcohol and tobacco use) and obesity. Table 4.15 lists results of univariate analyses for baseline and follow-up subjects, and Table 4.16 does so for recurrent falls at baseline and follow-up. A greater number of risk factors were associated with falls at baseline than at follow-up. However, some variables such as total number of drugs, and specific drugs (beta blockers, calcium channel blockers, antidepressants and psycholeptics), and hip and waist

Table 4.12: Biological predictors for recurrent falls, by non-faller and recurrent fallers: results of univariate analyses (baseline and follow-up surveys) (percentages)

Variable	Survey sample					
	Baseline			Follow-up		
	Non-fallers n = 616	Recurrent fallers n = 92	OR (95% CI)	Non-fallers n = 501	Recurrent fallers n = 40	OR (95% CI)
Age in years (median, IQR)	74 (69-78)	74 (70-81)	1.03 (0.99 –1.06)	76 (69-81)	75 (69-78)	1.03 (0.98 – 1.09)
Age group (years)						
65-69	26.9	20.7	1	20.8	17.5	1
70-74	28.2	32.6	1.51 (0.82 – 2.78)	32.1	30.0	1.09 (0.41 – 2.86)
75-79	25.5	17.4	0.89 (0.44 – 1.79)	25.0	25.0	1.15 (0.42 – 3.14)
80+	19.3	29.3	1.98 (1.05 – 3.73)*	22.2	27.5	1.46 (0.54 – 3.90)
Gender						
Male	24.7	15.2	1	24.0	17.5	1
Female	75.3	84.8	1.82 (1.0 – 3.32)*	76.0	82.5	1.51 (0.65 – 3.51)
Self-rated health						
Good/Very good	45.1	55.4	1	52.7	55.0	1
Average/Poor/Very poor	54.9	44.6	0.66 (0.43 – 1.03)	47.3	45.0	0.91 (0.48 – 1.74)
Perceived health compared to a year ago						
Better/same	93.0	73.9	1	92.2	65.0	1
Worse	7.0	26.1	4.70 (2.69 – 8.23)*	7.8	35.0	6.65 (3.20–13.81)*
Self-rated mobility						
Independent	87.0	66.3	1	82.4	67.5	1
Difficulty	13.0	33.7	3.40 (2.08 – 5.57)*	17.6	32.5	2.23 (1.13 – 4.61)*

Table 4.12 (continued)

Variable	Non-fallers	Recurrent fallers	OR (95% CI)	Non-fallers	Recurrent fallers	OR (95% CI)
Medical conditions (self-reported)						
Hypertension	24.5	38.0	1	30.9	25.0	1
	70.5	62.0	0.68 (0.43 – 1.08)	69.1	75.0	1.37 (0.65 – 2.88)
Stroke	93.8	76.1	1	94.6	85.0	1
	6.2	23.9	4 .78 (2.67 – 8.54)*	5.4	15.0	3.05 (1.18 – 7.90)*
Parkinson's disease	98.7	88.0	1	98.4	97.5	1
	1.3	12.0	10.32 (4.03 – 26.41)*	1.6	2.5	1.56 (0.19 – 12.77)
Diabetes	73.5	81.5	1	67.3	82.5	1
	26.5	18.5	0.63 (0.36 – 1.10)	32.7	17.5	0.43 (0.19 – 1.00)
Memory loss	93.0	93.5	1	97.4	95.0	1
	7.0	6.5	0.93 (0.38 – 2.25)	2.6	5.0	2.31 (0.49–10.81)
Depression	91.9	82.6	1	95.0	82.5	1
	8.1	17.4	2.38 (1.29 – 4.39)*	5.0	17.5	4.15 (1.67–10.35)*
Arthritis	41.6	34.8	1	38.5	40.0	1
	58.4	65.2	1.34 (0.85 – 2.12)	61.5	60.0	0.95 (0.49 – 1.84)
Lung disease	89.8	82.6	1	92.0	95.0	1
	10.2	17.4	1.85 (1.01 – 3.36)*	8.0	5.0	0.61 (0.14 – 2.64)
Cardiovascular disease	79.1	48.9	1	63.3	40.0	1
	41.9	68.5	3.01 (1.89 – 4.81)*	36.7	60.0	2.64 (1.37 – 5.10)*
Foot disorders	85.4	60.9	1	74.9	42.5	1
	20.9	51.1	3.94 (2.51-6.20)*	25.1	57.5	4.13 (2.13 – 7.98)*
Dizziness/vertigo	95.6	88.0	1	82.2	65.0	1
	14.6	39.1	3.76 (2.34 – 6.04)*	17.8	35.0	2.63 (1.32 – 5.24)*
Cancer			1	93.8	92.5	1
	4.4	12.0	2.96 (1.42 – 6.20)*	6.2	7.5	1.21 0.35 – 4.15)

Table 4.12 (continued

Variable	Non-fallers	Recurrent fallers	OR (95% CI)	Non-fallers	Recurrent fallers	OR (95% CI)
Number of comorbidities (median, IQR)	3 (2-4)	4 (3-6)	1.58 (1.39 – 1.81)*	3 (2-4)	4 (3-6)	1.28 (1.10 – 1.47)
Hearing						
Good	73.1	60.9	1	77.8	55.0	1
Poor	26.9	39.1	1.74 (1.11 – 2.75)*	22.2	45.0	2.86 (1.48 – 5.51)
Vision						
Good	91.9	96.7	1	93.6	87.5	1
Poor	8.1	3.3	1.05 (0.48 – 2.30)	6.4	12.5	2.13 (0.78 – 5.83)
Urine control						
Good	81.5	56.5	1	77.8	50.0	1
Poor	18.5	43.5	3.39 (2.14 – 5.36)*	22.2	50.0	3.62 (1.88 – 6.97)*
Previous falls						
No	—	—	—	78.5	22.5	1
Yes				21.5	77.5	12.61 (5.82–27.30)*

* Significant association

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Table 4.13: Association of physical assessments and measurements with a fall: results of univariate analysis (baseline and follow-up surveys)

Variable	Baseline survey			Follow-up survey		
	Non fallers n = 616	All fallers n = 221	OR (95% CI)	Non fallers n = 493	All fallers n = 139	OR (95% CI)
Geriatric Depression Score (median, IQR)	2 (1-4)	3 (1-5)	1.12 (1.07–1.18)*	2 (1-2)	2 (1-2)	1.13 (1.05–1.20)*
Cognitive score (SOMCT)	4 (2-10)	4 (2-10)	1.01 (0.99 – 1.04)	3 (0-6)	2 (0-6)	0.99 (0.96 – 1.03)
Alcohol use (U/Wk) (median, IQR), range	0.00 (0-0), 0-7	0.00 (0-0), 0-8	1.00 (0.98 – 1.02)	0.00 (0-0), 0-7	0.00 (0-0), 0-14	1.16 (0.93 – 1.46)
Systolic BP supine (mmHg)	145 (133-158)	138 (129-149)	0.98 (0.97–0.99)*	139 (125-156)	140 (132-146)	0.99 (0.98–1.00)*
Diastolic BP supine (mmHg)	89 (80-98)	84 (77-93)	0.98 (0.97–0.99)*	87 (75-96)	84 (76-91)	0.99 (0.97–1.00)*
Pulse rate supine (bpm)	71 (64-80)	69 (61-79)	0.99 (0.97–1.00)*	69 (59.5-77.5)	68 (60-71)	1.00 (0.99 – 1.02)
Systolic BP standing (mmHg)	143 (131-155)	139 (128-150)	0.99 (0.98–1.00)*	140 (128.5-157.5)	139 (123-152)	1.00 (0.99 – 1.01)
Diastolic BP standing (mmHg)	89 (80-96)	86 (77-93)	0.98 (0.97–1.00)*	87 (76.5-98)	87 (74-96)	1.01 (0.99 – 1.02)
Pulse standing (bpm)	73 (66-84)	74 (65-86)	1.00 (0.99 – 1.01)	75 (65.5-84.5)	71 (67-80)	1.01 (1.00 – 1.03)
Hand grip (Kg) (median, IQR)	16 (11-20)	14 (9-20)	0.97 (0.96–0.99)*	13 (2.25-25)	12 (10-15)	0.97 (0.94–0.99)*
One leg stand eyes open (seconds)	7 (3-17)	10 (3-25)	1.02 (1.01–1.04)*	—	—	—
One leg stand eyes shut (seconds)	3 (1-6)	3 (1-6)	1.02 (0.99 – 1.05)	—	—	—
Up & Go test (seconds)	16 (12-21)	13 (11-18)	0.99 (0.96–1.00)*	12 (10-15)	12 (11-13)	1.00 (0.97 – 1.02)
Chair stands (seconds)	16 (12-20)	13 (9-17)	0.94 (0.92–0.96)*	13 (10-16)	13 (11-16)	0.96 (0.93–0.98)*
Feet together (seconds)	—	—	—	30 (30-30)	30 (30-30)	1.00 (0.99 – 1.01)
Near tandem (seconds)	—	—	—	21 (12.5-30)	30 (16.8-30)	1.00 (0.98 – 1.02)

SOMCT = Short Orientation Memory Concentration Test; PB = Blood Pressure; bpm = beats per minute; Kg = Kilogram; IQR= interquartile range; U/Wk = units/week; *significant association.

Table 4.14: Association of physical assessments and measurements with recurrent falls. results of univariate analysis (baseline and follow-up surveys) (frequencies and percentage distribution)

Variable	Baseline survey			Follow-up survey		
	Non fallers n = 616	Recurrent fallers n = 92	OR (95% CI)	Non fallers n = 501	Recurrent fallers n = 40	OR (95% CI)
Depression score, (median, (IQR))	2 (1-4)	3 (1-5)	1.14 (0.07 – 1.22)	2 (1-2)	4 (2-5)	1.25 (1.13–1.38)*
Cognitive score, (median, (IQR))	4 (2-10)	6 (2-10)	1.01 (0.98 – 1.05)	3 (0-6)	0 (0-7)	1.02 (0.96 – 1.08)
Systolic BP supine (mmHg)	145 (133-158)	138 (129-149)	0.99 (0.98–1.00)*	139 (125-156)	136 (118-145)	0.98 (0.96–1.00)*
Diastolic BP supine (mmHg)	89 (80-98)	84 (77-93)	0.99 (0.97–1.00)*	87 (75-96)	79 (67-91)	0.96 (0.94–0.99)*
Pulse rate supine (mmHg)	71 (64-80)	70 (61-79)	0.99 (0.97 – 1.01)	69 (59-77)	69 (60-80)	1.01 (0.99 – 1.03)
Systolic BP standing (mmHg)	143 (131-155)	139 (128-150)	0.99 (0.98–1.00)*	140 (128-157)	121 (111-137)	0.99 (0.97–1.00)*
Diastolic BP standing (mmHg)	89 (80-96)	86 77-93)	0.99 (0.97–1.00)*	87 (67-98)	78 (66-88)	1.00 (0.97 – 1.02)
Pulse standing (bpm)	73 (66-84)	76 (65-86)	1.01 (0.99 – 1.03)	75 (65-84)	74 (68-86)	1.02 (1.00–1.05)*
Hand grip (kg), (median, (IQR))	16 (11-20)	13 (9-20)	0.96 (0.93–0.99)*	13 (2-25)	12 (4-17)	0.94 (0.90–0.98)*
One leg stand (seconds) eyes open	7 (3-17)	8 (3-25)	1.01 (0.99 – 1.03)	–	–	–
One leg stand (seconds) eyes shut	3 (1-6)	3 (1-6)	1.01 (0.97 – 1.06)	–	–	–
Timed Up & Go (seconds)	16 (12-21)	14 (11-18)	1.01 (0.98 – 1.03)	12 (10-15)	14 (11-21)	1.03 (1.00–1.06)*
Chair stands (seconds)	16 (12-20)	12 (9-17)	0.92 (0.89–0.94)*	13 (10-16)	12 (0-16)	0.94 (0.90–0.98)*
Feet together test (seconds)	–	–	–	30 (10-32)	30 (22-30)	0.99 (0.97 – 1.02)
Near tandem (seconds)	–	–	–	21 (12-30)	30 (13-30)	0.97 (0.94–1.00)*

SOMCT = Short Orientation Memory Concentration Test; PB = Blood Pressure; bpm = beats per minute; Kg = Kilogram; IQR= interquartile range; *significant association.

measurements showed significant association with falls both at baseline and follow-up, whereas BMI or waist/hip ratio showed no association. Fear of falls was associated with falls at baseline but not at follow up. It should be noted that performance of basic activities of daily living (ADLs) and instrumental activities of daily living (IADLs) is reported only at follow-up, and was not assessed at baseline (see section 3.4). The basic ADLs score and the IADLs score were not associated with falls (Table 4.15).

Behavioural risk factors significantly associated with recurrent falls at baseline and follow-up were total number of medications; specific medication which included analgesics, antidepressants and psycholeptics; and hip and waist measurements. The hip/waist ratio derived from the waist and hip measurements had no association with recurrent falls. Basic ADLs and IADLs scores were not associated with falls at follow-up. Tobacco use and the use of cardiac drugs, antihypertensive drugs, beta-blockers, calcium channel blockers, thyroid replacement therapy and anti-inflammatory drugs were associated with recurrent falls at baseline but not at follow-up (Table 4.16).

4.2.5.3 Socio-demographic and environmental predictors of falls

Table 4.17 shows socio-demographic and environmental factors assessed for association with a fall. Socio-demographic factors were marital status, ethnic group, education level, previous occupational category, type of housing (formal or informal), toilet facility (indoors or only outdoors), and a socio-economic status (SES) index score (possession of eight household items). Environmental factors recorded were the presence of mats/rugs and stairs/steps in the dwelling. Risk factors significantly associated with falls both at baseline and follow-up were ethnicity, previous occupation, indoor/outdoor location of the toilet and SES score. Total number of inhabitants in a household was associated with falls only at baseline while level of

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Table 4.15: Behavioural predictors for a fall by non-fallers and fallers: results of univariate analyses (baseline and follow-up surveys) (percentage distribution)

Variable	Baseline survey			Follow-up survey		
	Non-faller n = 616	Fallers n = 221	OR 95% CI	Non-fallers n = 493	Fallers n = 139	OR 95% CI
Fear of falling	64.3	53.4	1	36.1	39.9	1
	35.7	46.6	0.64 (0.47 – 0.88)*	63.9	60.1	1.17 (0.79 – 1.73)
Total number of drugs (median, IQR)	4 (2-5)	5 (3-8)	1.23 (1.16 – 1.30)*	4 (2-6)	4 (2-6)	1.08 (1.01–1.15)*
Drug use (%)						
Anti-diabetic drugs	84.9	78.7	1	83.8	83.5	1
	15.1	21.3	1.52 (1.03 – 2.24)*	16.2	16.5	1.02 (0.62 – 1.70)
Cardiac drugs	95.3	90.5	1	93.5	95.0	1
	4.7	9.5	2.12 (1.18 – 3.81)*	6.5	5.0	0.76 (0.33 – 1.77)
Antihypertensive drugs	74.8	86.9	1	96.1	95.0	1
	25.2	13.1	0.45 (0.29 – 0.69)*	3.9	5.0	1.32 (0.54 – 3.21)
Diuretics	66.1	66.5	1	51.9	50.4	1
	33.9	33.5	0.98 (0.71 – 1.36)	48.1	49.6	1.06 (0.73 – 1.55)
Beta blockers	81.5	73.5	1	80.9	69.1	1
	18.5	26.5	1.57 (1.09 – 2.25)*	19.1	30.9	1.90 (1.24–2.90)*
Calcium channel blockers	65.7	74.7	1	62.1	71.2	1
	34.3	25.3	0.65 (0.46 – 0.92)*	37.9	28.8	0.66 (0.44–1.00)*

Table 4.15 (continued)

Variable	Non-fallers	Fallers	OR 95% CI	Non-fallers	Fallers	OR 95% CI
ACE inhibitors	65.7	59.7	1	61.3	64.7	1
	34.4	40.3	1.28 (0.94 – 1.76)	38.7	35.3	0.86 (0.58 – 1.27)
Lipid modifying drugs	81.5	74.2	1	68.6	64.7	1
	18.5	25.8	1.53 (1.06 – 2.20)*	31.4	35.3	1.19 (0.80 – 1.76)
Thyroid	97.4	92.3	1	96.3	94.2	1
	2.6	7.7	3.12 (1.55 – 6.30)*	3.7	5.8	1.61 (0.68 – 3.79)
Anti-inflammatory drugs	85.6	67.9	1	83.6	79.9	1
	14.4	32.1	12.80 (1.95 – 4.02)*	16.4	20.1	1.28 (0.79 – 2.07)
Analgesics	80.7	67.9	1	73.6	69.1	1
	19.3	32.1	1.98 (1.40 – 2.79)*	26.4	30.9	1.25 (0.83 – 1.89)
Psycholeptics	97.1	90.2	1	97.8	92.1	1*
	2.9	9.8	2.08 (1.00 – 4.31)*	2.2	7.9	3.77 (1.60–8.88)*
Antidepressants	96.3	87.3	1	95.1	90.6	1
	3.7	12.7	3.74 (2.10 – 6.65)*	4.9	9.4	2.02 (1.00–4.07)*
Bronchodilators	93.7	91.0	1	93.5	94.2	1
	6.3	9.0	1.47 (0.84 – 2.58)	6.5	5.8	0.88 (0.39 – 1.95)
Anti-osteoporosis	99.0	99.5	1	99.0	99.3	1
	1.0	0.5	0.46 (0.06 – 3.86)	1.0	0.7	0.71 (0.08 – 6.10)
Laxatives	99.4	96.8	1	99.6	99.3	1
	0.6	3.2	5.00 (1.45–17.26)*	0.4	0.7	1.78 (0.16–19.76)

Table 4.15 (continued)

Variable	Non-fallers	Fallers	OR 95% CI	Non-fallers	Fallers	OR 95% CI
Anti-thrombotic	68.0	65.6	1	66.3	71.2	1
	32.0	34.4	1.11 (0.80 – 1.54)	33.7	28.8	0.80 (0.53 – 1.20)
Tobacco use (%)						
Never	68.5	52.5	1	64.7	59.7	1
Current/Previous	31.5	47.5	1.97 (1.44 – 2.69)*	35.3	40.3	1.66 (0.86 – 3.20)
Alcohol use (%)						
Never	77.8	70.6	1	77.9	74.8	1
Current/Previous	22.2	29.4	1.46 (1.03 – 2.06)*	22.1	25.2	1.51 (0.72 – 3.04)
Hip circumference (cm) (median, IQR)	108 (98-120)	102 (95-112)	0.98 (0.97 – 0.99)*	99 (95-107)	102 (94-106)	0.98 (0.97–0.99*)
Waist circumference (cm) (median, IQR)	97 (89-105)	93 (83-100)	0.98 (0.97 – 0.99)*	94 (87-100)	91 (85-94)	0.98 (0.96–0.99)*
Waist-hip ratio	0.91 ± 0.01	0.92 ± 0.03	1.27 (0.24 – 6.61)	0.93 (0.83-1.0)	0.90 (0.85-0.94)	0.63 (0.06 – 6.68)
BMI (Kg/m^2) (median, IQR)	28 (25-31)	27 (24-32)	0.98 (0.96 – 1.01)	27 (24-30)	25 (23-29)	0.98 (0.95–1.01)
ADL score (median, IQR), range	—	—	—	6.0 (6.0-6.0), 1-6	6.0 (6.0-6.0), 3-6	0.77 (0.53–1.11)
IADL score (median, IQR)	—	—	—	8 (6-9), 0-9	9 (6-9), 1-9	0.96 (0.88 – 1.06)

ADL= activities of daily living; IADL = Instrumental activities of daily living; Kg = Kilogram; IQR= interquartile range; cm=centimetre; m=metre; *significant association.

Table 4.16: Behavioural predictors for recurrent falls by non-fallers and recurrent fallers: results of univariate analyses (baseline and follow-up surveys) (percentage distribution)

Variable	Baseline sample			Follow-up sample		
	Non-fallers n = 616	Fallers n = 92	OR 95% CI	Non-fallers n = 501	Fallers n = 40	OR 95% CI
Fear of falling	35.7 64.3	45.1 54.9	1 10.68 (0.44 – 1.06)	35.7 64.3	41 59.0	1 11.23 (0.63 – 2.30)
Total drugs taken (median, IQR)	4 (2-5)	6 (3-8)	1.30 (1.20 – 1.40)*	4 (2-6)	5 (2.5-11)	1.17 (1.06 – 1.29)*
Drug use (%) Anti-diabetic drugs	84.9 15.1	83.2 16.3	1 1.10 (0.60 – 1.99)	83.6 16.4	87.5 12.5	1 10.73 (0.28 – 1.91)
Cardiac drugs	95.3 4.7	88.0 12.0	1 12.75 (1.32 – 5.71)*	93.6 6.4	92.5 7.5	1 11.17 (0.34 – 4.00)
Antihypertensive	74.8 25.2	89.1 10.9	1 0.36 (0.18 – 0.72)*	96.2 3.8	92.5 7.5	1 2.03 (0.57 – 7.17)
Diuretics	66.1 33.9	64.1 35.9	1 1.09 (0.69 – 1.72)	51.7 48.3	50.0 50.0	1 1.08 (0.56 – 2.05)
Beta blockers	81.5 18.5	69.6 30.4	1 1.93 (1.18 – 3.14)*	81 19.0	72.5 27.5	1 1.61 (0.78 – 3.35)
Calcium channel blockers	65.7 34.3	76.1 23.9	1 0.60 (0.36 – 1.00)*	62.1 37.9	77.5 22.5	1 0.48 (0.22 – 1.02)
ACE inhibitors	65.6 34.4	57.6 42.4	1 1.40 (0.90 – 2.19)	61.5 38.5	62.5 37.5	1 0.95 (0.49 – 1.85)
Lipid modifying drugs	81.5 18.5	73.9 26.1	1 1.55 (0.93 – 2.58)	68.3 31.7	67.5 32.5	1 1.05 (0.53 – 2.10)
Thyroid drugs	97.4 2.6	93.5 6.5	1 2.62 (1.00 – 6.87)*	96.4 3.6	90.00 10.0	1 2.94 (0.94 – 9.14)
Anti-inflammatory drugs	85.6 14.4	70.7 29.3	1 2.46 (1.49 – 4.06)*	83.8 16.2	77.5 22.5	1 1.48 (0.68 – 3.32)

Table 4.16 (continued)

Variable	Non-fallers	Fallers	OR 95% CI	Non-fallers	Fallers	OR 95% CI
	80.7	62	1	73.5	57.5	1
Analgesics	19.3	38.0	2.56 (1.61 – 4.09)*	26.5	42.5	2.05 (1.06 – 3.95)*
	97.1	90.2	1	95.2	80.0	1
Psycholeptics	2.9	9.8	3.60 (1.57 – 8.28)*	4.8	20.0	4.88 (1.48–16.09)*
	96.3	85.9	1	97.6	90.0	1
Antidepressants	3.7	14.1	4.24 (2.07 – 8.71)*	2.4	10.0	4.90 (2.04–11.76)*
	93.7	88.0	1	93.6	92.5	1
Bronchodilators	6.3	12.0	2.01 (0.99 – 4.08)	6.4	7.5	1.17 (0.34 – 4.00)
	99.0	98.9	1	99.0		1
Anti-osteoporosis	1.0	1.1	1.12 (0.13 – 9.39)	1.0	0.0	NS (cell with 0)
	99.4	98.9	1	99.6	97.5	1
Laxatives	0.6	1.1	1.68 (0.19 – 15.21)	0.4	2.5	6.31 (0.56 – 71.11)
	68.0	56.5	1	66.7	75.0	1
Anti-thrombotic	32.0	43.5	1.64 (1.05 – 2.55)*	33.3	25.0	0.66 (0.31 – 1.38)
Tobacco use (%) Never smoked	68.5	51.1	1	64.9	52.5	1
Current/Previous	31.5	48.9	2.08 (1.34 – 3.24)*	35.1	47.5	1.66 (0.86 – 3.20)
Alcohol use (%) Never drank	77.8	76.1	1	78.2	70.0	1
Current/previous	22.2	23.9	1.10 (0.66 – 1.84)	21.8	30.0	1.51 (0.72 – 3.04)
ADL score (median, IQR), range	—	—	—	6 (6-6),1-6	6 (6-6), 5-6	0.70 (0.44 – 1.12)
IADL score (median, IQR), range	—	—	—	8 (6-9), 0-9	7 (5-9), 1-9	0.99 (0.77 – 1.02)
Alcohol units	00 (0-0)	00 (0-0)	1.18 (0.95 – 1.47)	2 (1-4)	1 (1-2)	0.79 (0.44-1.40)
BMI (Kg/m^2)	28 (25-31)	27 (24-32)	0.98 (0.94 – 1.02)	27 (24-30)	22 (19-22)	0.95 (0.90 – 1.01)
Hip measurement cm	108 (98-120)	102 (95-112)	0.98 (0.97 – 0.99)*	99 (95-107)	97 (88-109)	0.97 (0.94 – 1.00)*
Waist	97 (89-105)	93 (83-100)	0.98 (0.97 – 0.99)*	94 (87-100)	84 (73-102)	0.96 (0.94 – 0.99)*

ADL= activities of daily living; IADL = Instrumental activities of daily living; Kg = Kilogram; IQR= interquartile range; cm=centimetre; m=metre; *significant association.

education was associated with falls at follow-up. Factors not significantly associated with a fall at baseline and follow-up were marital status, type of housing, and presence of stairs/steps in the dwelling.

Socio-demographic and environmental factors significantly associated with recurrent falls at baseline and follow-up were ethnic group, toilet facility (indoors or outdoors), occupation and having mats in the dwelling. Presence of stairs/steps in the dwelling had no association with recurrent falls. Marital status and level of education were associated with recurrent falls at follow-up but not at baseline. SES index was associated with falls at baseline only (Table 4.18).

4.2.5.4 Baseline risk factors associated with falls on follow-up: longitudinal univariate analyses

Longitudinal analyses were conducted on the data of subjects in the follow-up survey. Of the 632 subjects in the follow-up survey, 138 reported a fall during the interval to follow-up. This fall was used as a dependent variable, and risk factors for falls reported or measured at baseline were used as independent variables.

Variables significantly associated with a fall at follow-up in univariate analyses were: Biological (perceived health worse than to a year ago, depression, foot disorders, dizziness/vertigo, poor urine control, total number of comorbid diseases, history of a previous fall); behavioural (use of antidepressant and use of psycholeptic drugs, the total number of drugs used); and socio-economic and environmental (ethnic group, level of education (primary level of education was protective against a fall when compared to no schooling), toilet indoors, total number of inhabitants in a household, SES index score). Physical assessment and measurement scores showed no association, apart from hand grip strength and the timed Up and Go test which showed a trend towards being protective (Table 4.19).

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Table 4.17: Socio-demographic and environmental predictors of a fall, by non-fallers and faller: results of univariate analyses (baseline and follow-up surveys) (percentage distribution)

Variable	Baseline sample			Follow-up sample		
	Non-fallers n = 616	Fallers n = 221	OR 95% CI	Non-fallers n = 493	Fallers n = 139	OR 95% CI
Marital status (%)						
Married	29.4	36.7	1	29.0	26.6	1
Widowed	59.9	51.6	0.69 (0.49 –0.97)*	62.5	61.2	1.01 (0.71 – 1.71)
Divorced/separated	4.2	4.5	0.86 (0.40 – 1.86)	3.4	4.3	1.41 (0.52 – 3.84)
Never married	6.5	7.2	0.89 (0.47 – 1.69)	5.1	7.9	1.76 (0.79 – 3.91)
Ethnic group (%)						
Black African	43.0	8.1	1	32.5	14.4	1
Coloured	41.7	61.1	7.73 (4.59 – 13.02)*	51.1	56.8	2.47 (1.45 – 4.19)*
White	13.0	27.1	8.41 (3.12 – 22.67)*	1.8	2.9	3.56 (1.00–12.61)*
Indian	2.3	8 3.6	11.04 (6.16–19.78)*	14.6	17.1	4.00 (2.17 – 7.39)*
Level of education (%)						
No schooling	5.5	5.0	1	2.6	5.6	1
Primary	31.5	21.7	0.77 (0.36 – 1.63)	34.3	20.9	0.32 (0.12 – 0.87*
Secondary	57.6	65.2	1.25 (0.62 – 2.54)	56.8	64.0	0.58 (0.22 –1.50)
Post school qualification	5.5	18 8.1	1.64 (0.67 – 3.98)	6.3	10.1	0.84 (0.27 – 2.56)
Occupation category (%)						
Unskilled	43.3	19.0	1	35.1	29.5	1
Skilled	47.2	65.6	13.17 (2.16 – 4.64)*	54.2	54.0	1.16 (0.76 – 1.78)
Professional/managerial	9.4	15.4	3.73 (2.18 – 6.36)*	10.8	16.5	1.83 (1.01 –3.32)*
Housing (%)						
Formal	99.5	98.2	1	99.0	98.6	1
Informal	0.5	1.2	13.77 (0.84–16.96)	1.0	1.4	1.42 (0.27 – 7.42)

Table 4.17 (continued)

Variable	Non-fallers	Fallers	OR 95% CI	Non-fallers	Fallers	OR 95% CI
Piped water (%)						
Indoors	97.4	98.9	1	96.3	98.6	1
Outdoors	2.6	1.1	1.23 (0.50 – 3.02)	3.7	1.4	0.38 (0.09 – 1.68)
Toilet facility (%)						
Indoor	67.9	98.9	1	69.0	86.3	1
Outdoor	32.1	1.1	8.25 (4.50 – 15.12)*	31.0	13.7	0.35 (0.21 – 0.59)
Stairs in or to dwelling (%)						
No	94.5	90.7	1	92.0	89.8	1
Yes	5.5	9.3	1.76 (0.98 – -3.19)	8.0	10.2	1.31 (0.69 – 2.50)
Mats in dwelling (%)						
No	75.2	62.0	1	64.7	57.6	1
Yes	24.8	38	0.67 (0.48 – 0.94)*	35.3	52.5	0.74 (0.50 – 1.09)
Total number resident in dwelling (median, IQR)	4 (4-7)	2.5 (2-4)	0.75 (0.74 – -0.85)	2 (1-6)	2 (1-4)	0.94 (0.86 – 1.04)
SES score (median & IQR)	7 (6 – 8)	8 (7-8)	1.57 (1.34 – 1.84)*	7 (6 – 8)	8 (7-8)	1.42 (1.16–1.74)*

SES= Socio-economic Status index; score of 8 items in household; *significant association.

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Table 4.18: Socio-demographic and environmental predictors for recurrent falls, by non-fallers and recurrent fallers: results of univariate analyses (baseline and follow-up surveys) (percentage distribution)

Variable	Baseline sample			Follow-up sample		
	Non-fallers n = 616	Fallers n = 92	OR (95% CI)	Non-fallers n = 501	Fallers n = 40	OR (95% CI)
Marital status (%)						
Married	29.4	30.4	1	28.9	15.0	1
Widowed	59.9	58.7	0.96 (0.58 – 1.54)	62.7	65.0	2.03 (0.82 – 5.03)
Divorced/separated	4.2	4.3	0.99 (0.32 – 3.06)	3.4	5.0	2.82 (0.53 – 15.11)
Never married	6.5	6.5	0.97 (0.38 – 2.50)	5.0	15.0	5.76 (1.72 – 19.29)*
Ethnic group (%)						
Black African	43.0	3.3	1	32.7	5.0	1
Coloured	41.7	67.4	21 (6.60 – 68.75)	51.1	65.0	8.22 (1.92 – 35.11)
Indian	2.3	2.2	12.62 (1.95 – -81.73)	1.8	5.0	17.78 (2.24 – 141.14)
White	13.0	27.2	27.60 (8.12 – 93.82)	14.4	25.0	11.11 (2.37 – 52.01)
Level of education (%)						
No schooling	5.5	5.4	1	2.6	10.0	1
Primary	31.3	20.7	10.67 (0.23-1.91)	33.9	25.5	0.17 (0.05 – 0.64)*
Secondary	57.6	69.6	1.23 (0.46-3.25)	57.3	57.5	0.27 (0.08 – 0.88)*
Post school qualification	5.5	4.3	0.80 (0.20-3.24)	6.2	10.0	0.42 (0.09 – 1.94)
Occupation category (%)						
Unskilled	43.3	23.9	1	35.0	25.0	1
Skilled	47.2	62.0	2.38 (1.41 – 3.99)*	54.3	52.5	1.36 (0.62 – 2.95)
Professional/managerial	9.4	4.3	2.72 (1.29 – 5.71)*	10.7	22.5	2.94 (1.13 – 7.61)*
Housing (%)						
Formal	99.5	100	Two cells with <1 NS	99.0	95.0	1
Informal	0.5	0		1.0	5.0	5.15 (0.97 – 27.42)

Table 4.18 (continued)

Variable	Non-fallers	Fallers	OR 95% CI	Non-fallers	Fallers	OR 95% CI
Toilet facility (%)						
Indoors	67.9	98.9	1	69.1	95.0	1
Outdoors only	32.1	1.1	43.1 (6.0–311.6)*	30.9	5.0	0.12 (0.03 – 0.49)
Stairs in or to dwelling (%)						
No	94.5	92.9	1	92.1	85.0	1
Yes	5.5	7.1	1.32 (0.54 – 3.26)	7.9	15.0	0.49 (0.19 – 1.24)
Mats in dwelling (%)						
No	24.8	38	1	35.3	52.5	1
Yes	75.2	62.0	0.53 (0.34 – 0.85)*	64.7	47.5	0.49 (0.26 – 0.94)
Total number in dwelling (median, IQR)	4 (2-7)	3 (2-4)	0.79 (0.71 – -0.87)*	2 (1-6)	2 (1-4)	0.86 (0.72- – 1.02)
SES index score (median & IQR)	7 (6 – 8)	7 (7 -8)	1.54 (1.23 – 1.93)*	7 (6 - 8)	8 (7 - 8)	1.36 (0.96 – 1.92)

SES= Socio-economic Status index; score of 8 items in household. IQR=interquartile range; *significant association.

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Of the 632 subjects in the follow-up survey, 40 reported recurrent falls during the interval to follow-up. Recurrent falls (≥2 falls) in the period to follow-up was used as a dependent variable, and risk factors for falls reported or measured at baseline were used as independent variables. Variables significantly associated with recurrent falls were similar to those associated with any fall, but with a few variations in the association. Self-reported stroke, self-rated mobility, hip measurement, cognitive score, waist measurement, diastolic blood pressure and stairs in a dwelling, not associated with any fall, were associated with recurrent falls. Level of education and socio-economic status index score, the variables associated with any fall, were not associated with recurrent falls.

Variables associated with recurrent falls were: Biological (perceived poor health compared to a year ago, self-reported poor mobility, medical conditions (stroke, depression, foot disorders, dizziness/vertigo), poor urine control, total number of comorbid diseases, and history of a previous fall); physical assessments and measurements (Geriatric Depression Scale score, cognitive score, hand grip strength, hip measurement, and waist measurement,); behavioural (use of anti-inflammatory, use of antidepressant and use of psycholeptic drugs, the total number of drugs used,); and socio-economic and environmental (ethnic group, toilet indoors, stairs in the dwelling, and total number of inhabitants in a household) (Table 4.20). Risk factors independently associated with falls on longitudinal analyses are discussed in section 4.2.7.4.

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Table 4.19: Longitudinal univariate analysis: predictors of falls, by non-fallers and fallers

Risk factor	Follow-up sample		
	Non fallers n=494	Fallers n=138	OR (95% CI)
Biological			
Self-rated mobility (%)			
Independent	90.6	84.2	1
Difficult	9.3	15.8	1.32 (0.78 – 2.24)
Perceived health compared to a year ago (%)			
Better/same	91.5	85.5	1
Worse	8.5	14.5	1.82 (1.03 – 3.22)*
Foot disorders (%)			
No	76.4	64.5	1
Yes	25.4	35.5	1.51 (1.01 – 2.26)*
Dizziness/vertigo (%)			
No	83.7	66.9	1
Yes	16.3	33.1	2.47 (1.61 – 3.79)*
Depression (%)			
No	91.3	84.2	1
Yes	8.7	15.8	1.99 (1.14 – 3.46)*
Number of comorbidities (median, (IQR)	3 (2-4)	4 (2-5)	1.20 (1.07 – 1.34)*
Urine control (%)			
Good	78.7	68.3	
Poor	21.3	3.7	1.66 (1.09 – 2.52)*
Measurements			
Five chair stands(median, IQR)	15 (11-20)	13(10-19)	0.97 (0.94 – 0.99)*
Geriatric Depression Scale score (median, (IQR))	2 (1-3)	2 (1-4)	1.06 (0.99 – 1.13)*
Cognitive score (median, (IQR)	4 (0.0 – 8.0)	4 (1.5–10.0)	1.02 (0.99 – 1.06)
Hand grip strength (kg)	16 (11.0 – 20)	14 (11 – 19)	0.99 (0.97 – 1.02)
Up & Go test	14 (11 – 20)	14 (11 – 19)	0.99 (0.97 – 1.02)
Behavioural			
Use of anti-inflammatory drugs (%)	13.8	20.9	1.42 (0.92 – 2.20)
Use of antidepressants (%)	4.9	10.8	2.39 (1.22 – 4.69)*
Use of psycholeptics (%)	3.0	7.2	2.49 (1.09 – 5.68)*
Total number of medications (median, (IQR))	4 (2-6)	4 (3-7)	1.08 (1.02 – 1.15)*
History of previous falls (%)	21.5	46.0	3.17 (2.13 – 4.17)*

Table 4.19 (continued)

Risk factor	Non-faller	Faller	OR (95% CI)
Socio-economic and environmental			
Ethnic group (%)			
Black African	32.9	14.4	1
Coloured	50.3	56.8	2.54 (1.49 – 4.31)*
White	2.2	3.6	3.94 (2.13 – 7.29)*
Indian	14.6	25.2	3.68 (1.16 – 11.68)*
Level of education (%)			
No schooling	3.2	7.2	1
Primary	30.6	18.0	0.26 (0.11 – 0.65)*
Secondary	60.0	66.2	0.49 (0.21 – 1.12)
Post school qualification	6.1	8.6	0.64 (0.23 – 1.80)
Toilet facility (%)			
Indoor	74.8	89.9	1
Outdoor	25.2	10.1	0.34 (0.19 – 0.61)*
Socio-economic status index score (median, (IQR))	7 (6-8)	8 (7-8)	1.27 (1.05 – 1.54)*
Total number resident in dwelling (median, (IQR))	3 (3-4)	2 (2-5)	0.91 (0.84 – 0.98)*

IQR= interquartile range. Table shows only factors significantly associated with any falls; *significant association.

Table 4.20: Longitudinal univariate analysis: predictors of recurrent falls, by non-fallers and recurrent fallers

Risk factor	Follow-up sample		
	Non fallers n = 494	Recurrent fallers n = 40	OR (95% CI)
Biological			
Self-rated health (%)			
Good/Very good	51.7	60.0	1
Average	41.9	27.5	0.57 (0.27 – 1.20)
Poor/Very poor	6.4	12.5	1.67 (0.60 – 4.69)
Perceived health compared to a year ago (%)			
Better	8.4	30.0	1
Same	71.1	60.0	1.75 (0.59 – 5.15)*
worse	20.6	10.0	7.29 (2.22 – 23.88)*
Self-rated mobility (%)			
Independent	87.6	65.0	1
Difficulty	12.4	35.0	3.75 (1.86 – 7.57)*

Table 4.20 (continued)

Risk factor	Non-faller	Recurrent Fallers	OR (95% CI)
Self-reported stroke (%)			
No	92.8	80.0	1
Yes	7.2	20.0	3.28 (1.40 – 7.65)*
Self-reported depression (%)			
No	91.2	75.0	1
Yes	8.8	25.0	3.50 (1,60 – 7.63)*
Self-reported foot disorders (%)			
No	74.3	55.0	1
Yes	25.7	45.0	2.39 (1.24 – 4.60)*
Self-reported dizziness/vertigo (%)			
No	83.4	55.0	1
Yes	16.6	45.0	4.17 (2.14 – 8.13)*
Urine control (%)			
Good	78.4	65.0	1
Poor	21.6	35.0	1.97 (0.99 – 3.91)
Number of comorbidities	3 (2-4)	4 (3-6)	1.36 (1.13 – 1.64)*
Measurements			
Geriatric Depression Scale score (median, (IQR))	2 (1-4)	2 (1-5)	1.11 (1.00 – 1.23)*
Cognitive score	4 (0 – 8)	6 (2 – 10)	1.05 (1.00 – 1.11)*
Hand grip (kg) (median, IQR)	16 (11-21)	13 (5-20)	0.95 (0.91 – 0.99)*
Waist circumference (cm)	96 (88-105)	93 (79-99)	0.98 (0.95 – 1.00)*
Hip circumference (cm)	106 (98-118)	100 (93-112)	0.98 (0.95 – 1.00)*
Diastolic BP (mmHg) (standing)	88 (79-95)	82 (77-91)	0.99 (0.97 – 1.01)
Behavioural			
Total number of medications (median, (IQR))	4 (2-6)	5 (3-7)	1.15 (1.05 – 1.27)*
Use of anti-inflammatory drugs (%)			
No	86.2	70.0	1
Yes	13.8	30.0	2.23 (1.19 – 4.59)*
Use of antidepressants (%)			
No	95.2	85.0	1
Yes	4.8	15.0	3.46 (1.32 – 9.02)*
Use of psycholeptics (%)			
No	96.8	90.0	1
Yes	3.2	10.0	3.55 (1.12 – 11.25)*
History of previous falls (%)			
No	78.6	92.5	1
Yes	21.4	7.5	12.61 (6.82 – 27.30)*

Table 4.20 (continued)

Risk factor	Non-faller	Recurrent faller	OR (95% CI)
Socio-economic and environmental			
Ethnic group (%)			
Black African	33.1	7.5	1
Coloured	50.3	62.5	5.42 (1.61 – 18.25)*
White	2.2	7.5	6.75 (1.61 – 18.25*
Indian	14.4	22.5	14.73 (2.66 – 81.66)*
Toilet facility (%)			
Outdoor	25.1	5.0	1
Indoor	74.9	95.0	6.37 (1.51 – 26.78)*
Stairs in dwelling			
No	94.7	85.0	1
Yes	5.3	15.0	3.23 (1.24 – 8.45)*
Total number resident in dwelling (median, (IQR))	3 (2-6)	2 (1-4)	0.84 (0.73 – 0.98)*

IQR= interquartile range. Table shows only factors significantly associated with recurrent falls; *significant association.

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4.2.5.5 Baseline risk factors associated with falls and loss to follow-up: Longitudinal multinomial logistic univariate analyses

Longitudinal multinomial logistic regression analyses were conducted for both univariate analyses and logistic regression models. The dependent variable included non-fallers, fallers and subjects lost to follow-up, as reported at follow-up with independent variables collected at the baseline survey. For univariate analyses, non-fallers were the reference group. Of the 837 subjects in the baseline survey, 138 reported a fall during the interval to follow-up, 494 did not report a fall and 205 were lost to follow-up.

Comparing non-fallers to fallers, variables significantly associated with a fall in univariate analyses were: Biological: (perceived worse health than to a year ago, poor self-rated mobility, cardiovascular disease, depression, foot disorders, dizziness/vertigo, poor urine control, total number of comorbid diseases);

Table 4.21: Longitudinal univariate analysis: predictors of falls, by non-fallers and fallers and lost to follow up: (baseline survey risk factors) (frequencies and percentage distribution, odds ratios and 95% confidence intervals, with non faller as a reference group)

Variable	Baseline survey sample				OR (95% CI)
	Non-fallers versus fallers		Non-fallers versus lost to follow-up		
	Faller n = 170	OR (95% CI)	Non-faller n = 462	Lost to follow-up n = 205	
	N (%)		N (%)	N (%)	
Age in years (median, IQR)	73 (69 – 78)	1.00 (0.97–1.03)	73 (69 – 78)	76 (71 – 81)	1.06 (1.03 – 1.09)*
Age group (years)					
65 – 69	54 (31.8)	1	138 (29.9)	38 (18.5)	1
70 – 74	45 (26.5)	0.85 (0.54 – 1.35)	135 (29.2)	49 (23.9)	1.32 (0.81 – 2.14)
75 – 79	38 (22.4)	0.89 (0.55 – 1.45)	109 (23.6)	57 (27.8)	1.90 (1.17 – 3.07)*
80^{+}	33 (19.4)	1.05 (0.63 – 1.76)	80 (17.3)	61 (29.8)	2.77 (1.70 – 4.52)*
Gender					
Male	33 (19.4)	1	114 (24.7)	50 (24.4)	1
Female	137 (80.6)	1.36 (0.88 – 2.01)	348 (75.3)	155 (75.6)	1.06 (0.69 – 1.49)
Self-rated health					
Good/Very good	101 (59.4)	1	239 (51.7)	61 (29.8)	1
Average/Poor/very poor	69 (40.6)	0.73 (0.51 – 1.05)	223 (48.3)	144 (70.2)	2.53 (1.78 – 3.59)*
Perceived health compared to a year ago					
Same/Better	139 (81.8)	1	431 (93.3)	176 (85.9)	1
Worse	31 (18.2)	3.10 (1.82 – 5.28)*	31 (6.7)	29 (14.1)	2.29 (1.34 – 3.91)*
Self-rated mobility					
Independent	138 (81.2)	1	410 (88.7)	150 (73.2)	1
With Difficulty	32 (18.8)	1.83 (1.13 – 2.96)*	52 (11.3)	55 (26.8)	2.89 (1.89 – 4.41)*

Table 4.21 (continued)

Variable	Faller N (%)	OR (95% CI)	Non-faller N (%)	Lost to follow-up N (%)	OR (95% CI)
Level of education (%)					
No schooling	8 (4.7)	0.89 (0.31 – 2.54)	18 (3.9)	19 (9.3)	2.96 (1.12 – 7.78)*
Primary	36 (21.2)	0.51 (0.25 – 1.08)	140 (30.3)	65 (31.7)	1.30 (0.60 – 2.83)
Secondary	112 (65.9)	0.81 (0.41 – 1.60)	276 (59.7)	111 (54.1)	1.12 (0.53 – 2.40)
Post school qualification	14 (8.2)	1	28 (6.1)	10 (4.9)	1
Occupation category					
Unskilled	32 (18.8)	1	182 (39.4)	95 (46.3)	1
Skilled/services	112 (65.9)	2.77 (1.79 – 4.29)*	230 (49.8)	94 (45.9)	0.78 (0.55 – 1.11)
Professional/management	26 (15.3)	2.96 (1.61 – 5.41)*	50 (10.8)	16 (7.8)	0.61 (0.33 – 1.13)
Marital Status					
Married	64 (37.6)	1	136 (29.4)	62 (30.2)	1
Widowed	86 (50.6)	0.68 (0.46 – 0.99)*	270 (58.4)	127 (62.0)	1.03 (0.71 – 1.49)
Divorced	6 (3.5)	0.55 (0.21 – 1.43)	23 (5.0)	7 (3.4)	0.67 (0.27 – 1.64)
Never married	14 (8.2)	0.90 – (0.45 – 1.80)	33 (7.1)	9 (4.4)	0.60 (0.27 – 1.33)
Ethnic group					
Black African	9 (5.3)		173 (37.4)	101 (49.3)	1
Coloured	113 (66.5)	10.15 (5.00–20.60)*	214 (46.3)	65 (31.7)	0.52 (0.36 – 0.75)*
Indian	6 (3.5)	11.53 (3.34–38.83)*	10 (2.2)	6 (2.9)	1.03 (0.36 – 2.91)
White	42 (24.7)	12.45 (5.73–26.94)*	65 (14.1)	33 (16.1)	0.87 (0.53 – 1.41)
Medical conditions (self-reported)					
Hypertension	69 (40.8)	1	145 (31.4)	51 (24.9)	1
	100 (59.2)	0.65 (0.45 – 0.94)*	317 (68.6)	154 (75.1)	1.38 (0.95 – 2.00)
Stroke	150 (88.2)	1	432 (93.5)	188 (91.7)	1
	20 (11.8)	1.92 (1.06 – 3.48)*	30 (6.5)	17 (8.3)	1.30 (0.70 – 2.42)
Parkinson’s disease	163 (95.9)	1	458 (99.1)	193 (94.1)	1
	7 (4.1)	4.92 (1.42 – 17.02)*	4 (0.9)	12 (5.9)	7.12 (2.27 – 22.35)*

Table 4.21 (continued)

Variable	Faller N (%)	OR (95% CI)	Non-faller N (%)	Lost to follow-up N (%)	OR (95% CI)
Diabetes	124 (72.9)	1	358 (77.5)	139 (68.1)	1
	46 (21.7)	0.96 (0.62 – 1.41)	104 (22.5)	65 (31.9)	1.60 (1.13 – 2.25)*
Memory loss	159 (93.5)	1	437 (94.6)	178 (86.8)	1
	11 (6.5)	1.21 (0.58 – 2.51)	25 (5.4)	279 (13.2)	2.65 (1.50 – 4.69)*
Depression	143 (84.1)	1	424 (91.8)	182 (88.8)	1
	27 (15.9)	2.11 (1.24 – 3.57)*	38 (8.2)	23 (11.2)	1.41 (0.82 – 2.43)
Arthritis	57 (33.5)	1	189 (41.0)	89 (43.4)	1
	113 (66.5)	1.38 (0.91 – 2.00)	272 (59.0)	116 (56.6)	0.91 (0.65 – 1.27)
Lung disease	149 (88.2)	1	420 (90.9)	173 (88.9)	1
	20 (11.8)	1.33 (0.76 – 2.34)	42 (9.1)	31 (15.2)	1.78 (1.08 – 2.93)*
Cardiovascular disease	66 (38.8)	1	259 (56.1)	118 (57.6)	1
	104 (61.2)	2.01 (1.40 – 2.88)	203 (43.9)	87 (42.4)	0.94 (0.67 – 1.31)
Foot disorders	102 (60.0)		357 (77.3)	44 (21.5)	1
	68 (40.0)	2.27 (1.56 – 3.30)*	105 (22.7)	44 (21.5)	0.93 (0.62 – 1.38)
Dizziness/vertigo	117 (68.8)	1	388 (84.2)	168 (82.0)	1
	53 (31.2)	2.41 (1.60 – 3.64)*	73 (15.7)	37 (18.0)	1.17 (0.76 – 1.81)
Cancer	158 (92.9)	1	439 (95.2)	194 (94.6)	1
	12 (7.1)	1.52 (0.73 – 3.14)	22 (4.8)	11 (5.4)	1.13 (0.54 – 2.38)
Hearing					
Good	111 (65.3)	1	334 (72.3)	144 (70.2)	1
Poor	59 (34.7)	1.39 (0.95 – 2.02)	128 (27.7)	61 (29.8)	1.10 (0.77 – 1.59)
Vision					
Good	156 (91.8)	1	425 (92.0)	182 (88.8)	1
Poor/Very poor	14 (8.2)	0.15 (0.04 – 0.63)*	37 (8.0)	23 (11.2)	1.59 (0.91 – 2.78)
Urine control					
Good	111 (65.3)	1	372 (80.5)	163 (79.5)	1
Poor	59 (34.7)	2.20 (1.49 – 3.25)*	90 (19.5)	42 (20.5)	1.06 (0.71 – 1.60)

Table 4.21 (continued)

Variable	Faller N (%)	OR (95% CI)	Non-faller N (%)	Lost to follow-up N (%)	OR (95% CI)
Fear of falling	82 (48.2)	1	185 (40.0)	61 (29.8)	1
	88 (52.1)	0.72 (0.50 – 1.02)	277 (60.6)	144 (70.9)	1.58 (1.11 – 2.24)*
	55 (32.4)	1	120 (26.0)	51 (24.9)	1
Mats in dwelling	115 (67.6)	1.36 (0.93 – 2.00)	342 (74.0)	154 (75.1)	0.94 (0.65 – 1.38)
Drugs					
Anti-diabetic	127 (74.7)	1	392 (84.8)	178 (86.8)	1
	43 (25.3)	1.90 (1.23 – 2.91)*	70 (15.2)	27 (13.2)	0.85 (0.53 – 1.37)
Cardiac	153 (90.0)	1	438 (94.8)	196 (95.6)	1
	17 (10.0)	2.03 (1.06 – 3.88)*	29 (5.2)	9 (4.4)	0.84 (0.38 – 1.84)
Anti-hypertensive	150 (88.2)	1	351 (76.0)	152 (74.1)	1
	20 (11.8)	0.42 (0.25 – 0.70)*	111 (24.0)	53 (25.9)	1.10 (0.75 – 1.61)
Diuretics	114 (67.1)	1	320 (69.3)	120 (58.5)	1
	56 (32.9)	1.11 (0.76 – 1.61)	142 (30.7)	85 (41.5)	1.60 (1.13 – 2.24)*
Betablocker	123 (72.4)	1	369 (79.9)	173 (84.4)	1
	47 (27.6)	1.52 (1.01 – 2.27)*	93 (20.1)	32 (15.6)	0.73 (0.47 – 1.14)
Calcium channel blockers	27 (74.7)	1	311 (67.3)	132 (64.4)	1
	43 (25.3)	0.70 (0.47 – 1.04)	151 (32.7)	73 (35.6)	1.14 (0.81 – 1.61)
ACE inhibitors	106 (62.4)	1	301 (65.2)	129 (62.9)	
	64 (37.6)	1.13 (0.78 – 1.62)	161 (34.8)	76 (37.1)	1.10 (0.78 – 1.55)
Thyroid	154 (90.6)	1	450 (97.4)	200 (97.6)	
	16 (9.4)	3.90 (1.80 – 8.42)*	12 (2.6)	5 (2.4)	0.94 (0.33 – 2.70)
Anti-inflammatory	107 (62.9)	1	387 (83.8)	183 (89.3)	1
	63 (37.1)	3.04 (2.04 – 4.52)*	75 (16.2)	22 (10.7)	0.62 (0.37 – 1.03)
	116 (68.2)	1	366 (79.2)	165 (80.5)	1
Analgesics	54 (31.8)	1.77 (1.20 – 2.63)*	96 (20.8)	40 (19.5)	0.82 (0.55 – 1.22)

Table 4.21 (continued)

Variable	Faller N (%)	OR (95% CI)	Non-faller N (%)	Lost to follow-up N (%)	OR (95% CI)
Psycholeptics	162 (95.3)	1	445 (96.3)	199 (97.1)	1
	8 (4.7)	1.29 (0.55 – 3.05)	17 (3.7)	6 (2.9)	0.79 (0.31 – 2.03)
Antidepressants	145 (85.3)	1	448 (97.0)	193 (94.1)	1
	25 (14.7)	5.52 (2.79 – 10.90)*	14 (3.0)	12 (5.9)	1.99 (0.90 – 4.38)
Bronchodilators	155 (91.2)	1	432 (93.5)	191 (93.2)	1
	15 (8.8)	1.39 (0.73 – 2.66)	30 (6.5)	14 (6.8)	1.05 (0.55 – 2.04)
Anti-thrombotic	118 (69.4)	1	316 (68.4)	130 (63.4)	1
	52 (30.6)	0.95 (0.65 – 1.40)	146 (31.6)	75 (36.6)	1.25 (0.88 – 1.76)
Tobacco use	88 (51.8)	1	310 (67.1)	140 (68.3)	1
current/previous	82 (48.2)	1.90 (1.33 – 2.72)*	152 (32.9)	65 (31.7)	0.95 (0.67 – 1.35)
	124 (72.9)		361 (78.1)	150 (73.2)	1
Alcohol use	46 (27.1)	1.33 (0.88 – 1.99)	101 (21.9)	55 (26.8)	1.31 (0.90 – 1.92)
Comorbid disease (Median, IQR)	4 (3 – 5)	1.33 (1.20 – 1.48)*	3 (2 – 4)	3 (2 – 4)	1.06 (0.97-1.170)
Total number in household	2 (2 – 4)	0.82 (0.75 – 0.88)*	3 (2 – 6)	4 (2 – 7)	1.04 (0.98 – 1.10)
SES index score (Median, IQR)	8 (7 – 8)	1.63 (1.34 – 1.97)*	7 (6 – 8)	7 (5 – 8)	0.77 (0.66 – 0.88)*
Prescribed drugs (Median, IQR)	4 (1 -6)	1.15 (1.08 – 1.23)*	3 (1 – 5)	3 (1 – 5)	1.02 (0.95 – 1.09)
Total drugs (Median, IQR)	5 (3 – 8)	1.23 (1.15 – 1.30)*	4 (2 – 5)	4 (2 – 5)	1.00 (0.94 – 1.07)

Table 4.22: Association of physical assessments and measurements, by fall and follow-up history: results of univariate analysis (baseline survey), with non-fallers as a reference group

Variable	Baseline survey sample				
	Non-fallers versus fallers		Non-fallers versus subjects lost to follow-up		
	Faller N =170	OR(95% CI)	Non-faller N =462	Lost to follow-up N=205	OR(95% CI)
Geriatric Depression Score (median, IQR)	2 (1 – 4)	1.08 (1.02 – 1.15)*	2 (1 – 3)	2 (1 – 5)	1.13 (1.07 – 1.19)*
Cognitive score (SOMCT)	4 (2 – 8)	1.01 (0.98 – 1.05)	4 (0 – 8)	8 (4 – 14)	1.09 (1.06 – 1.12)*
Alcohol (U/WK) (median, IQR), range	0 (0.0 – 0.0), 0 – -28	0.98 (0.95 – 1.02)	0 (0.0 – 0.0), 0 – 7	0 (0.0 – 0.0), 0 – 4	1.00 (0.98 – 1.02)
Systolic BP supine (mmHg)	138 (129 – 150)	0.99 (0.98 – 1.00)*	144 (131 – 156)	144 (133 – 156)	0.99 (0.98 – 1.00)*
Diastolic BP supine (mmHg)	84 (77 – 93)	0.99 (0.97 – 1.00)*	88 (79 – 97)	89 (80 – 98)	0.99 (0.98 – 1.00)*
Pulse rate supine (bpm)	67 (60 – 78)	0.98 (0.97 – 0.99)*	71 (64 – 80)	72 (65 – 81)	1.01 (0.99 – 1.02)
Systolic BP standing (mmHg)	139 (129 – 150)	0.99 (0.98 – 1.00)*	142 (130 – 155)	145 (132 – 155)	1.00 (0.99 – 1.01)
Diastolic BP standing (mmHg)	86 (78 – 93)	0.98 (0.97 – 1.00)*	89 (79 – 96)	88 (81 – 96)	1.00 (0.99 – 1.01)
Pulse standing (bpm)	73 (65 – 86)	1.00 (0.99 – 1.01)	73 (65 – 84)	74 (67 – 84)	1.00 (0.99 – 1.01)
Hand grip (Kg) (median, IQR)	15 (10 – 21)	0.98 (0.96 – 1.00)*	16 (11 – 21)	12 (10 – 18)	0.95 (0.93 – 0.97)*
One leg stand eyes open (seconds)	12 (4– 30)	1.02 (1.01 – 1.04)*	9 (3 – 21)	4 (1 – 10)	0.95 (0.93 – 0.97)*
One leg stand eyes shut (seconds)	3 (2 – 7)	1.01 (0.98 – 1.05)	3 (2 – 6)	2 (1 – 4)	0.91 (0.87 – 0.96)*
Timed Up & Go test (seconds)	13 (11 – 17)	0.97 (0.95 – 0.99)*	15 (11 – 20)	19 (13 – 22)	1.03 (1.01 – 1.05)*
Chair stands (seconds)	13 (10 – 17)	0.95 (0.93 – 0.97)*	15 (11 – 20)	18 (12 – 20)	1.00 (0.98 – 1.02)

SOMCT = Short Orientation Memory Concentration Test; PB = Blood Pressure; bpm = beats per minute; Kg = Kilogram; IQR= interquartile range; U/Wk = units/week;*Significant association.

behavioural (use of drugs which include anti-diabetic, cardiac, antihypertensive, beta-blockers, and antidepressants), and a total number of drugs used; and socio-economic and environmental (ethnic group, occupation in particular skilled and professional/managerial employment, toilet indoors, number of inhabitants in the dwelling, an increase in SES index score), physical assessment and measurement scores (Geriatric Depression Scale score, hand grip strength, the timed Up & Go test, one leg stand eyes open) while slow performance of the chair stands was protective from a fall.

Variables significantly associated with loss to follow-up were: older age, poor self-rated health, perceived worse health than a year ago, self-reported poor mobility, no schooling, low socio-economic status (SES) index score, and certain medical conditions (diabetes, poor memory and lung disease); use of diuretics; physical assessment and measurement scores (high Geriatric Depression Scale score, high cognitive score (SOMCT), reduced hand grip strength, difficulty in performing the one leg stand and slow in performing to timed Up & Go test.

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4.2.5.6 Ethnicity and risk factors for falls

With ethnicity highly associated with the risk of a fall, selected risk factors were analysed to examine underlying differences in ethnic groups. Age, occupation, total number in a household, comorbid conditions, number of drugs, self-reported depression, use of antidepressants, use of psycholeptics, Geriatric Depression Scale score, self-rated health, perceived health compared to a year ago and mobility status were analysed by ethnic group. Table 4.23 shows differences in risk factors as reported by the different sub-samples: Black Africans were the reference group. Whites (OR 1.04, 95% CI 1.01– 1.08) were older while coloureds were slightly younger (OR 0.99, 95% CI 0.97 – 1.02) than black Africans, the median age was 74 years for black Africans and 73 years for coloureds, but 76.5 years for Indians and whites. More black Africans (78.1%) than whites (8.6%) worked in the unskilled labour force. The household density was higher in black Africans compared to the

other sub-samples. More whites (OR 2.00, 95% CI 1.06 – 3.75) and Indians (OR 1.30, 95% CI 1.12 – 1.53) reported feeling depressed compared to black Africans, but the Geriatric Depression Scale score was lower in whites (OR 0.89, 95% CI (0.83 – 0.97), a higher score signifying the presence of depression. Although coloureds were not significantly different from black Africans in self-reported depression, they used more antidepressants (OR 2.27, 95%CI 1.12 – 4.58) than black Africans, while the antidepressant use in whites (OR 1.30, 95% CI 0.49 – 3.43) was not significantly different. Psycholeptic drugs were used by a small number of subjects, and the use was higher in coloureds and whites than in black Africans. Although more black Africans reported poor health, the sub-sample reported a lower number of comorbid conditions and used fewer medications than their coloured (OR 1.41, 95% CI 1.31–1.51 and white (OR 1.39, 95% CI 1.18-1.52) counterparts.

4.2.6 Activities at time of the fall and environmental hazards predisposing to falls

Participants were asked to narrate activities in which they were engaged at the time of their last fall, as well as to identify obstacles, both indoors and outdoors, that might predispose them to a fall. Results shown pertain to the baseline data. The highest ranking activity, in which subjects engaged, indoors and outdoors, at the time of the fall was walking. Changing position was ranked second for indoor falls (Table 4.24).

The highest ranking environmental obstacles subjects identified as possibly having predisposed them to a fall indoors were stairs, a mat, a pet, children, toys and furniture. For outdoors, the highest ranked obstacles were steps/stairs, uneven and/or a slippery floor, ground or road, and clutter in the garden/yard and on pavements, which included bumping into people on pavements, and litter such as banana peels upon which subjects slipped (see Table 4.25).

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Table 4.23: Risk factors for falls by ethnic sub-sample (with black Africans as a reference group)

Variable	Baseline Survey sample						
	Reference	Black Africans versus Coloureds		Black Africans versus Indians		Black Africans versus Whites	
	Black African n = 283	Coloured n = 392	OR (95% CI)	Indian n = 22	OR (95% CI)	Whites n = 140	OR (95% CI)
Age in years (median, (IQR))	74 (69-78)	73 (69-78)	0.99 (0.97 – 1.02)	76.5 (70-81)	1.04 (0.98 – 1.11)	76.5 (70-81)	1.04 (1.01–1.08)*
Comorbidities (median, (IQR))	3 (2-4)	3 (2-5)	1.31 (1.19 – 1.44)*	3.5 (3-4.25)	1.33 (1.03 – 1.71)*	4 (2-5)	1.39 (1.18 – 1.52)*
Number of drugs (median, (IQR))	3 (1-4)	5 (3-7)	1.41 (1.31 – 1.51)*	4 (2-6.25)	1.30 (1.12 – 1.53)*	4.5 (2-7)	1.36 (1.25 – 1.49)*
Self-reported depression (%)							
No	260 (91.9)	350 (89.3)	1	20 (90.9)	1	119 (85.0)	1
Yes	23 (8.1)	42 (10.7)	1.36 (0.80 – 2.31)*	2 (9.1)	1.30 (1.12 – 1.53)*	21 (15.0)	2.00 (1.06 – 3.75)*
Geriatric Depression Scale score	1 (1-6)	2 (1-4)	0.96 (0.91 – 1.01)	2.5 (1-4)	0.93 (0.80 – 1.09)	2 (1-3)	0.89 (0.83 – 0.97)*
Use of antidepressants (%)					—		1
No	272 (96.1)	359 (91.6)	1	22 (100)		133 (95.0)	
Yes	11 (3.9)	33 (8.4)	2.27 (1.12 – 4.58)*	0 (0.0)	Empty cell	7 (5.0)	1.30 (0.49 – 3.43)
Use of psycholeptics (%)							
No	282 (99.6)	375 (95.7)		22 (100)	—	127 (90.7)	1
Yes	1 (0.4)	17 (4.3)	12.78 (1.69–96.63)*	0 (0.0)	Empty cell	13 (9.3)	28.87 (3.74–223.05)*

Table 4.23 (continued)

Variable	Reference	Black Africans versus Coloureds		Black Africans versus Indians		Black Africans versus Whites	
	Black African	Coloured	OR (95% CI)	Indian	OR (95% CI)	White	OR (95% CI)
Occupation category (%)							
Unskilled	221 (78.1)	68 (17.3)	1	8 (36.4)	—	12 (8.6)	1
Skilled	58 (20.5)	273 (69.6)	15.3 (10.3 – 22.6)*	11 (50.0)	—	94 (67.1)	156.5 (47–7 513.4)*
Managerial	4 (1.4)	51 (13.0)	41.4 (14.4 – 118.8)*	3 (13.6)	—	34 (24.3)	29.8 (15.3–58.1)*
Self-rated health (%)							
Good	55 (19.4)	217 (55.4)		14 (63.6)		115 (82.1)	
Poor	228 (80.6)	175 (44.6)	0.19 (0.14 – 0.28)*	8 (36.4)	0.14 (0.05 – 0.34)*	25 (17.9)	0.05 (0.03 – 0.09)*
Health compared to a year ago (%)							
Better	87 (30.7)	70 (17.9)	1	3 (13.6)	1	24 (17.1)	1
Same	181 (64.0)	260 (66.3)	1.78 (1.24-2.58)*	14 (63.7)	2.24 (0.63-8.01)*	107 (76.4)	2.14 (1.28 – 3.57)*
Worse	15 (5.3)	62 (15.8)	5.14 (2.70 – 9.80)*	5 (22.7)	9.67 (2.09–44.76)*	9 (6.4)	2.17 (0.85 – 5.58)*
Mobility (%)							
Independent	236 (83.4)	326 (83.2)	1	16 (72.7)	1	120 (85.7)	1
With difficulty	47 (16.6)	66 (16.8)	1.02 (0.67 – 1.53)	6 (27.3)	1.88 (0.70 – 5.06)	20 (14.3)	0.84 (0.47 – 1.48)
Total no. in household (median, IQR))	7 (5-8.5)	2.5 (2-5)	0.54 (0.49 – 0.59)*	3 (2 – -5)	0.61 (0.50 – 0.75)*	2 (1-3)	0.32 (0.26 – 0.38)*
SES Index score	6 (5 – 6)	8 (7 – 8)	6.35 (4.26 – 6.72)*	7 (7 – 8)	3.98 (2.39 – 4.26)*	8 (8 – 8)	5.23 (3.94 – 6.94)*
Cognitive score	8 (4 – 12)	4 (2 – 8)	0.93 (0.91 – 0.96)*	4 (1.5 – 8.5)	0.93 (0.86 – 1.00)*	2 (0 – 5.7)	0.83 (0.79 – 0.87)*
Hand grip strength (kg)	14 (10.5–19)	16 (10–22)	1.02 (1.00 – 1.04)*	13.5 (3.75–21.2)	0.98 (0.92 – 1.03)	16 (11 – 22)	1.04 (1.01 – 1.06)*

Table 4.23 (continued)

Variable	Reference	Black Africans versus Coloureds		Black Africans versus Indians		Black Africans versus Whites	
	Black African	Coloured	OR (95% CI)	Indian	OR (95% CI)	White	OR (95% CI)
One leg stand eyes open (secs)	3 (1 – 7)	13 (5 – 29)	1.14 (1.11 – 1.17)*	8.5 (0.0 – 21)	1.11 (1.06 – 1.16)*	13 (6 – 26)	1.14 (1.11 – 1.17)*
One leg stand eyes shut (secs)	1 (0.0 – 4.0)	4 (2.0 – 7.0)	1.17 (1.11 – 1.22)*	2.5 (0.0 – 5.2)	1.05 (0.93 – 1.20)	3 (2.0 – 6)	1.13 (1.07 – 1.19)*
Up & Go test (seconds)	20 (18 – 23)	13 (10 – 16)	0.90 (0.89 – 0.92)*	14 (10.5–20.2)	0.92 (0.86 – 0.98)*	12 (10 – 16)	0.89 (0.86 – 0.92)*
Chair stands (seconds)	20 (19 – 22)	13 (10 –16)	0.80 (0.77 – 0.83)*	11.5 (8.7–15.7)	0.79 (0.73 – 0.85)*	12. (10 – 15)	0.79 (0.73 – 0.82)*

SES= Socio-economic Status index; score of 8 items in household. IQR=interquartile range; kg=kilogram; *significant association.

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Table 4.24: Activities in which fallers were engaged at the time of a fall (baseline survey) (frequencies and percentage distribution)

Activity	Fallers baseline survey (n=221)	
	N	%
Outdoors		
Walking or working in yard or garden	58	26.3
Walking on a road/pavement	30	13.6
Walking in a public space	15	6.8
Turning around while standing in the yard or garden	3	1.4
Cycling on a road	2	0.9
Walking to visit a friend/family	2	1.0
Indoors		
Walking on level ground	37	16.7
Getting up from sitting/lying position	19	8.6
Engaged in physical activity	12	5.5
Bathing/showering	7	3.2
Standing/turning	7	3.2
Walking in a public space	6	2.7
Climbing or going down stairs	5	2.3
Climbing onto a stool/chair	5	2.3
Walking at a friend's/family member's home	3	1.4
Transferring	4	1.8
Unsure of activity	3	1.4

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4.2.7 Risk factors for falls: results of logistic regression analysis

Numerous risk factors for falls were identified in univariate analyses of the data. Logistic regression analyses were subsequently performed to identify risk factors independently associated with falls in the study sample. Factors associated with falls were entered into a stepwise logistic regression analysis model. Physical assessment variables, e.g. the timed Up & Go test and timed five chair stands, were entered as continuous variables. Variables with a P value of ≤ 0.05 were retained in the model. Separate models were run for the baseline and follow-up samples comparing non-fallers to fallers and non-fallers to recurrent fallers. The final

Table 4.25: Environmental hazards that predispose to falls identified by subjects (baseline) (frequencies and percentage distribution)*

Baseline survey (n=837)			
Outdoors	**N (%)**	**Indoors**	**N (%)**
Stairs/steps	293 (35)	Slippery floor	221 (26.4)
Road (uneven surface, potholes, stones, road works, slippery)	86 (10.3	Mats/loose carpet	189 (22.6)
Ground (stones, sand, uneven)	53(6.3)	Children/pets/toys	54 (6.5)
Garden (furniture, toys, plants, hose, washing line)	21 (2.5)	Stairs/steps	52 (6.2)
Veranda (slippery, uneven, holes)	20 (2.4	Furniture	37 (4.4)
Pavement (people, uneven, rubble, banana peels, cracked)	19 (2.3)	Getting out of a bath	31 (3.7)
Dogs barking	17 (2.0)	Wires, cords clutter on floor	26 (3.1)
Open council drains	14 (1.7)	Climbing a ladder	12 (1.4)
Wet grass	13 1.5)	Walking in socks, a long gown	12 (1.4)
Swimming pool (uncovered)	7 (0.8)	Uneven floor	2 (0.2)
Kerb	6 (0.7)	Overcrowded dwelling	1 (0.1)
Ladder	5 (0.6)		
Poor lighting	1 (0.1)		

*Percentages may not add up to100 as multiple answers were allowed.

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model for each of the baseline and follow-up samples is shown for any fall and recurrent falls, respectively.

4.2.7.1 Baseline sample logistic regression model

In the baseline sample, variables identified as independently contributing to a risk of falls were ethnicity, self-reported poor mobility, poor urine control, Parkinson's disease, diabetes, use of anti-inflammatory drugs, use of antidepressant drugs and higher Geriatric Depression Scale (GDS) score. An increase in hand grip strength was protective against a fall. For every kilogram increase in grip strength, the risk of a fall reduced by two per cent and for every unit increase in the GDS score, the odds of a fall increased by 15 per cent. Surprisingly, having systolic postural hypotension was protective against a fall. An increase in time to maintain one leg stance showed a trend towards an increase in risk of a fall, yet demonstrates ability to balance. For

every second increase in time spent standing on one leg, the risk of a fall increased by two per cent

Although the one leg stance was included in the model, the result was inconclusive as the odds were not significantly high and the confidence interval included one (OR 1.02; 95% CI 1.00 – 1.04) (see Table 4.26). This model correctly classified 78 per cent of the subjects. Variables in the final model for recurrent falls were ethnicity, self-reported poor mobility, poor urine control, Parkinson's disease, stroke, foot disorders, dizziness and use of antidepressant drugs. Self-reported hypertension was protective against recurrent falls, but blood pressure reading showed no association (see Table 4.27). This model correctly classified 88.7 per cent of the subjects.

Ethnicity, poor mobility, poor urine control, Parkinson's disease and use of antidepressant drugs were independent predictors for both a fall and recurrent falls. Ethnicity had the highest association with fall risk: particularly in whites (OR 14.94; 95% CI 7.46 – 29.92 for a fall and OR 21.25, 95% CI 5.54 – 81.51 for recurrent falls), when compared to black Africans.

Although a predictor for falls, ethnicity is a marker for other underlying risk factors for falls, such as socio-economic factors that may increase the risk of developing other risk factors. Examples of such risk factors are health conditions or environmental risk factors. To address the effect of ethnicity on other predictors for falls, logistic regression analyses were run for both all falls and recurrent falls that excluded ethnicity from the model (Tables 4.28) and 4.29). With the exclusion of ethnicity from the model, all predictors of all falls (Table 2.26) were retained in the model except systolic drop in blood pressure. In addition, occupation (skilled and managerial/professional), dizziness/vertigo, and cardiovascular disease were added to the predictors. Of the additional predictors, occupation (managerial/professional had the strongest association, OR 3.03, 95% CI 1.60 – 5.72). Paradoxically, poor

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vision and increase in time to perform the five chair stands were protective factors from a fall. For every second increase in time to complete the five chair stands, the odds of a fall reduced by three per cent. This model correctly classified 77.4 per cent of subjects. Similarly, predictors for recurrent falls (Table 4.27) were retained in the model except poor mobility and use of antidepressant drugs lost significance but total number of medications taken was added as a predictor of recurrent falls. Of the additional predictors, total number of medications taken had the strongest association, OR 1.25, 95% CI 1.13 – 1.37). For every additional medication taken, the odds of recurrent falls increased by 25 per cent. Paradoxically, five chair stands was protective from recurrent falls. For every second increase in time to complete the five chair stands, the odds of a fall reduced by five per cent (Table 4.29). This model correctly classified 88.2 per cent of subjects. The models remained stable on both forward and backward stepwise regression analysis.

4.2.7.2 Follow-up sample: logistic regression model

In the follow-up sample, variables identified as independently associated with the risk of a fall were history of previous falls, self-reported poor memory, poor urine control, and Geriatric Depression Scale score. History of previous falls showed the highest association: OR 2.16; 95% CI 1.40–3.33; $p < 0.001$. An increase in the basic ADL score showed a trend towards being protective and an outdoor toilet facility was protective against falls (see Table 4.30). This model correctly classified 79.8 per cent of subjects.

Variables identified as associated with risk of recurrent falls were history of a previous fall, perceived health worse than a year ago, marital status (being widowed or single), Geriatric Depression Scale score and foot disorder/s. For a unit increase in the Geriatric Depression Scale score the odds of a fall increased by 23 per cent. Surprisingly, having mats/rugs in the dwelling was protective against falls. The model correctly classified 94.2 per cent of the subjects. History of previous falls (OR 10.53;

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95% CI 4.17–26.56; p <0.001) and perceived worse health than a year ago (OR 4.97; 95% CI 1.86–13.33; p= 0.001) showed the highest association (Table 4.31). Variables identified as increasing the risk of both a fall and recurrent falls included history of a fall previous fall and the Geriatric Depression Scale score. Ethnicity, a significant predictor of falls at baseline, lost significance in the follow-up models.

4.2.7.3 Risk factors at follow-up survey: Logistic regression model without previous falls as a risk factor

History of a previous fall is a marker of a propensity to fall and not a risk factor for falls. Thus, inclusion of history of a previous fall in the model may have masked the significance of other risk factors. To examine the effect of history of a previous fall on other risk factors, logistic regression models for a fall and recurrent falls were run that excluded previous fall history as a risk factor. Predictors of a fall in the model were: Ethnicity (being white increased the risk of a fall); advanced age, female gender; self-reported memory loss; self-reported poor urine control; a high Geriatric Depression Scale score (increased probability of depression); and a high socio-economic status (SES) index score. This model correctly classified 79.4 per cent of subjects (Table 4.32). Changes in the model after the exclusion of history of previous a fall were the addition of ethnicity, age, gender and the socio-economic status index as predictors of falls. For every one year increase in age, the odds of a fall increased by 12 per cent, and for every unit increase in the SES index, the odds of a fall increased by 48 per cent while for every unit increase in the Geriatric Depression Scale score, the odds of a fall increased by 14 per cent (Table 4.32).

Predictors of recurrent falls were: Marital status (being widowed, divorced/separated or never married); and ethnicity (being coloured or white) and possibly being Indian, but the difference was not beyond that which might have occurred by chance in an underpowered analysis as demonstrated by the wide confidence interval), perceived health worse than a year ago, foot disorders, Geriatric Depression Scale (GDS) score and a reduced ability to perform instrumental activities of daily living (IADLs).

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Table 4.26 Baseline all falls logistic regression model

Variable	P value	OR	95% C I for OR	
			Lower	Upper
Ethnic group	<0.001			
Black African		1.00		
Coloured	<0.001	7.93	4.29	14.65
Indian	<0.001	9.58	3.19	28.76
White	<0.001	14.94	7.46	29.92
Self-reported poor mobility	<0.001	2.55	1.55	4.19
Self-reported Parkinson's disease	0.005	4.52	1.59	12.84
Self-reported poor urine control	0.021	1.59	1.07	2.37
Self-reported diabetes	0.001	2.18	1.37	3.46
Use of anti-inflammatory drug	0.001	1.95	1.29	2.95
Use of antidepressant drug	0.003	2.78	1.42	5.45
Systolic BP postural drop	0.020	0.39	0.18	0.86
Geriatric Depression Scale score	<0.001	1.15	1.08	1.24
Hand grip strength (kg)	0.050	0.98	0.96	1.00
One leg stand eyes open (seconds)	0.041	1.02	1.00	1.04

For every unit increase in the GDS score, the odds of recurrent falls increased by 18 per cent and every unit increase in the IADL score reduced the odds of recurrent falls by 22 per cent. The presence of mats/rugs in the dwelling was a protective factor from recurrent falls. This model correctly classified 93.9 per cent of subjects (Table 4.33). Changes to predictors of recurrent falls following the exclusion of history of previous falls were the addition of ethnicity and IADL score, and the timed Up and Go test showing a trend towards significance. The predictors in both a fall and recurrent falls models remained stable on backward and forward stepwise regression analyses.

Table 4.27: Baseline recurrent falls: Logistic regression model

Variable	P value	OR	95% C I for OR	
			Lower	Upper
Ethnic group	<0.001			
Black African		1.00		
Coloured	<0.001	13.33	3.66	48.62
Indian	0.065	6.65	0.89	49.86
White	<0.001	21.25	5.54	81.51
Self-reported conditions	.			
Poor mobility	0.002	2.59	1.40	4.78
Hypertension	0.017	.49	.27	.88
Previous stroke	0.004	2.82	1.39	5.73
Parkinson's disease	0.001	8.30	2.26	30.49
Foot disorders	0.005	2.13	1.25	3.62
Dizziness/vertigo	0.021	1.94	1.11	3.41
Poor urine control	0.018	1.93	1.12	3.34
Use of antidepressant drug	0.012	3.29	1.30	8.31

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4.2.7.4 Follow-up survey risk factors: Logistic regression models without history of previous falls or ethnicity

Ethnicity as previously discussed may be a marker of differences in socio-economic status and other factors arising from such differences. To examine the impact of ethnicity on other risk factors for falls, models for a fall and recurrent falls at follow-up were run with the exclusion of both a history of previous falls and ethnicity. Predictors of a fall were: Age, female gender, self-reported memory loss, self-reported poor urine control, use of psycholeptic drugs, Geriatric Depression Scale score and SES index score. For every one year increase in age, the odds of a fall

Table 4.28: Baseline all falls: Logistic regression model, without ethnicity

Variable	P Value	OR	95% C I for OR	
			Lower	Upper
Occupation	0.002			
Unskilled		1		
Skilled	0.004	2.02	1.25	3.26
Managerial/Professional	0.001	3.03	1.60	5.72
Near vision poor	0.029	0.36	0.15	0.90
Dizziness/vertigo	0.042	1.55	1.02	2.37
Cardiovascular disease	0.023	1.53	1.06	2.22
Self-reported poor mobility	0.014	1.91	1.14	3.19
Self-reported Parkinson's disease	0.012	3.73	1.33	10.41
Self-reported poor urine control	0.006	1.77	1.18	2.65
Self-reported diabetes	0.001	2.16	1.36	3.44
Use of anti-inflammatory drug	0.001	2.02	1.34	3.04
Use of antidepressant drug	0.001	3.23	1.64	6.37
Geriatric Depression Scale score	0.006	1.11	1.03	1.19
Hand grip strength (Kg)	0.011	0.97	0.95	0.99
One leg stand eyes open (seconds)	0.001	1.03	1.01	1.05
Five chair stands	0.035	0.97	0.95	1.00

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increased by 12 per cent and for every unit increase in the SES index and every unit increase in the GDS score the odds of a fall increased by 59 per cent and 13 per cent, respectively. Paradoxically, slow performance on the five chair stands was protective from a fall, for every second increase in time to complete the five chair stands, the odds of a fall reduced by three per cent. This model correctly classified 79.8 per cent of the subjects (Table 4.34). The difference in predictors for a fall in this model in comparison to that which excluded history of falls only (Table 4.32) was the addition of the use of psycholeptic drugs and the five chair stands as predictors of a fall. Predictors of recurrent falls were: Perceived health worse than a year ago, self-reported foot disorders, Geriatric Depression Scale score, low diastolic blood

Table 4.29: Baseline recurrent falls: Logistic regression model, without ethnicity

Variable	P Value	OR	95% C I for OR	
			Lower	Upper
Total number of drugs	<0.001	1.25	1.13	1.37
Five chair stands	0.004	0.95	0.92	0.98
Self-report conditions				
Hypertension	0.002	0.40	0.22	0.71
Previous stroke	0.001	3.46	1.69	7.09
Parkinson's disease	0.010	4.43	1.42	13.84
Foot disorders	0.002	2.29	1.34	3.90
Dizziness/vertigo	0.027	1.88	1.07	3.30
Poor urine control	0.015	1.97	1.14	3.40

Table 4.30: Risk factors for all falls: Logistic regression model, follow-up survey

Variable	P value	OR	95% C.I. for OR	
			Lower	Upper
History of previous falls	<0.001	2.16	1.40	3.33
Toilet facility outdoors	0.001	0.33	0.18	0.62
Self-reported memory loss	0.049	2.77	1.02	7.63
Basic ADL score	0.055	0.64	0.41	1.01
Self-reported poor urine control	0.026	1.65	1.06	2.57
Geriatric Depression Scale score	0.004	1.12	1.04	1.20

pressure, the timed Up & Go test. For every unit increase in the Geriatric Depression scale score, the odds for recurrent falls increased by 21 per cent and for every unit increase in the diastolic blood pressure the odds decreased by three per cent (Table 4.35).

Table 4.31: Risk factors for recurrent falls: Logistic regression model, follow-up survey

Variable	P value	OR	95% C.I. for OR	
			Lower	Upper
History of previous falls	<0.001	10.53	4.17	26.56
Marital status	0.025			
Married		1.00		
Widowed	0.033	3.73	1.11	12.56
Divorced/separated	0.122	4.89	0.65	36.54
Never married	0.003	12.98	2.46	68.56
Perceived worse health than a year ago	0.001	4.97	1.86	13.33
Self-reported depression	0.039	3.75	1.07	13.16
Self-reported foot disorder/s	0.010	3.08	1.31	7.26
Geriatric Depression Scale score	0.006	1.23	1.06	1.43
Mats/rugs in dwelling	0.032	0.38	0.15	0.92

For every second increase in the time to complete the timed Up & Go test, the odds of recurrent falls increased by four per cent. Paradoxically mats or rugs in the dwelling were protective from recurrent falls. The model correctly classified 93.5 per cent of subjects (Table 4.35). The difference in predictors of recurrent falls in this model compared to one that excluded previous history of falls only was the addition of low diastolic blood pressure and an increase in time to perform the timed Up and Go test as predictors of falls and exclusion of IADL score from the model. Predictors in the models remained stable on both backward and forward stepwise regression analyses.

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Table 4.32: Risk factors for all falls: Logistic regression without previous falls, with ethnic group, follow-up survey

Variable	P value	OR	95% C I for OR	
			Lower	Upper
Ethnic group	0.046			
Black African		1.00		
Coloured	0.378	1.37	0.68	2.77
Indian	0.379	1.91	0.45	8.06
White	0.015	2.58	1.21	5.53
SES index	0.006	1.48	1.12	1.94
Geriatric depression scale score	0.001	1.14	1.05	1.23
Female gender	0.027	1.88	1.08	3.28
Self reported memory loss	0.012	3.64	1.32	10.02
Self reported poor urine control	0.011	1.83	1.15	2.92
Age (years)	0.021	1.12	1.02	1.23

SES = Socio-economic status. Correctly classified 79.4%.

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4.2.7.5 Baseline risk factors associated with falls on follow-up: Longitudinal logistic regression analyses

Baseline risk factors independently associated with any fall were history of a fall reported prior to baseline, self-reported dizziness/vertigo and having a toilet outdoors was protective from sustaining a fall. The model correctly classified 78.1 per cent of the subjects (Table 4.36). Risk factors independently associated with recurrent falls included history of a fall prior to the baseline survey, self-reported dizziness/vertigo and self-reported poor mobility. The model correctly classified 92.5 per cent of the subjects (Table 4.37). None of the physical measurements or assessments was independently associated with falls or recurrent falls. History of a previous fall is independently associated with falls in all models involving data collected at follow-up.

Table 4.33: Risk factors for recurrent falls: Logistic regression model without previous falls, with ethnic group, follow-survey

Variable	P value	OR	95% C I for OR	
			Lower	Upper
Marital status	0.045			
Married		1		
Widowed	0.030	4.28	1.15	15.85
Divorced/Separated	0.050	7.69	1.00	59.13
Never married	0.006	9.70	1.89	49.69
Ethnic group	0.028			
Black African		1		
Coloured	0.024	6.96	1.29	37.45
Indian	0.007	26.61	2.48	285.93
White	0.009	11.34	1.83	70.23
Mats/rug in dwelling	0.028	0.36	0.14	0.90
Perceived health worse than a year ago	<0.001	6.72	2.48	18.21
Foot disorders	0.008	3.06	1.33	7.04
IADL Score	0.019	0.78	0.64	0.96
Geriatric Depression Scale score	0.018	1.18	1.03	1.36
Timed Up & Go test	0.065	1.03	0.99	1.06

IADL = Instrumental activities of daily living. Correctly classified 93.9%.

Table 4.34: Risk factors for all falls: Logistic regression model without previous fall or ethnic group, follow-up survey

Variable	P value	OR	95% C I for OR	
			Lower	Upper
Female gender	0.028	1.87	1.07	3.26
Memory loss	0.020	3.27	1.21	8.90
Self-reported poor urine control	0.007	1.88	1.19	2.97
Use of psycholeptic drugs	0.034	2.75	1.08	7.02
Age (years)	0.024	1.12	1.01	1.23
SES index	<0.001	1.59	1.24	2.04
Geriatric Depression Scale score	0.003	1.13	1.04	1.23
Five chair stands	0.033	0.97	0.94	0.99

SES = Socio-economic status. Correctly classified 79.8%.

Table 4.35: Risk factors for recurrent falls: Logistic regression model without variables previous falls or ethnic group, follow-up survey

Variable	P value	OR	95% C I for OR	
			Lower	Upper
Mats/rugs in dwelling	0.014	0.33	0.14	0.80
Perceived health worse than a year ago	<0.001	8,71	3.03	25.02
Foot disorders	0.005	3.32	1.45	7.61
Geriatric Depression Scale score	0.010	1.21	1.05	1.40
Diastolic blood pressure	0.039	0.97	0.93	0.99
Timed Up & Go test	0.013	1.04	1.01	1.07

Correctly classified 93.5%.

Table 4.36: Risk factors at baseline as predictors of falls at follow-up: Longitudinal logistic regression model

Variable	P value	OR	95% C.I. for OR	
			Lower	Upper
History of previous falls	<0.001	2.50	1.65	3.76
Self-reported dizziness	0.003	1.98	1.27	3.09
Toilet facility indoors	0.028	1.99	1.08	3.68

Table 4.37: Risk factors at baseline as predictors of recurrent falls at follow-up: Longitudinal logistic regression model

Variable	P value	OR	95% C.I. for OR	
			Lower	Upper
History of previous falls	<0.001	10.17	4.59	22.55
Self-reported dizziness	0.003	3.15	1.49	6.66
Self-reported poor mobility	0.004	3.31	1.48	7.41

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4.2.7.6 Baseline risk factor for subjects lost to follow up compared to fallers and non fallers at follow-up: Adjusted multinomial regression analysis

In order to identify variables independently associated with falls and loss to follow-up, baseline variables showing significant association on univariate analyses were entered into a multinomial logistic regression model. Loss to follow-up was used as the reference and history of a previous fall was excluded from the model. Compared to non-fallers, those lost to follow-up were likely to report their health as being poor, having poor mobility, suffer from Parkinson's disease and have a high score on the SOMCT (a high score signifying cognitive impairment). For every unit increase in the cognitive score, the odds of being lost to follow up increased by seven per cent and two per cent when compared to the followed-up non-fallers and fallers, respectively. Compared to fallers, those lost to follow-up were likely to be black African, report

poor health, have self-reported diabetes, and record lower supine pulse rate (Table 4.38). Age and gender were associated with falls but not loss to follow-up.

Table 4.39 shows predictors of falls in a longitudinal multinomial logistic regression model. History of a previous fall was excluded from the model. Predictors of a fall were: Ethnicity (white, coloured or Indian), use of anti-diabetic drugs , use of anti-inflammatory drugs, use of anti-depressants, self-reported poor urine control, high (poor) score on the SOMCT cognitive test and low supine pulse rate. Every unit increase in pulse rate decreased the odds of a fall by two per cent. Physical measurements were not predictors of falls. Paradoxically, ability to stand on one leg with eyes open was a risk factor for a fall.

4.3 Summary of the findings

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Overall findings of the logistic regression analyses showed the main independent risk factors for falls to be ethnicity in the baseline sample and history of previous falls in the follow-up sample. History of a previous fall, although included as a risk factor for falls in older persons, is a marker of a propensity to fall and not a cause of a fall. Ethnicity may be a marker of socio-economic differences and the development of risk factors may be enhanced by socio-economic status. Falls were reported less frequently by black Africans than subjects in other ethnic groups, although more black Africans than other subjects rated their health as poor. Contrary to an expectation that age and gender would be associated with falls, these factors played a minimal role – not even in univariate analyses. Age and gender became significant predictors of falls on exclusion of ethnicity and history of a previous fall from the model. Independent risk factors that were significantly associated with falls were mostly self-reported conditions (poor mobility, poor urine control, depression, Parkinson's disease, foot disorders), self-rated health status, and use of certain medications. Physical assessments, such as hand grip strength, unipedal stance and timed Up & Go test and timed five chair stands scores showed no association except on univariate analyses. The timed Up & Go test was a significant predictor of

Table 4.38: Adjusted multinomial regression analysis of risk factor for subjects lost to follow up compared to followed-up fallers and non-fallers

Variable	Subjects lost to follow-up versus non-fallers				Subjects lost to follow-up versus fallers			
	P Value	OR	95% CI for OR		P Value	OR	95% CI for OR	
			Lower	Upper			Lower	Upper
Ethnic group								
White		1				1		
Black African	<0.001	3.30	1.71	6.39	0.013	0.29	0.11	0.76
Indian	0.464	1.56	0.47	5.54	0.543	1.53	0.39	6.01
Coloured	<0.001	3.13	1.77	5.54	0.051	1.89	1.00	3.57
Female gender	0.020	1.86	1.10	3.15	0.014	2.46	1.20	5.04
Self-reported health	0.002	0.50	0.32	0.78	0.017	0.52	0.30	0.89
Self-reported poor mobility	0.024	0.56	0.34	0.93	0.908	0.96	0.51	1.83
Self-reported diabetes	0.069	0.63	0.39	1.04	0.020	0.32	0.12	0.84
Self-reported Parkinson's disease	0.005	0.17	0.05	0.59	0.228	0.48	0.15	1.57
Use of anti-diabetic drugs	0.035	1.98	1.05	3.72	<0.001	9.84	3.35	28.86
Use of anti-inflammatory drugs	0.0.59	1.73	0.98	3.06	<0.001	4.09	2.21	7.57
Use of anti-depressants	0.418	0.69	0.29	1.68	0.001	4.33	1.76	10.63
Self-reported poor urine control	0.421	1.21	0.76	1.92	0.007	2.11	1.23	3.64
Hand grip strength (kg)	0.001	1.05	1.02	1.08	0.039	1.04	1.00	1.08
One leg stand eyes open	0.125	1.02	0.99	1.04	0.002	1.04	1.02	1.07
Cognitive score (SOMCT)	<0.001	0.93	0.90	0.96	0.467	0.98	0.94	1.03
Pulse rate supine (bmp)	0.874	1.00	0.98	1.01	0.009	0.98	0.96	0.99

Table 4.39: Adjusted multinomial regression analysis of risk factor for fallers and subjects lost to follow-up, non-fallers as the reference category

Variable	Non-faller versus faller				non-faller versus Lost to follow-up			
	P Value	OR	95% CI for OR		P Value	OR	95% CI for OR	
			Lower	Upper			Lower	Upper
Ethnic group								
White		1				1		
Black African	<0.001	0.09	0.03	0.21	<0.001	0.30	0.16	0.59
Indian	0.975	0.98	0.30	3.23	0.464	0.64	0.20	2.10
Coloured	0.050	0.60	0.36	1.00	<0.001	0.32	0.18	0.56
Female gender	0.375	1.32	0.71	2.44	0.020	0.54	0.32	0.91
Self-reported health	0.880	1.03	0.66	1.62	0.002	2.00	1.28	3.11
Self-reported poor mobility	0.073	1.71	0.95	3.09	0.024	1.78	1.08	2.94
Self-reported diabetes	0.148	0.50	0.20	1.27	0.035	0.51	0.27	0.95
Self-reported Parkinson's disease	0.134	2.78	0.73	10.64	0.005	5.74	1.69	19.48
Use of anti-diabetic drugs	0.002	4.98	1.83	13.56	0.035	0.51	0.27	0.95
Use of anti-inflammatory drugs	<0.001	2.36	1.51	3.69	0.059	0.58	0.33	1.02
Use of anti-depressants	<0.001	6.24	2.90	13.42	0.418	1.44	0.60	3.48
Self-reported poor urine control	0.013	1.75	1.12	2.72	0.421	0.83	0.52	1.31
Hand grip strength (kg)	0.385	0.99	0.96	1.02	0.001	0.95	0.92	0.98
One leg stand (eyes open)	0.024	1.02	1.00	1.05	0.125	0.98	0.96	1.01
Cognitive score (SOMCT)	0.005	1.06	1.02	1.10	<0.001	1.07	1.04	1.11
Pulse rate supine (bmp)	0.004	0.98	0.96	0.99	0.874	1.00	0.99	1.01

recurrent falls only on exclusion of history of previous falls and ethnicity from the model. Of the measurements, only the Geriatric Depression Scale score was an independent predictor of falls except in longitudinal analysis where a high cognitive test score was a predictor of falls.

Although environmental risk factors for falls were not assessed, the environment is likely to have contributed significantly to the incidence of falls, in as much as most of the falls recorded were associated with slips and trips resulting from the faller's interaction with an obstacle in the environment. History of a previous fall was an independent risk factor across all models in the follow-up sample, reflecting the multi-causality of a fall. History of a previous fall does not represent a single risk factor as such but a reflection of the inherent and sometimes multi-factorial causation of a fall and increased chance of a recurrent fall in such an individual. Ethnicity was associated with falls at follow-up only when history of a previous fall was excluded from the model, reflecting confounding between ethnicity and history of a previous fall: that is, a fall reported at baseline.

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An attrition rate of 205 (24.5%) subjects was recorded, 50 (24.4%) of these subjects were reported as deaths in the period to follow-up. Subjects lost to follow-up were more frail than subjects who were followed up, in that they were likely to report poor mobility, poor health, and record high scores on the SOMCT cognitive test and the Geriatric Depression scale, as well as have poor hand grip strength and perform poorly on the timed Up & Go test.

Chapter 5

Discussion and evaluation

5.1 Introduction

The problem of falls in older people has mainly been a concern and addressed, variably, in developed regions; less attention has been given to research and intervention on the problem in the developing regions. The research questions that guided the present investigation in South Africa – for present purposes, a developing country, and the evidence subsequently yielded have both global and local relevance. The global relevance of the questions posed, for example, lies in the variation in prevalence rates of falls documented in literature emanating from studies in specific countries and across regions. The present study yielded evidence, interestingly, of differences in fall prevalence rates in different ethnic groups in South Africa; local relevance thus lies not only in the prevalence rates for falls established for the study population, but differential rates for ethnic groups as well. Ethnicity, particularly in multi-ethnic populations, as a contributing factor to falls prevalence rates has not previously been investigated as such, in a developing country context. An outcome of the present study – wide variance in the prevalence of falls across three ethnic sub-samples, has highlighted a need therefore for future studies to explore determinants of such differences.

Overall, a contribution of the present study has been the provision of a prevalence rate for falls in an African population (South Africa) in which no such rate had been established previously. The study also identified risk factors for falls in an African (or developing country) setting. As such, the study contributes to knowledge on falls and risk factors for falls in older populations in developing regions in general.

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Key findings of analyses of the data in Chapter 4 are discussed and interpreted broadly below. Later in the chapter, implications of the study outcome for policy formulation and intervention in a Public Health domain are considered practically. An evaluation of the study's contribution to knowledge on falls in older people and to methodology is undertaken in the chapter as well.

5.2 Main study findings

The main study findings are discussed comprehensively in terms of the sample profile, falls prevalence, circumstances and consequences of falls, and risk factors for falls.

5.2.1 Sample profile

The mean age of the study sample at baseline was 74 years and at follow-up was 75 years. The median age for recurrent fallers and for subjects lost to follow up was 76 years, respectively. The ages border the age at which individuals are at increased risk of a fall. Globally, the incidence of falls is found to increase with age, and the risk of falling is highest in persons aged ≥ 75 years (Fuller, 2000; Swift, 2001). Evidence from developed countries has shown that 30-60 per cent of community dwelling older persons aged 65 years and over fall at least once a year (Berg and others, 1997; Dolinis, Harrison & Andrews, 1997; Gill, Taylor & Pengelly, 2005; Luukinen and others, 1995; Tinetti, Speechley & Ginter, 1988).

The baseline sample for the present study totalled 837 and the follow-up sample 632 – reflecting an attrition rate of 24.5 per cent (n = 205). Data were thus available for longitudinal analysis for 75.5 per cent of subjects who participated in both the baseline and follow-up surveys. There was a significant difference in ethnicity between subjects lost to follow-up and those who were followed up. Half of subjects

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not followed up (50%) were black Africans and resided in Gugulethu. A reason for a high number of African subjects lost to follow-up may be a circular migratory pattern in this population (a cultural trend): subjects resident in Cape Town at the time of the baseline survey may have migrated (temporarily) to their ancestral home in a rural area when the follow-up survey was conducted. Attrition due to mortality and refusals, and other reasons (i.e. 24.5%) did change the socio-demographic profile of the follow-up samples to a limited extent, particularly in age, physical and mental health status, which enabled comparisons of the findings from the two surveys.

The proportion of females in the baseline sample was 76.5 per cent and in the follow-up sample, 77 per cent. The ratio of females to males was 3:1, which outstrips the ratio in the population age ≥65 years in the Western Cape Province: 44 per cent male, 56 per cent female (ratio 1.3:1) (Statistics South Africa, 2010).

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5.2.2 Prevalence of falls

Prevalence rates of falls at baseline of 26.4 per cent and at follow-up of 21.8 per cent in the present study are lower than rates reported in developed countries. However, the rates are similar to that reported in a retrospective study in Nigeria: 23 per cent (Bekibele & Gureje, 2010), but considerably higher than rates reported in studies in Asian countries: China 18% (Yu and others, 2009); Hong Kong 14.1% (Chu, Chiu & Chi, 2008) and 19.7% (Lee and others, 2006); South Korea 15% (Shin and others, 2009); Singapore 17% (Chan and others, 1997); Taiwan 18% (Chang and others, 2010); Thailand 19.8% (Assantachai and others, 2003); and in Latin America: Brazil 16.8% (Chaimowicz, Ferreira & Miguel, 2000). With the exception of the Hong Kong study by Chu and colleagues (2008), all were retrospective studies.

The lower prevalence rate of 21.8 per cent in the follow-up survey may be attributable to differential attrition of those at higher risk of falls, as demonstrated by the frail nature of subjects lost to follow-up compared to those who were followed up.

The effect of the attrition on the prevalence rate should be minimal, nonetheless, as half of the subjects who could not be followed up were black Africans who had the lowest rate of falls and the rate of falls reported at baseline did not differ between subjects followed up and those lost to follow up. History of a previous fall at baseline had no bearing on the death rate. However, the contribution of a fall to mortality in those who died, and were lost to follow-up, cannot be excluded.

The prevalence rates of falls and recurrent falls in the present study are similar to those in certain community based studies in Latin America: e.g. Brazil, 27.6 per cent (Rozenfeld, Camacho & Veras, 2003; Siqueira and others, 2011). However, higher rates have been reported in a prospective, community based study in Brazil – 29 per cent (Perracini & Ramos, 2002), and in a sample of institutionalised subjects – 38 per cent (Gonçalves and others, 2008). Prevalence rates of recurrent falls in studies in developing countries are similar to those in the present study, but range widely, even in reports on prospective studies: from 4.8 per cent in Hong Kong (Chu, Chiu & Chi, 2008) to 11 per cent in Brazil (Perracini & Ramos, 2002). Of note is that the majority of the studies, although community based, included subjects younger than those in the current study, i.e. age ≥ 60 years.

Although the prevalence rates of falls of 26.8 per cent and 21.8 per cent established in the present study, and of recurrent falls at follow-up of 6.3 per cent, are lower than rates reported in developed countries, the prevalence of recurrent falls at baseline of 11 per cent is similar to rates reported in developed countries both prospectively (11.5 per cent (O'Loughlin and others, 1993)) and retrospectively (10 per cent (Fletcher & Hirdes, 2002; Shumway-Cook and others, 2009)) The prevalence of recurrent falls does not vary significantly in different studies; presumably recurrent falls affect primarily frail individuals with multiple risk factors for falls whose phenotype and predisposition to falls may not differ significantly in different environments. (Frailty is defined here as having three or more of the following: muscle weakness, slow walking speed, exhaustion/poor endurance, low physical

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activity levels and unintentional weight loss (Woods and others, 2005)). However, in a prospective study in Australia, Tiedeman and others, (2008a) reported far higher rates: 22 per cent of recurrent falls in a sample of far older subjects, aged 74-98 years – but which may have included a large number of frail individuals. Factors such as study design, inclusion criteria and method of reporting impact the outcomes. Some studies report recurrent falls as a proportion of the total sample, while others report recurrent falls as a proportion of fallers (Ntagungira, 2005). In the present study, the proportion of recurrent fallers is reported as a proportion of the total sample.

5.2.2.1 Ethnic differences in fall rates

The study population was multi-ethnic and socio-economically diverse. Very few falls were reported in the black African sub-sample. The rate reported in the white sub-sample approximates rates in developed countries. The rate for the coloured sub-sample lies between the rates for the other two ethnic groups. The multi-ethnicity of the sample may partly explain why the prevalence rate falls between rates established in Asia and those in developed countries. Studies in Asia have tended to be conducted in homogenous populations, such as Chinese in Hong Kong. A lower risk of falls has also been reported in studies in minority populations in developed countries, such as Japanese Americans – which low prevalence has been attributed to better neuromuscular function in this group (Aoyagi and others, 1998; Fujita, 1994). Ethnic differences have been a subject of study particularly in the USA, but the findings have been conflicting and inconclusive.

Differences in propensity to fall may be related to life style factors. An earlier hospital based study in South Africa on fracture incidence reported a low incidence of fractures following a fall in blacks compared to whites (Solomon, 1968). This difference in incidence was explained by high levels of physical activity in the day-to-day lives of black people, such as walking long distances (due to a lack, or non-affordability of transport), agriculture, and fetching water and collecting firewood

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(Dibba and others, 1999; Schnaid, MacPhail & Sweet, 2000). Differences in physical activity levels persist in urban dwelling older populations. A majority of black older urban dwellers are socio-economically disadvantaged and have engaged in physically demanding unskilled work for most of their life. In the present study, 78 per cent of black Africans had worked as unskilled labourers, compared to 8.6 per cent of whites and 17.3 per cent of coloureds (Table 4.23). Differences in physical activity levels and socio-cultural life-styles may be factors that modify peak bone and muscle mass and function, and the rate of their decline, which will determine the maintenance of gait and balance and a propensity to fall in older age.

Other differences in the prevalence rate of falls in the different sub-samples may be due to differences in risk factors associated with falls, such as the presence of comorbid disease and intake of drugs. The rate of self-reported depression, the median Geriatric Depression Scale score, and the use of antidepressant drugs and/or psycholeptic drugs, all risk factors for falls, were significantly lower in black Africans compared to white subjects (Table 4.23). The median number of comorbid conditions was 3 in black Africans and coloureds, and 4 in whites; the total number of drugs taken was lowest in black Africans (the median number was 3 in black Africans, 5 in coloureds (with a high intake of herbal medication) and 4.5 in whites). In addition, age differences in the sub-groups were statistically significant; the oldest groups were Indians and whites, median age 76.5 years, respectively, followed by black Africans (74 years); coloureds were the youngest group (median age 73 years) (Table 4.23).

Other differences in the different ethnic groups pertained to living arrangements. Multi-generational co-residence is more common in black African than in other subgroups. The median number of residents per household in the sample was 7 for black Africans, 3 for Indians, 2.5 for coloureds and 2 for whites. The majority of falls were reported to have occurred while a subject was walking or was engaged in physical activity. It is probable that in black Africans, where multi-generational living

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arrangements are common, older co-residents may be less likely than others to engage in household chores and other activities that might predispose them to a fall.

To explain the unexpectedly low prevalence of falls in black Africans, data from other sources were examined. The low prevalence rate correlates with data from a community health centre in the suburb in which black Africans were sampled for the study, i.e. the Gugulethu Community Health Centre (a review of clinic records was carried out by the candidate in 2010). Over a four-month period, only 6.3 per cent of older persons presenting at the health centre did so for treatment of an injury sustained following a fall. Data collected over a three-month period from a tertiary trauma referral centre in the catchment area of the suburb showed that only 5.6 per cent of older persons who presented with injury secondary to a fall were black Africans (a review of hospital records carried out by the candidate in 2010). These proportions correspond with the low prevalence rate of falls, 6.4 per cent, in the black African sub-sample in the present study.

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5.2.3 Circumstances of the fall

Similar to findings of studies in developed countries, and in comparison with women, falls in men in the present study occurred mainly outdoors (68.2% versus 49.7% for men and women, respectively) and away from home (56.7% versus 48.3% for men and women, respectively). Falls were largely determined by gender differences in types of activity in which the subjects engaged. Indoor falls occurred mainly in the bedroom and kitchen. The majority of falls occurred during day time, a period of maximum activity. Trip and slips were the commonest precipitating factor for a fall, while dizziness/vertigo was the commonest symptom with multi-factorial causes in older persons, e.g. hypoglycaemia, postural hypotension, arrhythmias and middle ear disorders.

The commonest reported injuries from falls were soft tissue injuries, bruises (68% at baseline and 59% at follow-up), and lacerations (25%), which injuries are similar to those reported in studies in developed countries (Downton & Andrews, 1991; Hale, Delaney & McGaghie, 1992; Lord and others, 1993; O'Loughlin and others, 1993). Fall related fractures reported in the literature vary from 2.5 to 12 per cent and hip fractures from 0.2 to 2.6 per cent (Campbell, Borrie & Spears, 1989; Campbell and others, 1990; Downton & Andrews, 1991; Hale, Delaney & McGaghie, 1992; Lord and others, 1993; Nevitt and others, 1989; O'Loughlin and others, 1993; Tinetti, Speechley & Ginter, 1988; Wild, Nayak & Isaacs, 1981a; Wild, Nayak & Isaacs, 1981b). Fractures were reported in 14.4 per cent at baseline and 5.7 per cent at follow up (in proportion to the lower prevalence rate of falls), with a quarter of the fractures being of the hip. There was no gender difference in reported fractures at baseline: 17.6 per cent for men and 16.6 per cent for women. All six fractures reported at follow-up were in women. The number of fractures reported at follow-up was too few to draw a conclusion from this result. The incidence of hip fracture has been reported to be lower in developing countries than in developed countries (Moayyeri and others, 2006). However, even in developed countries reported rates vary widely, demonstrating variation in study design and reporting of outcomes.

Injury reported in the present study is likely to be an underestimate due to the retrospective nature of data collection. Major injuries such as hip fractures could also have been underestimated, as study subjects were older survivors and could walk unaided. Major trauma such as hip fracture contributes to mortality in this age group and may have contributed to the lower report of major injuries in the follow-up sample. The cause of death for those not followed up was not investigated and reported fractures were not verified with hospital records.

Fear of falling was reported in over half the sample, in both fallers and non-fallers, although at baseline fear of falling was reported significantly more often in subjects reporting a fall in the previous 12-month period (46.6% versus 35.7%), (Table 4.15).

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Fear of falling, although lacking standardised definition and assessment, has been reported in both fallers and non-fallers in other studies (Maki, 1997; Nevitt and others, 1989; Tinetti, Speechley & Ginter, 1988; Walker & Howland, 1991). Reported rates of fear of falling range widely depending on the method of measurement, from 20 to 73 per cent, depending on the timing of the last fall, with higher rates reported in those reporting a recent fall. Fear of falling is expressed even in those without previous experience of a fall because of the known consequences of a fall for an older person.

5.2.4 Risk factors for falls and recurrent falls

Risk factors for falls established in the investigation are discussed within the classification system used in Chapter 2: i.e. according to biological, behavioural and socio-economic factors. No significant difference in the type of risk factors associated with a fall or recurrent falls was found in logistic regression analyses: whether performed on data from the baseline sample, or follow-up subjects.

5.2 4.1 Biological risk factors

Univariate analyses included a large number of biological risk factors associated with falls (Tables 4.11 – 4.14). Unexpected findings were a lack of significant association between age and gender, and a fall or recurrent falls. Age group and gender were associated with falls only at baseline and then only in univariate analysis for recurrent falls (corresponding to the increased incidence rate of falls in women). Women and subjects aged 80 years and over had a higher proportion of falls than men and subjects in younger age groups. Age and gender were predictors of a falls only in a model that excluded history of a previous fall, a demonstration of the confounding effect that history of a previous fall has on other risk factors for falls. Advanced age has been associated with falls due to a combination of physiological factors that predispose to changes in gait and/or balance attributed to decreased muscle strength and an increase in co-morbid conditions associated with age

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(Rubenstein & Josephson, 2002; Rubenstein, 2006). It has been argued that women are at high risk of falls because of a higher number of comorbid conditions and associated high usage of medications, as well as higher rates of depression and gait and/or balance disorders (Chu, Chi & Chiu, 2005). However, no gender differences in age, nor in the Geriatric Depression Scale score or total prescribed medications were found at baseline in the present study, but women reported slightly more comorbid conditions: median, IQR: 3 (2-4) for men and 3 (2-5)) for women, p = 0.001 and medication intake (including over-the-counter drugs): median, IQR: 4 (2-5) for men and 4 (2-6) for women, P = 0. 021. In the follow-up sample, as at baseline, women reported greater comorbidity and medication intake (including over-the-counter drugs): medians IQR of: 3 (2-5) for men and 4 (3-6) for women, P = 0.002.

On logistic regression analyses (Tables 4.26 – 4.29) with control for confounders, factors independently associated with a fall in the baseline sample were ethnic group, self-reported poor mobility, self-reported Parkinson's disease, diabetes and poor urine control. For recurrent falls, additional risk factors to those above included self-reported hypertension, stroke and foot disorders and dizziness. In the follow-up sample biological risk factors for falls were the Geriatric Depression Scale score, self-reported memory loss and poor urine control. For recurrent falls factors included self-reported depression, foot disorder, and perceived worse health than a year ago. Cognitive impairment predisposes to falls in that it diminishes ability for dual tasking, to judge environmental hazards, and to correct posture to recover balance and prevent a fall (Hauer and others, 2003). Self-reported memory loss, but not the cognitive scale score (Short Orientation Memory Concentration Test) was independently associated with falls in this study. Literacy levels in the study sample could have invalidated the cognitive assessment score, thus diminishing the scale's sensitivity in ability to discriminate fallers from non-fallers, although this tool had been validated in a sample of black Africans living in a Cape Town suburb (Brodrick, 2002). However, both the Geriatric Depression Scale and the self-reported poor

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memory explore the item, *"Do you think your memory is worse than others?"* Both may reflect mood rather than cognition.

Self-reported depression and the Geriatric Depression Scale score are independent predictors of falls in the present study. This finding is not surprising, as depression and falls are known to share common risk factors such as poor self-rated health, poor cognitive status and impaired activities of daily living (Biderman and others, 2002), although these variables were adjusted for in the analysis. Medications to treat depression and other behavioural and psychological disorders increase a risk of falls in depressed and cognitively impaired older persons (Rubenstein, 2006). Self-perceived poor health has been reported as a risk factor for falls in other studies (Biderman and others, 2002; Gassmann, Rupprecht & Freiberger, 2009; Iinattiniemi, Jokelainen & Luukinen, 2009; Perracini & Ramos, 2002; Perracini & Ramos, 2002; Stel and others, 2003a). Self-rated health status has been found to be a reliable and sensitive measure of health status and to have implications for maintenance of functional ability in daily life and for survival. Poorer self-rated health is associated with attribution of a fall to one's own limitations and better self-rated health with attribution to the environment (Idler & Kasl, 1995). Physical and mental disability and impairment caused by comorbid conditions contribute to a sense of poor general health, and impairments predispose to an increased risk of a fall

The predominance of biological risk factors in association with falls signifies the role played by intrinsic factors (physical and mental disorders) in the causation of falls, with environmental factors being mainly triggers of and precipitants to a fall. However, it is possible that reporting was biased: those who had experienced a previous fall were more aware of their frailty, and readily reported physical and mental impairments; nonetheless, falls occur commonly in frail older persons.

Chronic medical conditions were independently associated with falls. It was no surprise therefore that Parkinson's disease was independently associated with a fall

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and recurrent falls, and history of a stroke was associated with recurrent falls in the baseline sample. These medical conditions affect muscle strength, gait and balance, and in some cases are associated with the development of cognitive impairment. An additional risk factor for falls in such individuals is a predisposition to adverse effects of medication such as those used to control symptoms of Parkinson's disease (postural hypotension, choreiform, dystonic and dyskinetic movements, confusion), or to control risk factors for stroke (antihypertensive). Self-reported diabetes was an independent risk factor for falls. Effects of treatment such as hypoglycaemia may predispose to falls in as much as poorly controlled diabetes may cause dehydration, dizziness and increased risk of a fall. Hearing impairment was associated with falls in univariate analysis but was not an independent risk factor for falls in this sample. However, a report of dizziness/vertigo was an independent predictor of recurrent falls at baseline. Hearing impairment is associated with middle ear degenerative disorders in old age which may cause vertigo and imbalance contributing to falls. A combination of drug adverse effects and undiagnosed middle ear disorders in a population with poor access to health care may have contributed to an increase in reported dizziness/vertigo which was independently associated with recurrent falls in the baseline sample (Table 4.27). Self-reported poor urine control was an independent risk factor for falls and recurrent falls in the baseline sample. The association with urinary incontinence could be due to confounding by co-morbidities (e.g. stroke or acute illness as well as due to hurrying to reach a toilet, increasing the likelihood of a trip or slip. Adverse effects from medications to treat the disorder may predispose such individuals to a fall.

In persons with diabetes, the condition may be complicated by neuropathies and foot disorders, which will additionally affect gait and/or balance, and lead to poor and slow mobility. The effects of foot disorders on falls have been reported in other studies (Chaiwanichsiri, Janchai & Tantisiriwat, 2009; Menz, Morris & Lord, 2006). Foot disorders such as corns, hallux valgus and pain alter gait and balance, and increase a risk of falling. Visual impairment in this study, although associated with

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falls in univariate analysis, was not independently associated with falls in logistic regression analyses. Paradoxically visual impairment was protective against falls in a model that excluded ethnicity (Table 4.28). It might be assumed that visually impaired persons are at increased risk of slips and trips, and hence at high risk of a fall. Visual impairment may have been under reported in the study as no formal assessments of vision were conducted; as was the case for other chronic medical conditions, the information on visual impairment was self-reported. In addition, as reported in a Nigerian study by Bekibele & Gujere (2010), persons with visual impairment are aware of their limitations and avoid risk taking behaviour that may predispose them to a fall, thus reducing the risk of falling.

Physical assessments and measurements conducted to elucidate the presence of physical and mental impairment mostly showed significant association with a fall in univariate analyses, but were not significant independent predictors of falls in logistic regression analyses. Apart from the Geriatric Depression Scale measurements, most physical measurements and tests of balance or physical strength (vital signs, the timed Up and Go test, five chair stands, feet together, semi tandem stand) used in the study were not independently associated with a fall although they showed an association on univariate analyses. Of the physical measurements, only hand grip strength, an increase in which was associated with slight reduction in the odds of a fall (OR 0.97; 95% CI, 0.95 – 0.99) at baseline. The timed Up & Go test was a predictor of falls only on the exclusion of history of a previous fall and ethnicity from the model, due to the confounding effect of these variables on the risk factors. The timed Up & Go test correlates with functional capacity, a decrement of which increases the propensity to fall (Podsiadlo & Richardson, 1991). Hand grip strength is a measure of general muscle strength which predicts function and ability to maintain balance through challenges in the environment (Jakobsen, Rask & Kondrup, 2010; Sayer and others, 2006; Taekema and others, 2010). In this study, hand grip strength was lowest in black Africans and a predictor of falls at baseline. The association between grip strength and falls significantly increased on exclusion

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of ethnicity from the model. On multinomial logistic regression analysis, poor grip strength was an independent predictor of loss to follow-up. Subjects lost to follow-up had multiple indicators of frailty compared to those that were followed up. The difficulty to perform the sit-to stand chair test was paradoxically protective from a fall. The chair "Sit to stand" test tests several functional components, including muscle strength, balance, co-ordination, joint range of motion and exercise tolerance and psychological status (Lord and others, 2002) The difficulty in performing the sit-to-stand chair test was particularly apparent in the black Africans (Table 4.23) who reported the least number of falls. Cultural beliefs and psychological factors of the older person being requested to perform some of the timed test may have had a bearing on the outcome.

The poor association with physical measurements demonstrated supports the finding and conclusion of Tiedemann and colleagues (2008): Tests demonstrate poor to fair sensitivity and specificity in identifying older people at risk of multiple falls. The authors recommended that physical assessment tests should be used for screening only to identify those in need of full evaluation; individually, the tests are not predictive of persons at risk of falls as such (Tiedemann and others, 2008a).

Contrary to expectations, postural hypotension, a known risk factor for falls (Chu, Chi & Chiu, 2005; Soteriades and others, 2002), was found in the baseline sample to be protective against falls. Orthostatic hypotension as a risk factor for falls has multi-factorial causation (drug use, postural change, warm environment, food and alcohol ingestion) (Mathias & Kimber, 1998), and is not always symptomatic. It is probable that additional risk factors are present in an older person with postural hypotension to contribute to a fall. Surprisingly, increased ability to stand on one leg – a measure of good balance – was an independent risk factor for falls. In general, the majority of subjects in the present study had difficulty in performing the one leg stand test which could have contributed to a contradictory finding of the test. The universal difficulty experienced by the study sample in performing the test prompted a decision not to

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perform the test at follow-up. The likely explanation of the apparent protective effect of orthostatic hypotension and the association between increased risk of a fall with the ability to stand on one leg could have been a chance finding, given the many statistical associations examined in this study.

5.2 4.2 Behavioural risk factors

Behavioural risk factors most significantly associated with falls in the study subjects found in univariate analyses were: total number of medications; intake of specific drugs; and hip and waist measurements, but not the waist/ hip ratio or body mass index (BMI). With the exception of a report from a recent study (Himes & Reynolds, 2012), BMI has not been found to be a risk factor for falls in other studies (Gassmann, Rupprecht & Freiberger, 2009; Hanlon and others, 2002; Pluijm and others, 2006; Stalenhoef and others, 2002; Tinetti, Speechley & Ginter, 1988), although unintentional weight loss has been linked to frailty (Woods and others, 2005). Fear of falling, which affects both fallers and non-fallers, showed association with a fall in the baseline sample, but not at follow-up. Basic activities of daily living (ADL) score and instrumental activities of daily living (IADL) showed a trend towards an association with a fall in the follow-up sample

Logistic regression analyses showed most behavioural risk factors not to be independent predictors of a fall. The only factors independently associated with a fall were use of specific drugs (anti-inflammatory drugs and antidepressants) at baseline, with psycholeptics associated with a fall in the follow-up sample. An increase in the score of basic ADLs (signifying ability to perform basic ADLs independently) showed a trend to be independently associated with reduced risk of a fall (Table 4.30). In a model that excluded history of a previous fall as a risk factor, good performance of IADL which is an indicator of physical and mental function, was protective from falls. Ability to perform basic ADLs and IADLs particularly in community dwelling older persons is a measure of physical and mental agility, a reduction of which may indicate the presence of biological risk factors for falls.

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Total number of medications, unlike in other studies (Clough-Gorr and others, 2008; Delbaere and others, 2006; Gassmann, Rupprecht & Freiberger, 2009; Pluijm and others, 2006; Ziere and others, 2006; Ziere and others, 2006), was independently associated with recurrent falls only in a model that excluded ethnicity as a risk factor for falls. However, this finding is similar to findings of a study in Brazil by Perracini and colleagues (2002), and other studies in developed countries (Bergland & Wyller, 2004; Gassmann, Rupprecht & Freiberger, 2009). An association between total number of medications and fall risk will depend on the prescribing habits of health practitioners (type of medications commonly taken by the subjects), the site of action of the drug and adverse effects of the drugs. A surprising finding in the present study was a lack of association of diuretics with a fall, even in univariate analyses. This finding could be explained by the liberal prescription of diuretics in the study population, leading to a loss of discriminatory ability. Diuretics are commonly prescribed in the study population at times for wrong indications such as dependent oedema. Anti-inflammatory drugs will be associated with falls, as they are mainly used in the management of musculoskeletal disorders which affect gait and balance from pain, muscle weakness or joint distortion. The finding of an association between medications and a fall in community based studies is hampered by the variety of classes of medications prescribed, which results in insufficient numbers of individuals taking a particular class of drug to contribute meaningfully to the analyses.

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Arthritis, unlike anti-inflammatory drugs, although commonly reported by study subjects, was not associated with a fall. A possible explanation for a lack of association may be that subjects who used anti-inflammatory drugs had more severe disease that impacted gait and balance more severely, and hence predisposed them to falls. Individuals with mild disease and tolerable symptoms may have felt it unnecessary to access health care, given barriers such as long waiting times and overcrowding at community health centres, as well as non-availability or non-affordability of appropriate transport to a centre. The majority of the study subjects

were dependent on a means tested social grant for income, and because of low socio-economic status face multiple barriers to accessing health care. The public transport system neither caters for persons of advanced age, or who are frail or have a disability. An association between antidepressant drugs and psycholeptics, and falls has been established (Chaimowicz, Ferreira & Miguel, 2000; Ensrud and others, 2002; Kelly and others, 2003; Liu and others, 1998; Wang and others, 2001), although some studies have shown no association (Bergland & Wyller, 2004; Graafmans and others, 1996; Mustard & Mayer, 1997; Tromp and others, 2001). In the present study, antidepressants were independently associated with falls in the baseline sample and psycholeptic drugs in the follow-up sample but only in a model that excluded previous falls and ethnicity as predictors of falls.

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An association between antidepressants and psycholeptic drugs and falls is commonly from side effects of the drugs. Adverse effects of centrally acting drugs such as antidepressants or psycholeptics, and specifically their interaction with other drugs or substances such as alcohol, are not always communicated to patients who would then take precautionary measures, and hence reduce the development of adverse effects from such interactions. However, even when adverse effects are cautioned, the caution is not always remembered or adhered to. A history of alcohol intake in the presence of a centrally acting drug may not be elicited and the older person may be unaware of the interaction and contribution of alcohol to a fall. Alcohol intake was not independently associated with falls in the study sample. However, there is a tendency in the older population to under report alcohol consumption, because of religious and social stigma. A lack of association between alcohol intake and falls in this study should therefore be interpreted with caution.

Indeed, studies on an association between alcohol and falls have been sparse and contradictory; the majority have relied on self report. Alcohol intake has been reported as a risk factor in some studies (Lima and others, 2009; Mukamal and others, 2004; Cawthon and others, 2006) and as protective in other studies

(Campbell, Borrie & Spears, 1989; O'Loughlin and others, 1993) and having no association (Lord and others, 1993). The contradictory findings have been explained by decreased alcohol intake in those with poor health and increased intake associated with good health. In addition, alcohol is under-reported as a risk factor for falls because an older person may not be aware of the association and not link the fall to alcohol intake.

History of a previous fall was a significant predictor of a fall and recurrent falls in the follow-up sample. History of a previous fall is not a risk factor *per se* (Lord, Menz & Tiedemann, 2003), but should alert a health care professional to investigate and manage physiological deficits and chronic medical conditions, and for an older person to take appropriate steps to change behaviour and prevent more falls. Steps to prevent further falls need to be instituted even when the older person reports the fall to have been accidental. At follow-up, the presence of history of a previous fall (OR 2.16; 95% CI 1.40-3.33 for a fall and OR 10.53; 95% CI 4.17-26.56 for recurrent falls) replaced ethnicity as being most significantly and independently associated with falls. Ethnicity may not be a risk factor for falls, but a proxy to multiple interacting physical, mental, cultural and life style factors that in combination contribute to a fall in the presence of appropriate environmental precipitants. The confounding effect of previous falls on other risk factor for falls has been demonstrated in this study in that risk factors for falls such as age, gender, and difficulty in performance of the timed Up & Go test and poor IADL score were independent predictors of falls only on exclusion of history of a previous fall from the models.

5.2.4.3 Socio-demographic and environmental factors

Socio-demographic and environmental predictors of falls – ethnic group, education level, previous occupational category, location of toilet facility and socio-economic status – were associated with a fall in univariate analyses. In logistic regression analyses only ethnic group in the baseline sample and location of the toilet facility in the follow-up sample were independently associated with falls. However, in a

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baseline model that excluded ethnicity as a predictor of falls (Table 4.28), previous occupational (skilled, managerial/professional) categories were an independent predictor for falls. Occupational category is linked to lifestyle factors that predisposes to the development of gait and balance disorders in older age and a propensity to fall.

A surprising finding was a protective association with a fall in those with an outdoor toilet facility (Tables 4.30 and 4.36). Logically, it may be presumed that access to an outdoor toilet would be hazardous because of exposure to environmental obstacles and poor lighting at night. An explanation for this protective factor could be that the facility is common in Gugulethu, where the majority of residents are black Africans. However, ethnicity was adjusted for in the analysis and this finding could be due to other confounders for which information was not collected The majority of black Africans reported their mobility as good; for the greater part of their life they had engaged in a physically demanding occupation (manual labour). The occupational engagement may have given them an advantage in muscle reserve capacity and function, and better maintenance of gait and balance.

Marital status was independently associated with recurrent falls at follow-up. Being widowed, divorced or single were independent predictors of falls (Table 4.31). Widowhood or being single in old age may predispose individuals to depression, poor health and loneliness, and/or increase the likelihood of their carrying out risky physical activities that may predispose them to a fall. Living arrangement in relation to falls has yielded conflicting findings, ranging from no association (Bootsma-van der Wiel and others, 2003; Covinsky and others, 2001; Iinattiniemi, Jokelainen & Luukinen, 2009; Stalenhoef and others, 2002; Stel and others, 2003a; Teno, Kiel & Mor, 1990; Tromp and others, 1998), to a high risk of falls (Biderman and others, 2002; Bootsma-van der Wiel and others, 2003; Chu, Chi & Chiu, 2005; Gassmann, Rupprecht & Freiberger, 2009; Iinattiniemi, Jokelainen & Luukinen, 2009; Reyes-

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Ortiz and others, 2004; van Bemmel and others, 2005), and being protective (Leung and others, 2010) in those who live alone.

The finding that the presence of mats/rugs in a dwelling is protective against recurrent falls was unexpected. It is possible that mats and rugs may have been present in the households of younger and fitter subjects who were not at risk of recurrent falls. Another possibility is that mats and rugs may have been removed in a household in which a frail older person resided to prevent falls. Mats and rugs were the second highest environmental obstacle spontaneously reported by study subjects as a hazard predisposing to a fall. Studies on socio-demographic and environmental risk factors on falls have not been robust. There is a need for further prospective investigation in this area, even in developed countries. Classification of these risk factors has neither been standardised, making comparison difficult.

5.2.4.4 Limitations in the determination of risk factors

A cross-sectional with a longitudinal/cohort study design was selected for this study. Determination of risk factors and their association with falls in the study sample was hindered by the cross-sectional data collection and retrospective recall of falls at baseline and follow-up. A cross-sectional study design has the advantage of providing baseline information on participants, but since risk factors and outcome or disease are determined simultaneously for each subject, only prevalent cases with the outcome are recorded. A temporality between a fall and a risk factor could not be established within the cross-sectional design, although consistency in an association of some risk factors at baseline and follow-up, and on longitudinal analyses increased the significance and relevance of the association.

Although a longitudinal/cohort study design was used to investigate factors that put individuals at risk for a fall, there are disadvantages inherent in longitudinal studies that impact on the present study as follows: The method of selection introduces bias in that persons who experienced falls may have been more willing to participate in

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the study than those who had not fallen; Non-participation and non-response can introduce biases that complicate interpretation of study findings. People lost to follow-up may be different from those who remain in the study. For example, if persons in the present study at increased risk for a fall were selectively lost to follow-up, the incidence rate for falls would be difficult to interpret and the report likely to be an under-estimate of the actual incidence; to give optimal results, repeated measurements are required at several points in time adding to study expense. For rare outcomes such as recurrent falls, large samples are required to allow for adequate analyses. Limited resources for this study did not make it possible to collect repeated measurements; a baseline survey may impact on subjects by making them more aware of fall risk and therefore modifying their behaviour and thus impacting on the measure of the outcome (fall incidence), as respondents become alerted to kinds of behaviours that are expected of them. This possibility may partly explain the lower prevalence rate of falls at follow-up, although a lack of information on those lost to follow-up could equally have contributed to the lower prevalence rate. Longitudinal analyses show that those lost to follow-up were more physically and mentally frail and may thus have been at an increased risk for falls. Periodic telephone communication and diary recordings kept by subjects in the interval to follow-up, not undertaken in the study, would have enabled more reliable recording of events and interpretation of the findings, but would have introduced bias in that not all subjects had access to a telephone and some were illiterate.

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A cross-sectional study design has the advantage of providing for a larger sample size and no bias of differential loss to follow-up. The follow-up study provided for longitudinal analyses and the advantage of temporal association of risk factors and a fall but with problems of differential loss to follow-up. Considering the challenges of collecting prospective data at frequent intervals in this study, the follow-up data provided for a longitudinal analysis of the association between baseline risk factors and the prediction of a fall in the period to follow-up. In addition, a finding of an

association of a risk factor to a fall both at baseline and follow-up strengthens the association.

Basic activities of daily living (ADLs) and instrumental activities of daily living (IADLs), assessed at follow-up, were marginally, independently associated with a fall and only on exclusion of history of a previous fall from the model. IADLs may not have had an association with a fall due to multi-generational living arrangements and cultural factors which prescribe that an older family member's IADLs are mainly performed by younger family members: not because the older person is unable to perform them, but because of cultural or ethnic norms and expectations.

Overall, a lack of continuous information gathering in the 12-month interval to follow-up impacted the calculation of an incidence rate of falls and prospective assessment of risk factors. The study design was largely determined by resources available to the candidate and resource limitations on the part of some subjects. Cultural factors may have impacted certain study results, specifically physical measurements.

Limitations on measurements and assessments as discriminators were as follows: Some subjects appeared not to understand a need to perform timed physical assessment and measurement tests optimally, which affected the results of the assessment. Although field workers demonstrated how a test should be performed and encouraged subjects to perform the test in a similar way, in order to obtain a reliable measurement, some measurements may not be an accurate measure of a subject's functional ability. The measurement may also have impacted the candidate's ability to discriminate fallers from non fallers. In addition, certain unmeasured confounding factors may have impacted the study findings.

The inclusion of history of a previous fall as a risk factor for falls has a confounding effect on several other risk factors as independent predictors of falls. An increase in time to perform the timed Up and Go test was an independent predictor of falls. This

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was evident only after history of a previous fall and ethnicity (a proxy for socio-economic factors) were excluded from the model. The timed Up & Go as a discriminator of persons at risk of a fall would be of particular value in poorly resourced environments as it is a simple and cheap test that could be conducted in any place including an older person's dwelling if a chair of an appropriate height is available.

A poorly maintained outdoor environment may have contributed to falls in more active subjects, who by implication may have been younger; hence, a lack of age discrimination between fallers and non-fallers occurred, although recurrent fallers did tend to be frail. This outcome may also have impacted on the association of physical test performance with a fall; despite falling, active older subjects would have performed well in such assessments. Some physical assessments such as the one leg stand had the opposite of the expected outcome: increased risk of a fall in those who were able to stand on one foot for longer periods, which signifies good balance and should predict reduced propensity to fall. The unexpected finding may be due to deficiencies in measurement. Despite intensive training of the field workers, observer bias in the interpretation of measurements cannot be excluded.

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5.3 Contribution of the study to knowledge

The contribution of the study to knowledge in the area of falls in older people is evaluated below. As no population based research had previously been conducted on falls in older persons in South Africa, it is contended that the study outcome and this thesis make a novel contribution to knowledge in this area in the country – as well as to knowledge in the SSA region and other developing countries broadly. A lack of local epidemiological knowledge in this subject area meant moreover that no data were available upon which the candidate might base the present study. No information existed either on the extent of the problem of falls in older individuals. A sub-study to calculate a sample size for the investigation was therefore conducted in

the same population. The sub-study was essential for the calculation of the required sample size for the investigation, in order to determine the prevalence of falls in the study population. If such information had been available, intervention to prevent falls may have been instituted earlier.

5.3.1 Review of the extant literature on falls

A specific contribution of the study and the thesis to knowledge on falls lies in the review and synthesis of the large body of literature from developed and developing countries carried out in Chapter 2. The review provided a base for the study's conceptualisation, design and execution, and the subsequent generation, analysis and interpretation of empirical evidence (Chapters 3–5). The only other review of literature on falls in older people in developing countries focused on Chinese populations (Kwan and others, 2011). The review in Chapter 2 is thus a novel effort to systematise literature on falls and outcomes in older people in developing countries in general.

A key contribution of the present study lies therefore in the establishment of a prevalence rate for falls in South Africa's older population, and its future documentation in literature, as well as in the identification of risks factors for falls in a multi-ethnic, urban older population – also to be published shortly. Indeed, the ethnic diversity of the sampled Cape Town population provided an opportunity to highlight associations of culture, lifestyle and socio-economic conditions on fall rates and risk factors for falls. Moreover, little was known previously on the consequences of a fall for an older person in the SSA region and the study has contributed to filling a gap in knowledge in that area as well.

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5.3.2 Prevalence of falls

Apart from the study's contribution to knowledge on falls through the establishment of prevalence rates, indicated in the sub-section above, the different prevalence rates found for the three ethnic groups (with the highest rate for whites and the lowest rate for black Africans) raise questions on underlying contributory factors to falls – given that subjects of all ethnic groups resided in the same geographical area.

The generalisability of the prevalence rates established in the Cape Town study to populations elsewhere in South Africa will depend on geographic, environmental and socio-economic features of populations in different sub-regions, as well as older individuals' access to health care. Given the diversity in multi-cultural South African society, the generalisability of average findings is probably limited, although the findings in the sub-populations may be generalisable to specific sub-populations.

Thus, the study's findings pinpoint ethnicity and (associated) socio-economic status as a factor in falls and fall risk, albeit explained inconclusively, and raise questions for future research.

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5.3.3 Consequences of falls

The main consequences of a fall reported by the subjects were injuries sustained, fear of falling again and having to give up certain physical activities. Although 70 per cent of the fallers had sustained injuries, only 40 per cent had sought medical attention. The most common reason given for not seeking medical attention was that the injury was perceived not to be sufficiently severe. However, long waiting times at community health centres and the cost of transport to a healthcare facility may have influenced a decision not to seek medical attention, even though health care at public facilities is provided free to social pensioners. The study has indicated a need to know more on the consequences of falls in South Africa's older population. In

addition, it has pinpointed a need to investigate how falls and their consequences are managed within the healthcare system. Insufficient investigation of underlying causation of a fall, and causative and hence risk factors for falls identified in such investigation need to be addressed.

5.3.4 Risk factors for falls

Self-reported history items were more strongly associated with falls risk than physical performance tests. Hand grip strength was a predictor of falls in the baseline sample and the Up & Go test was a predictor of falls in the follow-up sample in a model that excluded history of a previous fall as a risk factor. Of the physical assessments and measurements, the Geriatric Depression Scale score was the only measurement consistently associated with falls. Saliently, responses to questions in this scale are not dependent on, or influenced by education and hence literacy level – which had no influence on the final score. Cognitive impairment is a risk factor for falls, the (SOMCT) cognitive score was more significant a predictor of loss to follow-up than of falls. Neither did assessments and measurements such as the physical performance tests serve as a single measure of fall risk.

The findings on risk factors for falls further contradicted an initial expectation that the relatively hazardous external environment, due to under-developed urban infrastructure in the study suburb inhabited by black African subjects, would put these subjects at increased risk of a fall. Hence, an ethnicity factor in the incidence of falls calls for research into why falls are common in white older people and comparatively less so in black African older people.

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5.4 Evaluation of the study methods

The conduct of the study and its contribution to methodology are evaluated for the study design, the survey instrument and the chair validation study in sub-sections below. Thereafter, methodological limitations of the study design, and identified in execution of the study, are considered separately.

5.4.1 Study design

The study design, comprising a baseline survey and a 12-month follow-up survey, provided for the collection of two sets of data from the same sample – albeit with a smaller follow-up survey sample due to attrition. The study design therefore provided for analyses of longitudinal data from a sub-set of subjects who had participated in both surveys: specifically, an association of risk factors reported at baseline with a fall incidence in the interval to follow-up.

5.4.2 The survey instrument

The comprehensive instrument designed to collect data in the baseline and follow-up surveys included validated assessment tools for functional assessment. The instrument was tailored for the population sample in its design and content, and the adaptation of items and tests, and was modified after pre-piloting and piloting for efficient use in the study. Inclusion of a number of open ended items encouraged subjects to articulate their experience, views and perceptions relating to falls first hand. For example, the subjects were invited to verbalise circumstances surrounding their fall – i.e. describe activities in which they engaged at the time of the fall, the time of day of the fall, reasons for not seeking medical attention and how the fall had subsequently impacted their daily activities. Qualitative type items have not been routinely included in survey instruments to investigate falls.

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5.4.3 The chair validation study

As interviews with subjects to collect data were conducted in the subjects' dwelling, in order to facilitate and maximize their participation in the study, a collapsible, portable chair was required for field workers, to conduct a variety of mobility tests, and to carry easily using public transport. At the same time, the chair needed to match the specifications of a standard office chair used in standardised tests. The chair that was sourced and later used thus needed to be validated, which was done in a sub-study prior to the baseline survey and had a satisfactory outcome (Kalula and others, 2010). Results of tests of lower limb strength and balance using the collapsible chair correlated with those achieved in the use of a standard office chair (section 3.5).

The use of a portable chair to conduct physical assessments in subjects' dwellings, and not to rely on subjects having to travel to a central venue, such as a clinic or office where a standardised chair could be used for assessment, was novel. Moreover, interviews and assessments carried out in subjects' dwellings enabled inclusion of individuals in the study sample who would otherwise have had difficulty in travelling to a central venue for logistical and health reasons. Inclusion of these individuals in the sample thus increased the range of subjects, improving the generalisability of the study findings.

The chair validation study constitutes a contribution of the study to methodology in that it demonstrates how investigators in poorly resourced settings who conduct community based studies can overcome financial and logistical constraints – by transporting a portable assessment tool to subjects' dwellings, instead of submitting them to logistical challenges of having to travel to a central venue for testing.

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5.4 4 Methodological limitations

Despite the contribution the study makes to methodology for inquiries in the area of falls in older people, in developing country settings in particular, certain methodological limitations became evident during the investigation, and are discussed in sub-sections below.

5.4.4.1 Study design

A weakness in a cross-sectional study with a longitudinal design is that the probability of loss to follow-up is high. An attrition rate of 24.5 per cent between baseline and follow-up in the present study is indeed high. A further possible weakness in the study design was a single follow-up visit at the end point and a lack of censored data, which meant that the calculation of the incidence rate of falls may be an under estimate of the actual incidence. However, the design did serve to overcome resource limitations, mainly financial on the part of the candidate, and limited telephone access and low literacy levels of some subjects, but which meant that no regular or periodic follow-up with subjects could be carried out to learn about fall events and outcomes. Nonetheless, despite the high attrition rate, no significant change was noted in the profiles of the baseline and follow-up samples.

The cross-sectional nature of the data collected at baseline and follow-up may have introduced recall bias in the reporting of a fall (some subjects may have forgotten they had fallen), circumstances surrounding the fall and consequences of the fall in the interval between baseline and follow-up. Another limitation, common in studies in older populations, may have been a "health survivor" effect: a form of selection bias, with entry into a study dependent on survival to old age, and those who succumb to premature mortality from medical and other conditions excluded from sample selection. A "health survivor" effect may lead to under-representation of some risk factors associated with high mortality and over-representation of low mortality risk factors. This result may have led to homogeneity in the risk factors identified in the

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study sample, thus limiting an ability to detect associations. Another source of bias may have been volunteerism selection: the characteristics of subjects who volunteered to participate in the study may have differed from those who refused to participate. In addition, characteristics such as level of physical activity and level of fitness can affect the prevalence of falls as well as an association between falls and risk factors. In the present study, a lack of association between advanced age and risk of falls in the baseline sample may be such an example. It is possible therefore that individuals in the oldest age group who consented to participate in the study were relatively fit for their age. The sample selection criterion of being mobile, with or without a walking aid, eliminated the recruitment of individuals who were immobile or frail for the sample.

Information bias may have resulted in differential under-reporting of factors such as alcohol intake due to ethnic and/or religious proscriptions, and under-reporting of falls, possibly due to embarrassment to admit to a fall, which would have equated an admission of frailty.

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5.4.4.2 Field workers

Initially, two field workers were recruited and trained to work in each of three suburbs in the study area (a total of 6 field workers). The multi-ethnic, multi-lingual study population required that the field workers be conversant in the first language spoken by the majority of residents of a particular sub-sample and to be resident in that suburb (section 3.6). Given the high unemployment rate in the country, the recruitment and appointment of field workers had to be sensitively negotiated with community leaders – in the case of the black African sub-sample in Gugulethu, in particular. Invariably, a community leader would indicate his preference among candidates for appointment as a field worker in that suburb. Maintaining a good relationship with community leaders was essential to ensuring that the field workers would have access to sampled subjects in the area. As the field workers had limited experience, especially in carrying out physical assessments and taking

measurements, but also in interviewing, extensive training and retraining, and repeated role playing were required.

Data collection was closely monitored and cross-checked. Within a fortnight of the start of the study, and despite additional training, four of the six field workers had to be discharged, after counselling, because of inability to conduct satisfactory interviews. Only two field workers therefore conducted the remaining interviews. The one field worker is fluent in English and Afrikaans, and the other in English and isiXhosa; together they covered the main languages spoken by residents of the study areas. In retrospect, a greater number of field workers would have been preferable, to avoid interviewer fatigue and to ensure good quality interviews. Although the quality of the data collected was satisfactory, the small number of interviewers may be viewed as a limitation of the study. On the other hand the small number of field workers and screening for on-the-job competence could be seen as an advantage in terms of limiting inter-observer variability, and increasing reliability and validity of the data. The multi-ethnic study population may constitute a strength of the study, but multilingualism may have introduced bias in the administration of the questionnaire. The level of trainability of interviewers in developing country settings and an inconsistent data collection workforce may therefore present a challenge to investigators in these settings.

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5.4.4.3 Sample size distribution

The sample design provided for equal size sub-samples in three suburbs. However, mistrust of residents as a result of crime in the study areas, and consequent disinclination in some cases to allow a stranger into a dwelling to conduct an interview resulted in an under-sampling of subjects in one suburb, Plumstead, a predominantly “white” suburb. The under-sampling in this suburb required over-sampling in Wynberg, a suburb with a large number of coloured residents. The under and over sampling may thus have reduced the precision of the true prevalence of falls in persons of different ethnicity. Nevertheless, the prevalence of falls

established in the coloured sub-sample approximates that in the white sub-sample more closely than it does in the black African sub-sample (resident in Gugulethu). The small sub-sample of Indian participants (n=22 (2.6%) at baseline and n=13 (2.1%) at follow-up) reflects the low proportion (0.9%) of the older population of Indians resident in the Western Cape Province.

Where more than one older person was resident in a household, the oldest member who consented to be interviewed was recruited into the study. The selection of the oldest member of the household was done to augment male participation in the study. Although equal proportions of males and females (50 %) refused to participate in the study, males are under-represented in the actual sample when compared to the proportion of males in the older population of the Western Cape Province (1.3:1 female to male ratio, versus 3:1 in the study). It is possible that in "non-response households," where after three visits by a field worker no occupants were found at home, older male occupants may have been absent from the home more often than female occupants, who largely stay at home to engage in domestic chores – and fewer males were thus recruited. Despite a gender imbalance, the total study sample had an almost equal distribution of subjects in different age groups, which enabled group comparisons.

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5.5 Implications for public health

The study outcome yielded a wealth of information to guide future policy and intervention to prevent or reduce falls in older individuals, and thus to enhance their well-being and to save costs on multiple levels. Health promotion to foster the well-being of older persons has not been a health priority in South Africa. Yet health conditions that impact the functioning and well-being of older people are prevalent, as shown in the study. Intervention to address the problem of falls in older persons is

clearly required. Indeed, a prevalence rate for falls of over 20 per cent for an urban older population may be an under estimate even of the real prevalence rate.
Implications of the study findings for public health are discussed in terms of their relevance for 1) public policy and programmatic intervention, and 2) medical practice at all levels of healthcare.

5.5.1 Falls prevention policy formulation

In general, policies and programmes to foster the health and well-being of older persons in South Africa have neglected to address falls, risk factors for falls and consequences of falls. Yet causes of falls are often amenable to intervention to prevent or reduce further falls. Following on findings of this study, and of an earlier study on management of falls in a hospital emergency department (Kalula and others, 2006), programmes to raise awareness on the impact of a fall on an older person are indicated for laypersons and health professionals alike. Prevention of falls can help to maintain and enhance the well-being and quality of life of older individuals, and contribute to cost savings, in terms of direct costs to the health system, and indirect costs to communities, families and individuals. The study and thesis have highlighted a gap in the healthcare system in this regard – as well as pinpointed a need for public policy formulation, healthcare curriculum development, training of health professionals in falls and community based falls prevention strategies.

The multi-causation of falls calls for education in this regard, and an association of falls with mental and physical health needs to be placed high on health promotion and geriatric care policy agenda. Policy action is urgently needed to increase awareness, encourage behavioural modification and reduce risk factors, in order to decrease the incidence of falls.

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In the study, falls were largely associated with chronic medical conditions and poor health status; hence, with the burden of non-communicable diseases (NCDs). In South Africa – and indeed in sub-Saharan Africa, government programmes for the prevention and management of NCDs have largely been secondary to programmes to combat infectious diseases. A depriotisation of high morbidity/low mortality conditions (NCDs) that impact older individuals' physical and mental functioning in effect predisposes them to falls. To compound the problem, the South African government has up to now lacked evidence on falls, and an association between falls and NCDs. With evidence, such as the present study has yielded, and a willingness on the part of the government to develop and implement policy and programmes to control NCDs that incorporate health promotion, active ageing and falls prevention for the older population, enhanced health and well-being of older persons will follow.

In addition to an identification of biological risk factors for falls, the study highlighted a number of hazardous obstacles in the external environment which subjects perceived exposes them to a risk of falling: open manholes, poorly designed and/or constructed curbs, uneven sidewalk surfaces and potholes in roads, in particular. Hence, besides physical and mental health promotion, attention is needed from the government and local authorities to maintain and, if necessary, modify external environments towards creating age-friendly and safe environments for people of all ages.

A need for targeted falls prevention programmes, and steps in the design and implementation of such programmes are outlined in section 5.5.2.2. Although the design and implementation should be informed by international experience, programmes operated elsewhere should not simply be transposed to South Africa or other SSA countries. Programmes and their implementation need to be tailored to take cognisance of local population and environmental characteristics – at a user end (the patient or client). From a provider end, healthcare system standards and

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efficiency need to be improved, including adequate training of health care professionals in falls and falls prevention.

5.5.2 Falls prevention

The empirical study yielded extensive information which can serve to inform the design and implementation of intervention programmes to prevent and/or reduce falls in South Africa's older population – and indeed in older populations in other developing countries.

5.5.2.1 Falls prevention programmes

The introduction of falls prevention programmes in South Africa has been hampered by a lack of knowledge on the magnitude of the problem of falls in older people, as well as of associated, yet largely modifiable, risk factors for falls, and healthcare priorities of the government. A wide range of fall prevention strategies has been developed and are being implemented in developed countries. Such strategies, reviewed in Chapter 2, include exercise programmes, environmental modification (mainly the indoor environment), education and multi-factorial intervention. It is uncertain which of these approaches or intervention will be most appropriate and effective in local settings: particularly in multi-ethnic populations with differing socio-economic circumstances and lifestyles. Such variation will indeed impact older persons' participation in programmes.

Self-rated health status, a risk factor associated with falls in the present study, may for example impact falls prevention strategies through perceptions, attitudes, and expected behaviour and steps taken to prevent future falls. Understanding older individuals' own attribution of a fall to various intrinsic and extrinsic risk factors for falls is therefore critical for expected rehabilitation outcomes and participation in falls prevention programmes. A low expectation on the part of an individual of his/her ability to prevent a fall, often linked to a belief that the cause of a fall is external and

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uncontrollable, may lead to feelings of helplessness and depression, and denial – and in turn to a lack of motivation to take any strategic action to prevent a fall. In contrast, attribution of a fall to an internal factor that is modifiable or controllable may involve more positive expectations of being in control of the event, which would make the individual more amenable to remedial intervention (Weinberg & Strain, 1995).

In the present study, risk factors associated with falls were found to be mainly biological. An approach, or strategy to prevent falls is thus needed that focuses on general health improvement, such as dietary and life-style (reduced alcohol intake and smoking cessation) habits, and increased physical exercise – all risk factors, otherwise, for the development of certain non-communicable diseases. Education in prudent practices or behaviour in these areas should target not only older persons, but the entire population – starting with school children, who will benefit from the education across the life-course, and who in turn will influence the life-style behaviour of members of their household.

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Perceptions that falls are unavoidable in ageing are common among lay persons and health care workers alike, due to a lack in knowledge on ageing and health, particularly in countries with youthful populations, as in SSA. Further, based on information yielded in the present study and that of a previous study – which showed little or no knowledge of falls prevention modalities among health care workers (Kalula and others, 2006), education on falls prevention should not be confined to older persons and the lay public, but targeted at these workers as well. Indeed, health care training curricula are largely devoid of modules on ageing in these countries. In the present study, risk factors for falls were found to be amenable to clinical detection, and potentially amenable to public health education and intervention.

Apart from health illiteracy in a large proportion of the South African population, the older population in particular, it is noteworthy, as in other developing countries, that few or no opportunities exist for older persons to engage in physical activities: partly due to a paucity of facilities and services for these activities, but also concerns about personal safety outside their home. Cultural attitudes towards physical activity in old age and perceived lack of benefits and/or dangers thereof may additionally discourage participation in activities. Programmes need to be introduced therefore that emit positive messages to older persons of health and social benefits of participation in the programmes. The programmes should promote “active ageing,” rather than “falls prevention” with associated negative connotations. Apart from risk modification, targeted strategies should also be aimed at behavioural change. Psychological approaches to behavioural modification in beliefs and attitudes as to the benefits of exercise and physical activity in improving health and well-being should thus be included in all falls prevention intervention.

In the implementation of preventive strategies and programmes, a balance needs to be achieved between benefits and costs. As noted in Chapter 2, the yield of these programmes can be cost-effective if targeted at high risk individuals (Salkeld and others, 2000). A population based approach, although not well evaluated, could be considered, as it will cover a large number of individuals and not only high risk individuals. In 2011, the South African government together with other Heads of State and Government participated in the high-level meeting on the Prevention and Control of Non-communicable Disease (NCDs) in New York. South Africa’s government is a signatory to the summit declaration that calls for greater measures to be taken at global, regional and national levels to prevent and control NCDs, particularly in developing countries. The mortality rate from NCDs in these countries is high, and a vicious cycle has developed where NCDs and their risk factors worsen poverty and poverty contributes to the rise in NCDs (WHO, Non-communicable diseases and mental health, 2011). Such developments encourage the setting up of health promotion and falls prevention programmes for older persons. A falls and

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injury prevention programme despite the known limited success of such programmes in reducing falls should be developed as a component of a wider strategic plan alongside a public health plan for prevention of NCDs, where the value of exercise for enhanced balance, muscle strength and mobility is promoted, and risk factors such as smoking, excessive alcohol, unhealthy diets and drug abuse are highlighted as causes of not only accidents but NCDs as well.

5.5.2.2 Implementation of falls prevention programmes

Information garnered in the present study, disseminated in a summarised and simplified format, can serve to inform policy makers and planners of a need for and benefits of health promotion and falls prevention intervention for older persons. The responsibility for formulating such policy and initiating intervention resides with the National Department of Health through the Directorate of Chronic Diseases, Disabilities and Geriatrics, as well as the directorates of Nutrition, Mental Health, HIV/AIDS and Primary Health Care. In turn, the health department will need to work closely with the Department of Social Development, whose mandate it is to plan and co-ordinate social programmes in communities for groups such as older persons. Both departments already co-ordinate the functioning of some community based senior centres at which such prevention programmes could be introduced. Municipal managers for cities should be made aware of, and take responsibility for modification and maintenance of the built environment to ensure it is age and disability friendly. All levels of planning should involve managers of Community Based Organisations (CBOs), which are largely responsible for the implementation of services at a community level.

5.5.2.3 Falls intervention in healthcare practice

A general perception in the study population was that a fall is an accident and medical attention is only required if the injuries sustained are severe enough to warrant it. Clearly, no need was perceived for clinical investigation of the cause of a fall, even in the case of minor injury, with a view to preventing further falls. All too

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often, health professionals neither view a need to investigate the causes of the fall when treating the injuries of an older patient (Kalula and others, 2006). A key outcome of the study findings therefore is a need highlighted for education of the public and health professionals on a need for such investigation. Education for health professionals should not only include management of injuries, but an assessment of the physical, mental, psychological and social impact of the fall, and a consequent need for appropriate referral for management and the prevention of future falls. A purposefully established service at a tertiary level centre is recommended moreover to co-ordinate the training of multi-disciplinary health care professionals and to streamline referral.

Some risk factors associated with falls in the study are largely reversible and/or modifiable: through health promotion and fall prevention intervention. Within medical practice, risk factors identified during history taking should alert healthcare professionals to the risk of a fall, and a need to institute primary or secondary fall prevention intervention. Indeed, despite medical practice becoming increasingly technological, history taking may be more sensitive than physical assessments in identifying older individuals at risk of a fall. The study has thus highlighted a need for clinicians to ask relevant questions to elucidate fall risk. Physical measurements may not be as reliable a measure as history taking: for cultural, socio-demographic and other reasons.

The training of healthcare professionals in the assessment, management and referral of older persons presenting with a fall, and the assessment of fall risk is indicated at all levels of care, but particularly for healthcare professionals at the primary health care level and in emergency departments; these professionals are the first contact on a patient's entry into the health care system. Use of purposefully developed protocols, would help to streamline and make assessments efficient in overcrowded healthcare centres, where time available to healthcare practitioners for assessment and patient education, or counselling and referral is limited.

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5.5.2.4 Falls prevention by health agencies

Apart from implementation of falls prevention programmes by community based organisations, similar programmes should be initiated at health care facilities where patients present with injuries – at primary, secondary and tertiary levels. General practice to date has been to treat the injuries of a patient who has fallen, and not to attempt to establish possible underlying causes of the fall, nor to counsel or educate the patient in falls prevention. Protocols are needed to facilitate and guide management and screening for risk factors at these care levels – with the protocols tailored to the level of care. Professionals working at different care levels include clinicians, nurses, physiotherapists, occupational therapists, social workers, and health promoters and managers. All these professionals should participate in the development of falls management protocols as it will be their responsibility to implement them. Representatives of end users (i.e. older persons) and service providers (e.g. CBO managers and community representatives) should be represented in the development of the protocols.

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Workshops will need to be organised for various stakeholders prior to the development of falls management protocols for health care services and setting up of falls prevention interventions. Thrusts of such consultative workshops and the stakeholders who should be targeted for participation in the workshops are detailed below.

5.5.2.5 Workshops to develop falls prevention programmes

The design and implementation of falls prevention programmes in developing countries will be challenged by a scarcity of resources – financial, infrastructural and human – as well as ageist attitudes of health care providers. Limited human resources will mean that group programmes offered at community centres will be more feasible than home based programmes. Centre based programmes will require recruitment and training of ancillary workers to support the limited number of health care professionals and to manage the programmes collaboratively with CBO

personnel. Older persons will require resources, and support and encouragement to access and participate in these programmes, particularly in under resourced communities. To be successful and cost effective, the programmes should thus be community based and accessible, and enjoy community buy-in.

Falls are prevalent in the older population, and impact individuals' function and quality of life. Falls are mainly secondary to known risk factors, which are sometimes modifiable. Fall prevention interventions are indicated to prevent and reduce the rate of falls. The implementation of falls prevention programmes calls for the education of a wide range of stakeholders, including healthcare professionals, policy makers and planners, city managers, older persons and the community at large.

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Chapter 6

Conclusions and recommendations

6.1 Introduction

In this chapter, conclusions of the empirical study and thesis are drawn, and recommendations are made for public health intervention to prevent and reduce the incidence of falls in older people, and for future research. The conclusions are drawn in terms of the objectives set for the study: primarily, the establishment of a prevalence rate and a determination of risk factors for falls in the study population, i.e. persons aged > 65 years residing in the community in an urban centre.

6.2 Conclusions

Conclusions drawn from the study outcome are based variously on 1) outcomes of the review of the literature in Chapter 2; 2) key findings of the empirical study reported in chapters 4 and discussed in 5: 3) the appropriateness and limitations of the methodology; and 4) implications of the study outcomes for intervention.

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- Literature in this subject area has mainly emanated from countries in the developed world. In general, higher fall rates have been reported in Western countries than in Asian countries. Risk factors for falls are mainly multi-factorial and the majority are modifiable. Overall, risk factors have not differed widely between developed and developing countries.

- The literature has indicated moreover that a fall in an older person has physical, psychological, emotional and socio-economic consequences, and the causation, impact and consequences of a fall vary according to physical and mental ability.

- Intervention to prevent falls has mainly been instituted in developed countries; the effectiveness though limited has been demonstrated for both multi-factorial and uni-factorial intervention. Exercises have been found to be more effective when targeted at high risk fallers than random groups of older persons. Intervention programmes are under developed or nonexistent in South Africa and other SSA countries.

- The overall prevalence rate and the incidence of falls established in the present study are in general higher than rates reported in Asian countries, but lower than those reported in Western countries. Although fairly similar to rates established in studies in other developing countries, the present study's rate of 21.8-26.4 per cent falls in-between rates reported in developed countries and developing countries, particularly Asian countries in the latter case. However, the different prevalence rates established for the three sub-samples, or ethnic groups in the study, are of particular interest. The ethnic diversity of the Cape Town study's older population (the total baseline and follow-up survey samples comprised 17 per cent whites, for whom a prevalence rate of 42.9 per cent was established) may have contributed to the higher overall prevalence rate, compared to rates established in fairly homogenous populations in other countries. An understanding of contributors to differences in prevalence in different ethnic groups through future investigation will enhance to understanding of causality and risk factors, as well as procedures to prevent falls in older people.

- Overall risk factors independently associated with falls were self-reported diseases or symptoms (impaired mobility, Parkinson's disease, stroke, diabetes, poor urine control, dizziness, memory loss) and use of medications to manage chronic conditions (anti-inflammatory and anti-depressant drugs). Hence, risk factors for falls related mainly to non-communicable disease or treatments for the diseases. Ethnicity was strongly associated with falls at baseline but not at

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follow-up, except on exclusion of history of previous falls from the model. History of a previous fall and marital status (being single or widowed) were other predictors of falls at follow-up. Age, gender and ability to perform IADL were independent predictors of falls but only after exclusion of history of previous falls from the model. A previous fall is a marker of a propensity to fall and not a risk factor for falls. Environmental factors often triggered a fall. The set of risk factors identified in the study therefore highlights the role of non-communicable diseases in the causation of falls. Prevention and/or good management of non-communicable disease in older individuals will reduce risk of falling and enhance quality of life.

- Assessments and measurements in the study were generally poor in discriminating fallers from non-fallers; only the Geriatric Depression Scale score was consistently associated with falls. An increase in hand grip strength was associated with some protection from a fall and the timed Up & Go test was a predictor of falls after exclusion of history of a previous fall from the model. Hence, as determinants of risk factors for falls, assessments and measurements had limited value as a single measure, but may be of value in following progress in an individual's rehabilitation. Validated assessment tools for measuring physical performance need modification and adaptation for use in different environments.

- A limitation of the present study, a function of the study design, is a lack of censored measurements, and an inability to conduct follow-up telephone interviews with subjects and some subjects' inability to keep diary recordings in the interval between baseline and follow-up. As a consequence, no information was available on subjects lost to follow-up. Future studies should aim to adhere to the gold standard prospective study design, which aims to collect data at frequent and fixed intervals during the follow-up period. A contribution of the study design and its execution to methodology nevertheless lies in the study

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being conducted in a resource poor setting in a developing country, as well as in reporting on how the methodological challenges were overcome.

Overall, the conclusions provide valuable evidence to inform future policy, and intervention in the prevention of falls and clinical practice in the management and prevention of future falls.

6.3 Recommendations

Recommendations are made based on the conclusions drawn, 1) for Public Health intervention to prevent and reduce falls in older persons in South Africa – and indeed in other countries in SSA, and 2) for improved clinical practice in the management of falls. Thereafter, recommendations are made for future research in the subject area.

6.3.1 Public Health intervention

No policy and programmes to prevent falls exist in South Africa – and most likely, neither in other SSA countries. Both policy and programmes in this area are therefore indicated, to promote awareness of falls, and of risk factors for and consequences of falls in older persons, as well as to offer guidance on how risks may be reduced and factors contributing to falls modified. The study outcomes have provided such information and specific recommendations are as follows:

- Policy formulation, and programme design and implementation to prevent falls calls for collaboration between relevant government departments: in particular, the departments of Health and Social Development, and specifically the directorates of Chronic Diseases, Geriatrics and Disability in the Department of Health, and the Older Persons' Programme in the Department of Social Development. Local authorities and community based agencies working with

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older people also have a role to play in policy development and programme design and implementation. Collaborative efforts among role players may be initialised in a series of consultative workshops.

- Local authorities can contribute to the creation of age-friendly built environments. The disability movement in South Africa has already campaigned for the improvement and modification of environments towards ensuring easy and safe access for all. A campaign to prevent falls in older people should partner with existing movements with shared goals. The WHO Global Age Friendly Cities Network advocates "…inclusion of older people in aspects of life in cities including an enabling physical environment (Plouffe & Kalache, 2010)", and advocates working with city planners to make public spaces safe and accessible.

- The study yielded evidence for advocacy by health professionals and civil society to relevant government departments to formulate policy, and to deliver cost-effective programmes to promote older individuals' health and encourage fall prevention. The use of resources to improve existing infrastructure for health promotion and fall prevention programmes will have cost-benefits through a saving of scarce resources currently expended on the management of older clients with poor health, poor functioning and poor quality of life – because of a lack of health promotion and prevention programmes in the first instance. Other collaboration, e.g. the promotion of active ageing and healthy lifestyles by local media, will encourage older people to take charge of their physical and mental health towards avoidance of falling, as well as give them a sense that government and civil society care about their safety and well-being.

- The presence of a high number of chronic medical conditions in older persons who fall calls for education for these persons on lifestyle factors such as a poor diet, a lack of physical activity, the use of tobacco and the abuse of alcohol, as well as on the link between such behaviour and non-communicable diseases

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which impact physical and mental function. Screening for, and interactive management of these conditions by health professionals with older clients should be promoted and encouraged. A reduction in non-communicable diseases, or their improved detection and management will help to improve the physical and mental health of older individuals, and to reduce age related syndromes such as instability and falls. In resource poor communities, falls prevention programmes should ideally be linked to health and social services programmes already offered by non profit organisations (NPOs) to older clients in that community.

- The most prominent consequences of a fall in the study population were injuries, largely soft tissue injuries. Reported fractures included fractures of the hip. Other consequences were fear of falling again; not having fully recovered from the effects of the fall; and having to alter or forego certain activities engaged in before the fall. Consequences such as the foregoing, which impact quality of life, should be addressed in intervention that is instituted to prevent falls.

- For falls prevention programmes to be successful, they should aim to educate and support older people to maintain optimal health in general. The programmes should encourage older persons to engage in physical activity through exercise programmes offered at local venues such as schools, community centres, church halls and service centres. Involvement of older persons in setting up these services will give them a sense of ownership of the programmes and encourage them to participate in them. Training older persons to lead exercise groups in their community could create an invaluable resource to support the limited number of qualified healthcare workers. Participation in these programmes will increase if peers are encouraged to demonstrate that age is not a barrier to healthy and active living. Education on the physical, mental and social benefits of exercise should be offered simultaneously, with an aim to remove cultural, gender, literacy and other barriers to leisure time activities in

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this population. An evaluation process should be built into the implementation of the programmes.

6.3.2 Improved clinical practice on falls

- Education for health professionals in training institutions on ageing in SSA countries is unstructured. Governments and other funders should support the development of infrastructure, and encourage education and training institutions to develop curriculums that include training and education in Gerontology and Geriatrics.

- Training of health professionals in the management of falls in medical practice should include improved knowledge and skills in the prevention and management of falls, including screening for and management of consequences of a fall and risk factors for falls, as well as counselling and referral for appropriate investigation and care following a fall, or for those at risk of a fall. The training should be included in curriculums and offered through continuing medical education. Development and provision of simple screening protocols for guidance in the management of falls, particularly for health practitioners at primary level of healthcare and emergency departments, should be encouraged and supported. Patients treated in emergency and other departments should not only be treated for injuries sustained but also referred for management of risk factors.

- To contribute to the sustainability of community based intervention programmes, the tertiary centre could train trainers and other health care workers (medical practitioners, occupational therapists, physiotherapists, nurses and social workers) to work with older persons in this regard.

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6.3.3 Future research

The study and its outcome have highlighted gaps in knowledge and identified research questions to guide future research. Research needed within specific, related areas and on specific topics, including public health intervention in this area, as well as methodological considerations for future studies, is identified below.

In general, epidemiological studies are indicated in South Africa and across SSA countries, as well as in different ethnic groups within countries to investigate the incidence of falls and risk factors for falls. Adequately powered studies are required to investigate the associated factors, particularly for recurrent fallers, gender and ethnic differences in risk. Prospective studies for risk factors in different ethnic groups and populations will help to determine reasons for differences in prevalence and incidence rates – across the sub-continent and within multi-ethnic societies. Prospective studies in communities with limited access to resources, poor infrastructure and low literacy levels need to be adequately resourced. Community based studies require a sufficient number of adequately trained field workers who reside in close proximity to study participants to reduce travel. Longitudinal studies suggest regular visitation of households by field workers for follow-up and data collection: particularly in communities where subjects may be challenged in keeping weekly diaries and/or in participating in telephone interviews. Studies with such designs will minimise the effects of recall bias, and establish prospectively reliable data on the incidence of falls, risk factors for falls, consequences of falls, health seeking behaviour following a fall, and morbidity and mortality as a result of a fall.

Inquiry is needed into the relevance of physical assessments in studies such as reported here, in determining which individuals are at high risk of a fall. Evidence is needed to demonstrate their efficacy as fall risk assessment tools in different populations and settings. Similarly, the efficiency of the use of assessment protocols in comprehensive management of older persons at risk of falling, or who present at a

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health care facility following a fall needs evaluation. Research is also needed on barriers and enablers to the effectiveness of community based interventions. Finally, studies of the cost-effectiveness and outcomes of intervention programmes suggest a need for controlled studies with evaluative mechanisms.

6.3 Concluding remark

Falls are a common cause of morbidity and mortality in older persons in South Africa. However, falls are not inevitable in ageing, and some risk factors for falls are modifiable or reversible. Apart from the establishment of prevalence rates for falls, this study found that risk factors for falls, are largely intrinsic, and that certain environmental factors, or hazardous obstacles in under resourced environments may be "trigger" factors for falls. Health promotion and falls prevention programmes, when instituted, will benefit all older persons. Variation found in the prevalence of falls across different ethnic groups raises questions for future inquiry.

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Annexure 1

The Albertina and Walter Sisulu Institute of Ageing in Africa
University of Cape Town/Groote Schuur Hospital

Prevalence of and risk factors for falls in older people in an urban community in South Africa

BASELINE SURVEY QUESTIONNAIRE

Name: ____________________________		Record number **(Office use)**		☐☐☐
Sub-area: ______________________________________		Code		☐☐☐
Household address: ____ ____				
Telephone numbers (including area code):	0 ☐☐ / 0 ☐☐	☐☐☐☐☐☐☐ / ☐☐☐☐☐☐☐		
Name of interviewer:	____			
Date of interview:	☐☐ ☐☐ 2 0 0 ☐ D D M M Y Y Y Y			

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Interviewer: *All instructions to the interviewer in the questionnaire are in italics*

Interviewer: *Introduce yourself to the respondent as set out below.*

Good morning/afternoon. My name is ……………………………..……. I am working for the University of Cape Town. We are interviewing persons like yourself who are 65 years and older and live in this area, to learn about you, your health, and whether you have had a fall recently. Before I proceed, I will explain fully what the study is about and then invite you to participate in the study.

Part 1: Personal and household information

Section 1 Socio-demographic information

First, I would like you to give me some information about yourself.

Q1. How old are you at present?

Q2. In what year were you born?

D	D	M	M	1	9		

Interviewer: If there is a discrepancy in the two answers, draw the respondent's attention to the discrepancy and ask him/her:

That does not seem to be right when I add it up. Can you work that out for me?

Q3. Gender

Male	1	Female	2

Q4. What is your marital status at present?

Married	1	Widowed	2	Divorced/Separated	3
Never married	4	Cohabiting	5		

Q5. Race

Black African	1	Coloured	2	Indian	3
White	4	Other. specify ……………................			5

Q6. What language do you speak most commonly?

English	1	Afrikaans	2	Xhosa	3	Other, specify…………..	4

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Q7. What is the highest level of education you achieved?

No schooling and cannot read/write	1	Standards 6/7	5
No schooling but can read/write	2	Standards 8/9	6
Standard 3 or lower	3	Matriculation	7
Standards 4/5	4	Post-matriculation diploma	8
		University degree	9

Q8. What was your occupation for the most part of your working life?

……………………………………………………………………………..

Interviewer: Record the response verbatim. Will be coded at office.

		For office use

Q9. From which of the following sources do you yourself receive income at present?

		Yes	No	Unsure	Refuses	
1	Social old age pension	1	2	88	99	
2	Veteran's pension (war pension)	1	2	88	99	
3	Employer pension	1	2	88	99	
4	Retirement annuity	1	2	88	99	
5	Salary/wages from paid work (full time)	1	2	88	99	If yes Go to Q10
6	Salary/wages from paid work (part time)	1	2	88	99	If yes Go to Q10
7	Earnings from hawking, odd jobs, etc.	1	2	88	99	If yes Go to Q11
8	Children, other family	1	2	88	99	
9	Other, specify………………………	1	2	88	99	
10	No own income	1	2	88	99	

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Q10. If you are currently working in a paid job, what type of work are you doing?

……………………………………………………………………………………………..

For office use

Q11. If you currently do hawking or odd jobs, or engage in another income generating activity, what type of activity are you doing?

……………………………………………………………………………………………..

For office use

Section 2 Household information

Q12a. **Housing/living arrangements**

Who are the persons who live in this household? I only need to know the number of people and their relationship to you.

Person		**Total number**	
1	Respondent	0	1
2	Spouse, partner	0	
3	Son, daughter		
4	Son in-law, daughter in-law		
5	Sister, brother		
6	Other adults (age 18+) – related		
7	Other adults (age 18+) – not related		
8	Children age 14 – 18 years		
9	Children younger than 14 years		

Q12b. Total number of people who live in the dwelling

Q13. How long have you yourself lived in this dwelling? Years Months

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Q14. How long have you lived in this area, Years [|] Months [|]

Interviewer: Enter "00" for years if less than 12 months

Section 3 Housing conditions

Q15. What type of house do you live in?

Interviewer: Specify type of house/dwelling

Brick house	1	Shack	3
Flat	2	Room/shack in backyard	4
Other, describe……………………………………………………………….			5

Q16. What is the main source of water for the dwelling?

Piped (tap) – inside dwelling	1	Public tap	3
Piped (tap) – on site or in yard	2	Other, describe…………………	4

Q17. What type of toilet facility does the dwelling have?

Flush toilet – inside dwelling	1	Bucket toilet – in yard	3
Flush toilet – outside in yard	2	Bucket toilet - communal	4
Other, specify ……………………………………………………………….			5

Q18a. How many rooms are there in the dwelling, excluding the kitchen and bathroom? [|]

Q18b. How many rooms do you use for sleeping? [|]

Q19a. Do you live in a block of flats?

1 Yes	2 No

If no, go to Q20

Q19b. If you do live in a flat, on what floor is your flat? [|]

Q19c. Do you need to use stairs to get to your flat?

1 Yes	2 No

Q20. What type of floor do you have in the dwelling?

		Large carpet	Vinyl/ linoleum	Tiles	Cement	Other, specify
1	Living room	1	2	3	4	5……………………………….
2	Kitchen	1	2	3	4	5……………………………….
3	bedrooms	1	2	3	4	5……………………………….
4	Toilet	1	2	3	4	5……………………………….
5	Bathroom	1	2	3	4	5……………………………….

Q21. Are there mats/rugs on the floor?

1 Yes	2 No

Q22. Which of the following items does this household have, that are in working order?

	Item	Yes	No
1	Telephone or cell-phone	1	2
2	Stove/burner – electric or gas (not paraffin)	1	2
3	Electricity	1	2
4	Television set	1	2
5	Radio or hi fi	1	2
6	Refrigerator/deep freeze	1	2
7	Washing machine	1	2
8	Car	1	2

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Part 2 Falls Assessment

Section 4 History of falls

Q23a. Have you had a fall **in the last year** (by that, I mean did you fall to the ground, or a lower level)?

Yes [1] No [2] Unsure [88] **If no go to Q42a**

Q23b. If yes, about how many times did you fall **in the last year**? [ ][ ]

Q24a. Have you had a fall **in the last three months**?

Yes [1] No [2] Unsure [88]

Q24b. If yes, how many times did you fall **in the last three months**? [ ][ ]

Q25. Thinking of the last fall you had, how long ago did it happen?

Months [ ][ ] Weeks [ ][ ] [ ][ ]

Q26a. Where did you fall?

Outdoors	1	Indoors	2	Can't remember	88

If indoors go to Q26c

Q26b. If outdoors, where did the fall happen?

In the yard, outside the house	1
Away from the house, specify………………………………	2

Go to Q27

Q26c. If indoors,

Kitchen	1	Living room	3	Stairs	5
Bathroom	2	Bedroom	4	Other, specify…………………	6

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Q27. Which of the following factors contributed to your fall?

		Yes	No
1	Changed position e.g. standing from sitting	1	2
2	Tripped/slipped	1	2
3	Blacked out	1	2
4	Weak legs	1	2
5	Was knocked over	1	2
6	Other, specify……………………………………	1	2
88	Not sure/don't know	1	2

Q28. With your last fall, did you have any of these symptoms before the fall?

		Yes	No
1	Light-headedness	1	2
2	Palpitations	1	2
3	Loss of consciousness	1	2
4	Dizziness or vertigo	1	2
5	Other, specify……………………………………	1	2
88	Not sure/don't know	1	2

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Q29. Did somebody see you fall?

Yes [1] No [2] Unsure [88]

Q30. Were you able to get up from the floor or ground on your own immediately?

1	Yes
2	No, someone helped me up immediately
3	No, I was on the floor until someone came to assist me
4	Other specify………………………………………………………………………..
88	Unsure

Q31. At what time of the day did you fall?

Early morning	1	Afternoon	3	Night	5
Morning	2	Evening	4	Unsure/don't know	88

Q32. At the time of the fall, what was the lighting like at the place where you fell?

Well lit	1	Poorly lit	3	Unsure	88
Average/usual	2	Dark	4		

Q33. What were you doing at the time of the fall?

……………………………………………………………………………………………

Q34a. Were you hurt as a result of this fall?

Yes 1 No 2 Unsure 88 **If no go to Q36a**

Q34b. If yes, what injury/ies did you sustain? (Can have multiple answers)

		Yes	No	Can't remember	
1	Bruising	1	2	88	
2	Lacerations/cuts	1	2	88	
3	Head injury	1	2	88	
4	Fracture/broken bone/s	1	2	88	**If yes go to Q35**
5	Other, specify………………………..	1	2	88	

Q35. If you broke a bone/s, where was the fracture? (Can have multiple answers)

		Yes	No	Unsure
1	Arm	1	2	88
2	Wrist	1	2	88
3	Spine	1	2	88
4	Hip	1	2	88
5	ribs	1	2	88
6	Other, specify……………………………………	1	2	88

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Q36a. Did you have medical attention? Yes [1] No [2] Unsure [88] **If no go to Q38**

Q36b. If yes, where did you go for the medical attention?

		Yes	No	Unsure
1	Community health centre/Day hospital	1	2	88
2	General practitioner (GP)	1	2	88
3	Hospital	1	2	88
4	Traditional healer	1	2	88
5	Other, specify………………………………….….	1	2	88

Q37. What did the doctor/nurse/traditional healer tell you about the fall?

………………………………………………………………………………………

……………………………………………………………………………………..

Q38. If no, why did you not seek and/or get medical attention?

……………………………………………………………………………………….

……………………………………………………………………………………….

Q39a. Have you fully recovered from the effects of the last fall?

Yes [1] No [2] Unsure [88]

Q39b. If no, what effects do you still get from the fall?

………………………………………………………………………………………

………………………………………………………………………………………

Q39c. As a result of the fall did you give up or change any of your normal daily activities?

Yes [1] No [2] Unsure [88]

Q40a. Did you have more than one fall in the past year (12 months)?

Yes [1] No [2] Unsure [88] **If no go to Q42a**

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Q40b. You did say that you had more than one fall **in the last 12 months**, tell me about your most severe fall, did you sustain any injury/ies?

Yes [1] No [2] Unsure [88] **If no go to Q42a**

Q40c. If yes, what injury/ies did you sustain? (Can have multiple answers)

		Yes	No	Can't remember	
1	Bruising	1	2	88	
2	Lacerations/cuts	1	2	88	
3	Head injury	1	2	88	
4	Fracture/broken bone/s	1	2	88	**If yes, go to Q41**
5	Other, specify………………………..	1	2	88	

Q41. If you broke a bone/s, where was the fracture? (Can have multiple answers)

		Yes	No	Unsure
1	Arm	1	2	88
2	Wrist	1	2	88
3	Spine	1	2	88
4	Hip (femur)	1	2	88
5	ribs	1	2	88
6	Other, specify…………………………………	1	2	88

Q42a. Are you afraid of falling?

Yes [1] No [2] Unsure [88]

Q42b. Please explain why you say that…………………………………………………

………………………………………………………………………………………..

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Q43. What obstacles are there where you live, indoors and outdoors, that may cause you to fall?

a. Indoors **For office use**

1. ………………………………………………………………… ☐☐

2. ………………………………………………………………… ☐☐

3. ………………………………………………………………… ☐☐

4. ………………………………………………………………… ☐☐

b. Outdoors **For office use**

1. ………………………………………………………………… ☐☐

2. ………………………………………………………………… ☐☐

3. ………………………………………………………………… ☐☐

4. ………………………………………………………………… ☐☐

Q44a. Is there any other reason that may put you at risk of a fall?

Yes ☐ No ☐

Q44b. If yes, what are these reasons?

For office use

1. ………………………………………………………………… ☐☐

2. ………………………………………………………………… ☐☐

3. ………………………………………………………………… ☐☐

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Part 3: Health information

Section 5

5A Health status

Q45. In general, how would you rate your health at present?

Very Good	1	Good	2	Average	3	Poor	4
Very poor	5	Cannot say	88	Refuses	99		

Q46. Compared to a year ago, would you say that your health has improved, has become worse or has stayed the same?

Better now than a year ago	1
About the same	2
Worse than a year ago	3

Mobility

Q47. How easily are you able to get around these days?

1	Get around freely and independently
2	Get around but with difficulty
3	Can get around but only with a cane
4	Can get around but only with a walking frame
5	Cannot get around without the help of another person

University of Cape Town

Q48. The following questions are about activities you might do during a typical day. Does **your health now limit you** in these activities? If so how much?

		Yes limited a lot	Yes limited a little	No, not limited at all	Never do this activity	Unsure/ DKN
1	**Heavy house/yard work**, e.g. scrubbing the floor, sweeping the yard	1	2	3	4	88
2	**Light household work**, e.g. dusting, washing dishes, ironing	1	2	3	4	88
3	Climbing **three flights** of stairs	1	2	3	4	88
4	Climbing **one flight** of stairs	1	2	3	4	88
5	Bending, kneeling or stooping	1	2	3	4	88
6	Walk **long distance**, (more than one mile, one kilometre)	1	2	3	4	88
7	Walking **three blocks**	1	2	3	4	88
8	Walking **one block**	1	2	3	4	88
9	Bathing and dressing yourself	1	2	3	4	88

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Q49. During the **past 4 weeks**, did you have any of the following problems, as a result of poor **physical health/illness**?

		Yes	No	Unsure	Refuses
1	Had to cut down on the **amount of time** you spent on work or other activities	1	2	88	99
2	Had to **do less** than you would like	1	2	88	99
3	Were limited in the **kind** of work or other activities you could do	1	2	88	99
4	It took **longer** to perform the work or other activities	1	2	88	99

Q50. During the **past 4 weeks**, did you have any of the following problems **as a result of emotional problems** (such as feeling depressed or anxious)?

		Yes	No	Unsure	Refuses
1	Had to cut down on the **amount of time** you spent on work or other activities	1	2	88	99
2	Had to **do less** than you would like	1	2	88	99
3	Could not do work or other activities as **well** as usual	1	2	88	99

Q51a. During the **past 4 weeks**, how much **bodily pain** have you had?

None	Mild	Moderate	Severe	Very severe
1	2	3	4	5

Q51b. If you do have pain in which part of the body is the pain?

……………………………………………………………………………………

Q52. The following questions are about how specific problems in the **past 4 weeks** may have prevented you from doing certain things.

		Not at all	Slightly	Moderately	Quite a bit	Extremely
1	**Physical health or emotional problems** preventing you from doing your normal **social activities** with family or friends (e.g. going to church or mosque)	1	2	3	4	5
2	How much did **pain** prevent you from doing your **normal work** (including both work outside the home and housework)	1	2	3	4	5

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Q53. These questions are about how you feel and how things have been with you in the **past 4 weeks**. For each question please **give one answer** that comes closest to the way you have been feeling. How much **of the time** during the **past 4 week**s have you:

		All of the time	Most of the time	A good bit of the time	A little of the time	None of the time	Unsure
1	Felt full of energy	1	2	3	4	5	88
2	Felt anxious or nervous	1	2	3	4	5	88
3	Felt downhearted and depressed	1	2	3	4	5	88
4	Felt calm and peaceful	1	2	3	4	5	88
5	Felt worn out	1	2	3	4	5	88
6	Felt very happy	1	2	3	4	5	88
7	Felt tired	1	2	3	4	5	88

Q54. How true or false are each of the following statements for you?

	Statement	Agree	Disagree	Unsure
1	I seem to get sick a lot easier than other people	1	2	88
2	I am as healthy as anyone I know	1	2	88
3	I expect my health to get worse	1	2	88
4	My health is excellent	1	2	88

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Section B Geriatric Depression Scale (Short form)

Q55 a. I am going to ask you some questions on how you have felt over the past week.

	Choose the best answer for how you have felt over the past week.	Yes	No
1	Are you basically satisfied with life?		
2	Have you dropped many of your activities and interests?		
3	Do you feel that your life is empty?		
4	Do you often get bored?		
5	Are you in good spirits most of the time?		
6	Are you afraid that something bad was going to happen to you?		
7	Do you feel happy most of the time?		
8	Do you often feel helpless?		
9	Do you prefer to stay at home, rather than go out and do new things?		
10	Do you feel you have more problems with your memory than most?		
11	Do you think it is wonderful to be alive now?		
12	Do you feel pretty worthless the way you are now?		
13	Do you feel full of energy?		
14	Do you feel that your situation is hopeless?		
15	Do you think that most people are better off than you are?		

Q55 b. Score | | | **for office use**

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5C Cognitive Impairment Screen

Q56 a. **Short Orientation-Memory-Concentration Test**

Interviewer: Ask the respondent the following questions and mark the appropriate box for each question depending on a correct or incorrect response.

1.	What year is it now?	Correct	0	Incorrect	4
2.	What month is it now?	Correct	0	Incorrect	3

Interviewer: Say to the respondent: "Remember the following address. I will ask you to repeat it at the end of the test." *Use one of the following addresses, depending on which language the respondent uses.*

Xhosa: Pumla /Zibi / E505 / Jabula Street / Khayelitsha

Afrikaans: Jan / Smit / Blommetjies Straat / 42 / Athlone

English: John / Brown / 42 / Market Street / Cape Town

3.	About what time is it now? (within 60 mins)	Correct	0	Incorrect	3

4. Count backwards from 20 to 1

Interviewer: Please mark with an X where an error is made

20, 19, 18, 17, 16, 15, 14, 13, 12, 11, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1

Correct	0	1 error	2	More than 1 error	4

5. Say the months of the year backwards

Interviewer: Please mark with an X where an error is made

Dec, Nov, Oct, Sept Aug, July, Jun, May, Apr, Mar, Feb, Jan

Correct	0	1 error	2	More than 1 error	4

6.	Repeat the address	Correct	0	1 error	2	2 errors	4
		3 errors	6	4 errors	8	All incorrect	10

Q56b. TOTAL SCORE (28 maximum) [ ][ ] **For office use**

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5D Medical / Chronic conditions

Q57. Now I want to ask you about health conditions you may have. Have you ever **been told by a doctor/nurse/traditional healer** or other health professional that you have any of the following?

		Yes, currently receive treatment	**Yes**, do **not** currently receive treatment	No	Don't know
1	High blood pressure (hypertension)	1	2	3	88
2	Stroke	1	2	3	88
3	Parkinson's disease	1	2	3	88
4	Diabetes	1	2	3	88
5	Loss of memory	1	2	3	88
6	Depression	1	2	3	88
7	Arthritis	1	2	3	88
8	Chronic lung disease (Asthma / bronchitis / emphysema)	1	2	3	88
9	Coronary heart disease (angina)	1	2	3	88
10	Peripheral vascular disease (poor circulation to legs)	1	2	3	88
11	Heart failure	1	2	3	88
12	Foot problems, specify ……………..	1	2	3	88
13	Dizziness/vertigo	1	2	3	88
14	Cancer, specify……………………..	1	2	3	88
15	Other, specify ……………………….	1	2	3	88

5E Hearing

Interviewer: The following questions are asked with the respondent using a hearing aid, if that is customary for him/her.

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Q58a. Can you hear when people talk to you?

Yes, my hearing is good	Yes, but not always	No, never	Unsure	Refuses
1	2	3	88	99

Q58b. Can you follow the conversation when you are with several people?

Yes, all the time	1	No	3	Refuses	99
Yes, some of the time	2	Not sure	88		

5F Vision

Interviewer: The following questions are asked with the respondent wearing glasses or contact lenses, if that is customary for him/her.

Q59a. How much difficulty do you have in seeing and recognising an object or a person you know across the road?

None	1	Moderate	3	Extreme/cannot do	5
Mild	2	Severe	4		

Q59b. How much difficulty do you have in seeing and recognising an object at arms lengths for example, reading or sewing?

None	1	Moderate	3	Extreme/cannot do	5
Mild	2	Severe	4		

5G Urinary control

Q60a. Do you ever lose control of your urine?

Yes [1] No [2] Unsure [88] Refuses [99]

Q60b. Do you need to get up at night to pass urine?

Yes [1] No [2] Unsure [88] Refuses [99]

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5H Medication

Q61. What medicines/tablets/eye drops/inhalers/ointments/traditional medicines or muti do you use regularly at present and how long have you been on this medication? Please include pain killers such as Panado and Dutch medicines (Lennons). Please show me the containers or boxes for these medications.

Interviewer: *Check containers of medication being taken, including over-the-counter drugs and traditional medicines.*

Medication	Length of time on this medication		Period unknown	Prescribed	
	Years	**Months**		**Yes**	**No**
			88		
			88		
			88		
			88		
			88		
			88		
			88		
			88		
			88		
			88		
			88		

Q61a. Total number of prescribed drugs | | |

Q61b. Total number of “over-the-counter” medicines | | |

Q61c. Total number of traditional medicines/muti | | |

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Section 6 Social habits

6A. Tobacco use

I would now like to ask you about some of your habits

Q62a. Have you ever smoked tobacco or taken snuff?

Yes, currently 1	Yes, previously 2	No, never 3	Unsure 88	Refuses 99

If no go to Q63

Q62b. If you use tobacco currently, how many of the following products do you smoke or use each day?

		Number per day		
1	Manufactured cigarettes			
2	Hand rolled cigarettes			
3	Pipefuls of tobacco (per day)			
4	Number of times you take snuff per day?			
5	Other, specify………………………………….			

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6B. Alcohol

Q63a. Some people drink alcohol. Have you ever drunk alcohol (beer, wine, traditional beer, spirits)?

Yes, currently 1	Yes, previously 2	No, never 3	Unsure 88	Refuses 99

If yes go to Q63b

Q63b. If you currently drink alcohol, how many drinks did you have on average in one week?

Units			Unsure	88	Refuses	99

A unit = 1 glass wine; 1 (25 ml) measure of spirits; ½ (284 ml) pint beer

Part 4 Anthropometric measurement

Section 7 Blood pressure, height, weight, waist, hip circumference

7A. Blood pressure

I would now like to measure your blood pressure and pulse. I will need to repeat these readings two times.

First reading:

Interviewer: *The participant should remain sitting down for at least 5 minutes before recording blood pressure*

Q64a. Time 1

1. Systolic [| |] mm Hg
2. Diastolic [| |] mm Hg
3. Pulse rate [| |] / minute

Second reading:

Interviewer: *Read blood pressure at 3 minutes of standing*

Q64b. Time 2

1. Systolic [| |] mm Hg
2. Diastolic [| |] mm Hg
3. Pulse rate [| |] / minute

7B. Height

Ask the participant to take shoes off and stand as tall and straight as possible with feet together and arms held loosely at the side and shoulders relaxed as possible

Q65. Height (cm) [| |] . [ ]

7C. Weight

Place the weighing scale on level ground. Ensure the scale is on zero. Weigh without shoes, and remove heavy items of clothing and heavy jewellery.

Q66. Weight (Kg) [| |] . [ ]

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7D. Waist and hip circumference

I am now going to measure your waist and hips

Interviewer: *Take circumference measurements in centimetres. Waist circumference is measured around the narrowest point viewed from the front after exhaling. Hip circumference is measured at the point where the buttocks are maximally extended, when viewed from the side.*

Q67. Measurements:

1. Waist [ ][ ][ ] . [ ] cm
2. Hip [ ][ ][ ] . [ ] cm
3. Ratio waist / hip [ ] **for office use**

Part 5 Performance measures

We will now do some physical measurements and performance tests

Section 8

8A. Grip strength

Upper body strength

First, I am going to test how strong your hands are.

Q68. Have you had any surgery on your **left** arm, hand or wrist **in the last 3 months**, OR arthritis or pain in your **left** hand or wrist?

Yes [1] (Do not test left hand) No [2] Unsure [88]

Q69. Have you had any surgery on your **right** arm, hand or wrist in the **last 3 months** OR arthritis or pain in your **right** hand or wrist?

Yes [1] (Do not test right hand) No [2] Unsure [88]

Q70. Which hand do you use for signing and writing?

Right hand	1	Uses both	3	Refuses	99
Left hand	2	Don't know	88		

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While sitting, bend your elbow to 90 degrees with palm facing in (like shaking hands) and press your elbow against your side. Then grab two pieces of metal together like this.

Interviewer: Please demonstrate.

I will ask you to do this three times in each hand. Let's start with your **left** hand. Please take this in your **left** hand. If you feel pain or discomfort, tell me and we will stop.

When I say "squeeze," squeeze as hard as you can.

Interviewer: When respondent begins, say: squeeze, squeeze, squeeze.

Mea*sure grip strength ALTERNATELY, beginning with the left hand and then the right. Measure three times on each side*

Ready: Squeeze, squeeze, squeeze!

Q71a.1.	First test:	**left** hand	☐☐	Kilograms
2.	Second test:	**left** hand	☐☐	Kilograms
3.	Third test:	**left** hand	☐☐	Kilograms

Q71b. Did the respondent complete the test three times in the left hand?

Yes [1] No [2] Unable [3] Refuses [99]

Q72a. 1.	First test:	**right** hand	☐☐	Kilograms
2.	Second test:	**right** hand	☐☐	Kilograms
3.	Third test:	**right** hand	☐☐	Kilograms

Q72b. Did the respondent complete the test three times in the right hand?

Yes [1] No [2] unable [3] Refused [99]

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8B. Lower limb balance and strength

Interviewer: Say to the respondent: I would now like to test your balance.

A. One legged (flamingo) stands

Interviewer: This test should not be done on participants who use a walking aid or require another person's assistance to stand.

Interviewer, ask the participant to stand near a wall stand and next to him/her

I would like you to stand and stare straight ahead with arms folded across the chest and to choose a leg and raise it off the floor to ankle height. The foot should be flat and parallel to the floor. The test is done with eyes open and eyes shut.

Interviewer please demonstrate

On the word GO, I would like you to raise your foot and try to keep the foot up for as long as you can.

Interviewer: start timing from the word "Go" and continue to time until participant loses balance and drops their foot. Record this time in the box. If participant remains on one leg for longer than 30 seconds, instruct him/her to stop and record 30 seconds on the sheet.

Q73a. 1. Enter time in seconds Eyes open ☐☐ . ☐☐

2. Enter time in seconds Eyes shut ☐☐ . ☐☐

If < 30 seconds, indicate reason:

3.

Tried, but lost balance	1	Not attempted	2	Other, specify…………….	3

Q73b. **For office use** 1 point if ≥ 30 seconds Score: Eyes open ☐

0 points if < 30 seconds Score: Eyes shut ☐

University of Cape Town

B. Timed Get-up-and-Go Test

Interviewer: *Put a chair (chair should be 45 cm in height) on firm ground. Put a tape measure on the floor measuring 3 metres and say to the respondent:*

I would like you to sit in this chair wearing your normal shoes and then to stand up. Walk to the end of the tape measure at your normal walking speed, turn, and walk back to the chair and sit down. I am going to record the time it takes for you to do this whole exercise. On the word "go," stand up and walk.

Interviewer: *Start timing from the word go and end when participant sits back in the chair.*

Q74a. 1. Time to complete test [ ][ ] . [ ][ ] seconds

If > 20 seconds or unable indicate reason:

2.

Finished the test but slow	1	Unable without help	2
Other, specify…………………………………………………			3

Score:

If < 10 seconds 3 points
If 10 – 20 seconds 2 points
If > 20 seconds 1 point
If unable 0 points

Q74b. Score [ ][ ] **for office use**

University of Cape Town

C. The chair stand

Interviewer: *Use a 45 cm height chair. Put it on firm ground against a wall. Ask the participant to stand with arms across the chest. If this is done successfully ask the participant to stand up and sit down five times as quickly as possible. Time from the initial sitting position to the end of the fifth stand.*

Q75a. 1. Time to complete test ☐☐ ☐☐ seconds

2. comment on test performance if time to finish >16.7 secs

Finished the test but slow	1	Unable without help	2
Other, specify……………………………………………………			3

Q75b. Score: ☐ **for office use**

If < 11.1 seconds 4 points
If 11.2 – 13.6 seconds 3 points
If 13.7 – 16.6 seconds 2 points
If > 16.7 seconds 1 point
If unable to do test 0 points

END OF INTERVIEW: Thank you very much for your co-operation

University of Cape Town

Annexure 2

The Albertina and Walter Sisulu Institute of Ageing in Africa
University of Cape Town/Groote Schuur Hospital

Prevalence of and risk factors for falls in older people in an urban community in South Africa

Chair Validation Study Questionnaire

	Record number ☐☐☐

Surname: ______________________________

Name: ______________________________

Address ______________________________

____

Telephone numbers (including area code): | 0 | | | | | | | | | | |

Name of interviewer: ______________________________

Date of interview:

				2	0	0	
D	D	M	M	Y	Y	Y	Y

Interviewer: Introduce yourself to the respondent as set out below.

Good morning/afternoon. My name is …………………………..……. I am working for the University of Cape Town. We are interviewing persons like yourself who are 65 years and older and live in this area, to learn about you, your health, and whether you have had a fall recently. Before I proceed, I will explain fully what the study is about and then invite you to participate in the study.

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Q1 How old are you? | | | |

Q2 In what year were you born?

				1	9		
D	D	M	M	Y	Y	Y	Y

Q3 Gender:

Male	1	Female	2

Q4 What is your marital status at present?

Married	1	Widowed	2	Divorced/Separated	3
Never married	4	Cohabiting	5		

Housing/living arrangements

Q5 Who are the persons who live in your household? I do not need to know the names. I only need to know the number of people and their relationship to you.

	Person	Total number	
1	Respondent	0	1
2	Spouse, partner	0	
3	Son, daughter		
4	Son in-law, daughter in-law		
5	Sister, brother		
6	Other adults (age 18+) – related		
7	Other adults (age 18+) – not related		
8	Children age 14 – 18 years		
9	Children younger than 14 years		
10	Old age home (with support)		
11	Retirement complex (independent living)		

Cape Town

Medical/chronic conditions

Q6 Now I want to ask you about health conditions you may have at present

	Health condition	Yes	No		Health condition	Yes	No
1	Arthritis - hips			8	Hypertension		
2	Arthritis - knees			9	Stroke		
3	Arthritis - shoulders			10	Parkinson's disease		
4	Pain in hips			11	Chronic lung disease		
5	Pain in knees			12	Heart failure		
6	Pain in shoulders			13	Angina		
7	Pain in back			14	Diabetes		
				15	Other……………………		

Q7 How easily are you able to get around these days?

1	Get around freely and independently
2	Get around but with difficulty
3	Can get around but only with a cane
4	Can get around but only with a frame
5	Cannot get around without the help of another person

Q8 Have you had a fall **in the last year** (by that, I mean did you fall to the ground, or a lower level)?

Yes [1] No [2] Unsure [88]

Q8b. If yes, about how many times did you fall **in the last year**? [|]

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Timed Get-up-and-Go Test

Interviewer: *Put both chairs (chair should be 45 cm in height) on firm ground. Put a tape measure on the floor measuring 3 metres in front of each chair and draw a line. A second line should be drawn in front of the chair (chair line) and another line drawn 30 cm in front of the chair line (foot line) and say to the respondent:*

I would like you to sit in this chair wearing your normal shoes. Your toes should be touching the foot line. I will ask you to stand up and walk to the end of the tape measure or 3 meter line at your normal walking speed. You should cross over the line with both feet, turn, and walk back to the chair and sit down. I am going to record the time it takes for you to do this whole exercise. The first try will not be recorded as it is just for practice. The test has to be done on both chairs. On the word “go,” stand up and walk.

Interviewer: *The subject should use their usual walking aid if this is the norm. Start timing from the word go and end when participant sits back in the chair.*

Q9A **Standard chair**

1a. Time to complete test ☐☐ ☐☐ seconds

1b. Time to complete test ☐☐ ☐☐ seconds

2. If > 20 seconds or unable indicate reason:

Finished the test but slow	1	Unable without help	2
Other, specify………………………………………………			3

Score:

If < 10 seconds	3 points
If 10 – 20 seconds	2 points
If > 20 seconds	1 point
If unable	0 points

Score ☐☐ **for office use**

University of Cape Town

Q9B Folding chair

1a. Time to complete test [ ][ ] [ ][ ] seconds

1b. Time to complete test [ ][ ] [ ][ ] seconds

2. If > 20 seconds or unable indicate reason:

Finished the test but slow	1	Unable without help	2
Other, specify…………………………………………………			3

Score [ ][ ] **for office use**

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Q10. Was a walking aid used during the test?

1	None
2	Cane/stick
3	Frame

Q11a. Did the subject have any difficulties in performing the test?

Yes [ ] No [ ]

Q11b. If yes, what was the difficulty?

……………………………………………………………………………………..

……………………………………………………………………………………..

END OF INTERVIEW: **Thank you for your participation**

Annexure 3

The Albertina and Walter Sisulu Institute of Ageing in Africa
University of Cape Town/Groote Schuur Hospital

Prevalence of and risk factors for falls in older people in an urban community in South Africa

FOLLOW-UP SURVEY QUESTIONNAIRE

Name: ____________________________		Record number **(Office use)**	☐☐☐
Sub-area: ____________________________________		Code	☐☐☐
Household address: ____ ____			
Telephone numbers (including area code):	0☐☐ / 0☐☐	☐☐☐☐☐☐☐ / ☐☐☐☐☐☐☐	
Name of interviewer:	____		
Date of interview:	☐☐☐☐ 2 0 1 ☐ D D M M Y Y Y Y		

Interviewer: *All instructions to the interviewer in the questionnaire are in italics*

Interviewer: *Introduce yourself to the respondent as set out below.*

Good morning/afternoon. My name is ………………………………..……. I am working for the University of Cape Town. You were previously interviewed regarding falls. I am doing a follow up visit, to learn about you, your health, and whether you have had a fall since the last time you were interviewed. Before I proceed, I will again explain fully what the study is about and then invite you to participate in the follow up study.

University of Cape Town

Part 1: Personal and household information

Section 1 Socio-demographic information

First, I would like you to give me some information about yourself.

Q1. How old are you at present?

Q2. In what year were you born?

D	D	M	M	1	9		

Interviewer: If there is a discrepancy in the two answers, draw the respondent's attention to the discrepancy and ask him/her:

That does not seem to be right when I add it up. Can you work that out for me?

Q3. Gender

Male	1	Female	2

Q4. What is your marital status at present?

Married	1	Widowed	2	Divorced/Separated	3
Never married	4	Cohabiting	5		

Q5. Race

Black African	1	Coloured	2	Indian	3
White	4	Other. specify …………..................			5

Q6. What language do you speak most commonly?

English	1	Afrikaans	2	Xhosa	3	Other, specify…………..	4

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Q7. What is the highest level of education you achieved?

No schooling and cannot read/write	1	Standards 6/7	5
No schooling but can read/write	2	Standards 8/9	6
Standard 3 or lower	3	Matriculation	7
Standards 4/5	4	Post-matriculation diploma	8
		University degree	9

Q8. What was your occupation for the most part of your working life?

………………………………………………………………………………..
Interviewer: Record the response verbatim. Will be coded at office.

For office use

Q9. From which of the following sources do you yourself receive income at present?

		Yes	No	Unsure	Refuses	
1	Social old age pension	1	2	88	99	
2	Veteran's pension (war pension)	1	2	88	99	
3	Employer pension	1	2	88	99	
4	Retirement annuity	1	2	88	99	
5	Salary/wages from paid work (full time)	1	2	88	99	If yes Go to Q10
6	Salary/wages from paid work (part time)	1	2	88	99	If yes Go to Q10
7	Earnings from hawking, odd jobs, etc.	1	2	88	99	If yes Go to Q11
8	Children, other family	1	2	88	99	
9	Other, specify……………………..	1	2	88	99	
10	No own income	1	2	88	99	

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Q10. If you are currently working in a paid job, what type of work are you doing?

……………………………………………………………………………………………..

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Q11. If you currently do hawking or odd jobs, or engage in another income generating activity, what type of activity are you doing?

……………………………………………………………………………………………..

For office use

Section 2 Household information

Q12a. **Housing/living arrangements**

Who are the persons who live in this household? I only need to know the number of people and their relationship to you.

Person		**Total number**	
1	Respondent	0	1
2	Spouse, partner	0	
3	Son, daughter		
4	Son in-law, daughter in-law		
5	Sister, brother		
6	Other adults (age 18+) – related		
7	Other adults (age 18+) – not related		
8	Children age 14 – 18 years		
9	Children younger than 14 years		

Q12b. Total number of people who live in the dwelling

Q13. How long have you yourself lived in this dwelling? Years Months

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Q14. How long have you lived in this area, Years [|] Months [|]

Interviewer: Enter "00" for years if less than 12 months

Section 3 Housing conditions

Q15. What type of house do you live in?

Interviewer: Specify type of house/dwelling

Brick house	1	Shack	3
Flat	2	Room/shack in backyard	4
Other, describe…………………………………………………………….….			5

Q16. What is the main source of water for the dwelling?

Piped (tap) – inside dwelling	1	Public tap	3
Piped (tap) – on site or in yard	2	Other, describe…………………	4

Q17. What type of toilet facility does the dwelling have?

Flush toilet – inside dwelling	1	Bucket toilet – in yard	3
Flush toilet – outside in yard	2	Bucket toilet - communal	4
Other, specify ………………………………………………………………..….			5

Q18a. How many rooms are there in the dwelling, excluding the kitchen and bathroom? [|]

Q18b. How many rooms do you use for sleeping? [|]

Q19a. Do you live in a block of flats?

1 Yes	2 No

If no, go to Q20

Q19b. If you do live in a flat, on what floor is your flat? [|]

Q19c. Do you need to use stairs to get to your flat?

1 Yes	2 No

Q20. What type of floor do you have in the dwelling?

		Large carpet	Vinyl/ linoleum	Tiles	Cement	Other, specify
1	Living room	1	2	3	4	5…………………………
2	Kitchen	1	2	3	4	5…………………………
3	bedrooms	1	2	3	4	5…………………………
4	Toilet	1	2	3	4	5…………………………
5	Bathroom	1	2	3	4	5…………………………

Q21. Are there mats/rugs on the floor?

1 Yes	2 No

Q22. Which of the following items does this household have, that are in working order?

	Item	Yes	No
1	Telephone or cell-phone	1	2
2	Stove/burner – electric or gas (not paraffin)	1	2
3	Electricity	1	2
4	Television set	1	2
5	Radio or hi fi	1	2
6	Refrigerator/deep freeze	1	2
7	Washing machine	1	2
8	Car	1	2

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Part 2 Falls assessment

Section 4 History of falls

Q23a. Have you had a fall **since the last time I visited you** (by that, I mean did you fall to the ground, or a lower level)?

Yes [1] No [2] Unsure [88] **If no go to Q42a**

Q23b. If yes, about how many times did you fall **since last visited**? [|]

Q24a. Have you had a fall **in the last three months**?

Yes [1] No [2] Unsure [88]

Q24b. If yes, how many times did you fall **in the last three months**? [|]

Q25. Thinking of the last fall you had, how long ago did it happen?

Months [|] Weeks [|] Days [|]

Q26a. Where did you fall?

Outdoors	1	Indoors	2	Can't remember	88

If indoors go to Q26c

Q26b. If outdoors, where did the fall happen?

In the yard, outside the house	1
Away from the house, specify……………………………….	2

Go to Q27

Q26c. If indoors,

Kitchen	1	Living room	3	Stairs	5
Bathroom	2	Bedroom	4	Other, specify…………………	6

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Q27. Which of the following factors contributed to your fall?

		Yes	No
1	Changed position e.g. standing from sitting	1	2
2	Tripped/slipped	1	2
3	Blacked out	1	2
4	Weak legs	1	2
5	Was knocked over	1	2
6	Other, specify……………………………………	1	2
88	Not sure/don't know	1	2

Q28. With your last fall, did you have any of these symptoms before the fall?

		Yes	No
1	Light-headedness	1	2
2	Palpitations	1	2
3	Loss of consciousness	1	2
4	Dizziness or vertigo	1	2
5	Other, specify……………………………………	1	2
88	Not sure/don't know	1	2

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Q29. Did somebody see you fall?

Yes	1	No	2	Unsure	88

Q30. Were you able to get up from the floor or ground on your own immediately?

1	Yes
2	No, someone helped me up immediately
3	No, I was on the floor until someone came to assist me
4	Other specify………………………………………………………………………..
88	Unsure

Q31. At what time of the day did you fall?

Early morning	1	Afternoon	3	Night	5
Morning	2	Evening	4	Unsure/don't know	88

Q32. At the time of the fall, what was the lighting like at the place where you fell?

Well lit	1	Poorly lit	3	Unsure	88
Average/usual	2	Dark	4		

Q33. What were you doing at the time of the fall?

…………………………………………………………………………………………

Q34a. Were you hurt as a result of this fall?

Yes 1 No 2 Unsure 88 **If no go to Q36a**

Q34b. If yes, what injury/ies did you sustain? (Can have multiple answers)

		Yes	No	Can't remember
1	Bruising	1	2	88
2	Lacerations/cuts	1	2	88
3	Head injury	1	2	88
4	Fracture/broken bone/s	1	2	88
5	Other, specify………………………..	1	2	88

If yes go to Q35

Q35. If you broke a bone/s, where was the fracture? (Can have multiple answers)

		Yes	No	Unsure
1	Arm	1	2	88
2	Wrist	1	2	88
3	Spine	1	2	88
4	Hip	1	2	88
5	ribs	1	2	88
6	Other,specify……………………………………	1	2	88

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Q36a. Did you have medical attention? Yes [1] No [2] Unsure [88] **If no go to Q38**

Q36b. If yes, where did you go for the medical attention?

		Yes	No	Unsure
1	Community health centre/Day hospital	1	2	88
2	General practitioner (GP)	1	2	88
3	Hospital	1	2	88
4	Traditional healer	1	2	88
5	Other, specify…………………………………..…	1	2	88

Q37. What did the doctor/nurse/traditional healer tell you about the fall?

……………………………………………………………………………………

…………………………………………………………………………………..

Q38. If no, why did you not seek and/or get medical attention?

……………………………………………………………………………………

……………………………………………………………………………………

Q39a. Have you fully recovered from the effects of the last fall?

Yes [1] No [2] Unsure [88]

Q39b. If no, what effects do you still get from the fall?

……………………………………………………………………………………

……………………………………………………………………………………

Q39c. As a result of the fall did you give up or change any of your normal daily activities?

Yes [1] No [2] Unsure [88]

Q40a. Did you have more than one fall since **my last visit**?

Yes [1] No [2] Unsure [88] **If no go to Q42a**

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Q40b. You did say that you had more than one fall **since my last visit,** tell me about your most severe fall, did you sustain any injury/ies?

Yes [1] No [2] Unsure [88] **If no go to Q42a**

Q40c. If yes, what injury/ies did you sustain? (Can have multiple answers)

		Yes	No	Can't remember	
1	Bruising	1	2	88	
2	Lacerations/cuts	1	2	88	
3	Head injury	1	2	88	
4	Fracture/broken bone/s	1	2	88	**If yes, go to Q41**
5	Other, specify………………………..	1	2	88	

Q41. If you broke a bone/s, where was the fracture? (Can have multiple answers)

		Yes	No	Unsure
1	Arm	1	2	88
2	Wrist	1	2	88
3	Spine	1	2	88
4	Hip (femur)	1	2	88
5	ribs	1	2	88
6	Other, specify……………………………….	1	2	88

Q42a. Are you afraid of falling?

Yes [1] No [2] Unsure [88]

Q42b. Please explain why you say that…………………………………………………

………………………………………………………………………………………..

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Part 3: Health information

Section 5

5A Health status

Q43. In general, how would you rate your health at present?

Very Good	1	Good	2	Average	3	Poor	4
Very poor	5	Cannot say	88	Refuses	99		

Q44. Compared to a year ago, would you say that your health has improved, has become worse or has stayed the same?

Better now than a year ago	1
About the same	2
Worse than a year ago	3

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Mobility

Q45. How easily are you able to get around these days?

1	Get around freely and independently
2	Get around but with difficulty
3	Can get around but only with a cane
4	Can get around but only with a walking frame
5	Cannot get around without the help of another person

Q46. The following questions are about activities you might do during a typical day. Does **your health now limit you** in these activities? If so how much?

		Yes limited a lot	Yes limited a little	No, not limited at all	Never do this activity	Unsure/ DKN
1	**Heavy house/yard work**, e.g. scrubbing the floor, sweeping the yard	1	2	3	4	88
2	**Light household work**, e.g. dusting, washing dishes, ironing	1	2	3	4	88
3	Climbing **three flights** of stairs	1	2	3	4	88
4	Climbing **one fligh**t of stairs	1	2	3	4	88
5	Bending, kneeling or stooping	1	2	3	4	88
6	Walk **long distance**, (more than one mile, one kilometre)	1	2	3	4	88
7	Walking **three blocks**	1	2	3	4	88
8	Walking **one block**	1	2	3	4	88
9	Bathing and dressing yourself	1	2	3	4	88

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Q47. During the **past 4 weeks**, did you have any of the following problems, as a result of poor **physical health/illness**?

		Yes	No	Unsure	Refuses
1	Had to cut down on the **amount of time** you spent on work or other activities	1	2	88	99
2	Had to **do less** than you would like	1	2	88	99
3	Were limited in the **kind** of work or other activities you could do	1	2	88	99
4	It took **longer** to perform the work or other activities	1	2	88	99

Q48. During the **past 4 weeks**, did you have any of the following problems **as a result of emotional problems** (such as feeling depressed or anxious)?

		Yes	No	Unsure	Refuses
1	Had to cut down on the **amount of time** you spent on work or other activities	1	2	88	99
2	Had to **do less** than you would like	1	2	88	99
3	Could not do work or other activities as **well** as usual	1	2	88	99

Q49a. During the **past 4 weeks**, how much **bodily pain** have you had?

None 1	Mild 2	Moderate 3	Severe 4	Very severe 5

Q49b. If you do have pain in which part of the body is the pain?

……………………………………………………………………………………

Q50. The following questions are about how specific problems in the **past 4 weeks** may have prevented you from doing certain things.

		Not at all	Slightly	Moderately	Quite a bit	Extremely
1	**Physical health or emotional problems** preventing you from doing your normal **social activities** with family or friends (e.g. going to church or mosque)	1	2	3	4	5
2	How much did **pain** prevent you from doing your **normal work** (including both work outside the home and housework)	1	2	3	4	5

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Q51. These questions are about how you feel and how things have been with you in the **past 4 weeks**. For each question please **give one answer** that comes closest to the way you have been feeling. How much **of the time** during the **past 4 weeks** have you:

		All of the time	Most of the time	A good bit of the time	A little of the time	None of the time	Unsure
1	Felt full of energy	1	2	3	4	5	88
2	Felt anxious or nervous	1	2	3	4	5	88
3	Felt downhearted and depressed	1	2	3	4	5	88
4	Felt calm and peaceful	1	2	3	4	5	88
5	Felt worn out	1	2	3	4	5	88
6	Felt very happy	1	2	3	4	5	88
7	Felt tired	1	2	3	4	5	88

Q52. How true or false are each of the following statements for you?

	Statement	Agree	Disagree	Unsure
1	I seem to get sick a lot easier than other people	1	2	88
2	I am as healthy as anyone I know	1	2	88
3	I expect my health to get worse	1	2	88
4	My health is excellent	1	2	88

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5B Physical Function

Q53a. How able you are to do the following activities?

	Function	Independent	With support/ supervision	Needs a person to do the task
1	Feed yourself	1	2	3
2	Getting dressed	1	2	3
3	Using the toilet	1	2	3
4	Bathing	1	2	3
5	Getting out of bed	1	2	3

Q53b. Score [ ] **for office use**

Q54a. How able are you to do the following activities?

	Function	Independent	With support/ supervision	Needs a person to do the task	Never does the activity
1	Shopping	1	2	3	4
2	Preparing meals	1	2	3	4
3	Housekeeping e.g. cleaning the house and tidying up	1	2	3	4
4	Doing the laundry	1	2	3	4
5	Using public transport	1	2	3	4
6	Taking medication	1	2	3	4
7	Collecting your pension money?	1	2	3	4
8	Managing your pension money that is paying bills and budgeting, keeping track of the money.	1	2	3	4
9	Using the telephone	1	2	3	4

Q54b. Score [ ] **for office use**

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Section B Geriatric Depression Scale (Short form)

Q55a. I am going to ask you some questions on how you have felt over the past week.

Choose the best answer for how you have felt over the past week.		Yes	No
1	Are you basically satisfied with life?		
2	Have you dropped many of your activities and interests?		
3	Do you feel that your life is empty?		
4	Do you often get bored?		
5	Are you in good spirits most of the time?		
6	Are you afraid that something bad was going to happen to you?		
7	Do you feel happy most of the time?		
8	Do you often feel helpless?		
9	Do you prefer to stay at home, rather than go out and do new things?		
10	Do you feel you have more problems with your memory than most?		
11	Do you think it is wonderful to be alive now?		
12	Do you feel pretty worthless the way you are now?		
13	Do you feel full of energy?		
14	Do you feel that your situation is hopeless?		
15	Do you think that most people are better off than you are?		

Q55b. Score | | | **for office use**

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5C Cognitive Impairment Screen

Q56a. **Short Orientation-Memory-Concentration Test**

Interviewer: Ask the respondent the following questions and mark the appropriate box for each question depending on a correct or incorrect response.

1.	What year is it now?	Correct	0	Incorrect	4
2.	What month is it now?	Correct	0	Incorrect	3

Interviewer: Say to the respondent: "Remember the following address. I will ask you to repeat it at the end of the test." *Use one of the following addresses, depending on which language the respondent uses.*

Xhosa: Pumla /Zibi / E505 / Jabula Street / Khayelitsha

Afrikaans: Jan / Smit / Blommetjies Straat / 42 / Athlone

English: John / Brown / 42 / Market Street / Cape Town

3.	About what time is it now? (within 60 mins)	Correct	0	Incorrect	3

4. Count backwards from 20 to 1

Interviewer: Please mark with an X where an error is made

20, 19, 18, 17, 16, 15, 14, 13, 12, 11, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1

Correct	0	1 error	2	More than 1 error	4

5. Say the months of the year backwards

Interviewer: Please mark with an X where an error is made

Dec, Nov, Oct, Sept Aug, July, Jun, May, Apr, Mar, Feb, Jan

Correct	0	1 error	2	More than 1 error	4

6.	Repeat the address	Correct	0	1 error	2	2 errors	4
		3 errors	6	4 errors	8	All incorrect	10

Q56b. TOTAL SCORE (28 maximum) [ ][ ] **For office use**

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5D Medical / Chronic conditions

Q57. Now I want to ask you about health conditions you may have. Have you ever **been told by a doctor/nurse/traditional healer** or other health professional that you have any of the following?

		Yes, currently receive treatment	**Yes**, do **not** currently receive treatment	No	Don't know
1	High blood pressure (hypertension)	1	2	3	88
2	Stroke	1	2	3	88
3	Parkinson's disease	1	2	3	88
4	Diabetes	1	2	3	88
5	Loss of memory	1	2	3	88
6	Depression	1	2	3	88
7	Arthritis	1	2	3	88
8	Chronic lung disease (Asthma / bronchitis / emphysema)	1	2	3	88
9	Coronary heart disease (angina)	1	2	3	88
10	Peripheral vascular disease (poor circulation to legs)	1	2	3	88
11	Heart failure	1	2	3	88
12	Foot problems, specify ……………..	1	2	3	88
13	Dizziness/vertigo	1	2	3	88
14	Cancer, specify……………………..	1	2	3	88
15	Other, specify ……………………….	1	2	3	88

5E Hearing

Interviewer: The following questions are asked with the respondent using a hearing aid, if that is customary for him/her.

Q58a. Can you hear when people talk to you?

Yes, my hearing is good	Yes, but not always	No, never	Unsure	Refuses
1	2	3	88	99

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Q58b. Can you follow the conversation when you are with several people?

Yes, all the time	1	No	3	Refuses	99
Yes, some of the time	2	Not sure	88		

5F Vision

Interviewer: The following questions are asked with the respondent wearing glasses or contact lenses, if that is customary for him/her.

Q59a. How much difficulty do you have in seeing and recognising an object or a person you know across the road?

None	1	Moderate	3	Extreme/cannot do	5
Mild	2	Severe	4		

Q59b. How much difficulty do you have in seeing and recognising an object at arms lengths for example, reading or sewing?

None	1	Moderate	3	Extreme/cannot do	5
Mild	2	Severe	4		

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5G Urinary control

Q60a. Do you ever lose control of your urine?

Yes [1] No [2] Unsure [88] Refuses [99]

Q60b. Do you need to get up at night to pass urine?

Yes [1] No [2] Unsure [88] Refuses [99]

5H Medication

Q61. What medicines/tablets/eye drops/inhalers/ointments/traditional medicines or muti do you use regularly at present and how long have you been on this medication? Please include pain killers such as Panado and Dutch medicines (Lennons). Please show me the containers or boxes for these medications.

Interviewer: Check containers of medication being taken, including over-the-counter drugs and traditional medicines.

Medication	Length of time on this medication		Period unknown	Prescribed	
	Years	**Months**		**Yes**	**No**
			88		
			88		
			88		
			88		
			88		
			88		
			88		
			88		
			88		
			88		
			88		

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Q61a. Total number of prescribed drugs ☐☐

Q61b. Total number of "over-the-counter" medicines ☐☐

Q61c. Total number of traditional medicines/muti ☐☐

Section 6 Social habits

6A. Tobacco use

I would now like to ask you about some of your habits

Q62a. Have you ever smoked tobacco or taken snuff?

Yes, currently 1	Yes, previously 2	No, never 3	Unsure 88	Refuses 99

If no go to Q63

Q62b. If you use tobacco currently, how many of the following products do you smoke or use each day?

		Number per day		
1	Manufactured cigarettes			
2	Hand rolled cigarettes			
3	Pipefuls of tobacco (per day)			
4	Number of times you take snuff per day?			
5	Other, specify……………………………………			

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6B. Alcohol

Q63a. Some people drink alcohol. Have you ever drunk alcohol (beer, wine, traditional beer, spirits)?

Yes, currently 1	Yes, previously 2	No, never 3	Unsure 88	Refuses 99

If yes go to Q63b

Q63b. If you currently drink alcohol, how many drinks did you have on average in one week?

Units [ ][ ] Unsure [88] Refuses [99]

A unit = 1 glass wine; 1 (25 ml) measure of spirits; ½ (284 ml) pint beer

Part 4 Anthropometric measurement

Section 7 Blood pressure, height, weight, waist, hip circumference

7A. Blood pressure

I would now like to measure your blood pressure and pulse. I will need to repeat these readings two times.

First reading:

Interviewer: *The participant should remain sitting down for at least 5 minutes before recording blood pressure*

Q64a. Time 1
1. Systolic [ ][ ][ ] mm Hg
2. Diastolic [ ][ ][ ] mm Hg
3. Pulse rate [ ][ ][ ] / minute

Second reading:

Interviewer: *Read blood pressure at 3 minutes of standing*

Q64b. Time 2
1. Systolic [ ][ ][ ] mm Hg
2. Diastolic [ ][ ][ ] mm Hg
3. Pulse rate [ ][ ][ ] / minute

7B. Height

Ask the participant to take shoes off and stand as tall and straight as possible with feet together and arms held loosely at the side and shoulders relaxed as possible

Q65. Height (cm) [ ][ ][ ] . [ ]

7C. Weight

Place the weighing scale on level ground. Ensure the scale is on zero. Weigh without shoes, and remove heavy items of clothing and heavy jewellery.

Q66. Weight (Kg) [ ][ ][ ] . [ ]

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7D. Waist and hip circumference

I am now going to measure your waist and hips

Interviewer: *Take circumference measurements in centimetres. Waist circumference is measured around the narrowest point viewed from the front after exhaling. Hip circumference is measured at the point where the buttocks are maximally extended, when viewed from the side.*

Q67. Measurements:

1. Waist [ ][ ][ ] . [ ] cm
2. Hip [ ][ ][ ] . [ ] cm
3. Ratio waist / hip [ ] **for office use**

Part 5 Performance measures

We will now do some physical measurements and performance tests

Section 8

8A. Grip strength

Upper body strength

First, I am going to test how strong your hands are.

Q68. Have you had any surgery on your **left** arm, hand or wrist **in the last 3 months**, OR arthritis or pain in your **left** hand or wrist?

Yes [1] (Do not test left hand) No [2] Unsure [88]

Q69. Have you had any surgery on your **right** arm, hand or wrist in the **last 3 months** OR arthritis or pain in your **right** hand or wrist?

Yes [1] (Do not test right hand) No [2] Unsure [88]

Q70. Which hand do you use for signing and writing?

Right hand	1	Uses both	3	Refuses	99
Left hand	2	Don’t know	88		

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While sitting, bend your elbow to 90 degrees with palm facing in (like shaking hands) and press your elbow against your side. Then grab two pieces of metal together like this.

Interviewer: Please demonstrate.

I will ask you to do this three times in each hand. Let's start with your **left** hand. Please take this in your **left** hand. If you feel pain or discomfort, tell me and we will stop.

When I say "squeeze," squeeze as hard as you can.

Interviewer: When respondent begins, say: squeeze, squeeze, squeeze.

Mea*sure grip strength ALTERNATELY, beginning with the left hand and then the right. Measure three times on each side*

Ready: Squeeze, squeeze, squeeze!

Q71a.1.	First test:	**left** hand	☐☐	Kilograms
2.	Second test:	**left** hand	☐☐	Kilograms
3.	Third test:	**left** hand	☐☐	Kilograms

Q71b. Did the respondent complete the test three times in the left hand?

Yes [1] No [2] Unable [3] Refuses [99]

Q72a. 1.	First test:	**right** hand	☐☐	Kilograms
2.	Second test:	**right** hand	☐☐	Kilograms
3.	Third test:	**right** hand	☐☐	Kilograms

Q72b. Did the respondent complete the test three times in the right hand?

Yes [1] No [2] unable [3] Refused [99]

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8B. Lower limb balance and strength

No practice is allowed for these tests and they should be carried out in bare feet. The person can be helped by the interviewer each time to assume the position and the person should then indicate when she is ready to begin the test unaided.
If the person cannot assume the position, the test is failed at that stage.

Timing is stopped if (i) the person moves their feet from the proper position, (ii) the interviewer provides contact to prevent a fall or (iii) the person touches the wall with a hand.

Interviewer, ask the participant to stand near a wall stand and next to him/her
Say to the respondent: I would now like to test your balance.

A. Feet together stand

Interviewer: Please demonstrate. Start timing when respondent is ready
Ask participant to put feet together and allow standing for at least 10 seconds.

Q73a. 1. Enter time in seconds | | |

If < 10 seconds, indicate reason:

2.

Tried, but not able	1	Not attempted	2	Other, specify………	3

Q73b. **For office use.** Score1 point if ≥ 10 seconds; 0 points if < 10 seconds

B. Near-tandem stand

Interviewer say to respondent: Position your feet so that your big toe is close to the heel of the other foot. The big toes and the heel should be 2.5 cm (1 inch) apart. When you feel stable, close your eyes and stay like this for at least 30 seconds.

Interviewer: Please demonstrate. Start timing when respondent closes his/her eyes.

Q74a. 1. Enter time in seconds | | |

If < 30 seconds, indicate reason:

2.

Tried, but not able	1	Not attempted	2	Other, specify………	3

Q74b. **For office use.** Score1 point if ≥ 30 seconds; 0 points if < 30 seconds.

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C. Timed Get-up-and-Go Test

Interviewer: *Put a chair (chair should be 45 cm in height) on firm ground. Put a tape measure on the floor measuring 3 metres and say to the respondent:*

I would like you to sit in this chair wearing your normal shoes and then to stand up. Walk to the end of the tape measure at your normal walking speed, turn, and walk back to the chair and sit down. I am going to record the time it takes for you to do this whole exercise. On the word "go," stand up and walk.

Interviewer: *Start timing from the word go and end when participant sits back in the chair.*

Q75a. 1. Time to complete test ☐☐ ☐☐ seconds

If > 20 seconds or unable indicate reason:

2.

Finished the test but slow	1	Unable without help	2
Other, specify…………………………………………………			3

Score:

If < 10 seconds 3 points
If 10 – 20 seconds 2 points
If > 20 seconds 1 point
If unable 0 points

Q75b. Score ☐☐ **for office use**

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C. The chair stand

Interviewer: *Use a 45 cm height chair. Put it on firm ground against a wall. Ask the participant to stand with arms across the chest. If this is done successfully ask the participant to stand up and sit down five times as quickly as possible. Time from the initial sitting position to the end of the fifth stand.*

Q76a. 1. Time to complete test [ ][ ] [ ][ ] seconds

2. comment on test performance if time to finish >16.7 secs

Finished the test but slow	1	Unable without help	2
Other, specify…………………………………………………			3

Q76b. Score: [ ] **for office use**

If < 11.1 seconds 4 points
If 11.2 – 13.6 seconds 3 points
If 13.7 – 16.6 seconds 2 points
If > 16.7 seconds 1 point
If unable to do test 0 points

END OF INTERVIEW: Thank you very much for your co-operation

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Annexure 4

Prevalence and risk factors for falls in older people in an urban community in South Africa

INFORMED CONSENT FORM

Dear Participant

You are invited to participate in a study being conducted among persons like yourself, who are 65 years or older and living in this community. We are collecting information on general health status and finding out about older persons who may have had a fall in the past year and factors that may have caused the person to fall. To participate, we require you to complete a consent form, which indicates that you understand the aims of the project and what the nature and limits of your participation will be. If there is any information in the form below that you do not understand, please ask me to explain it to you.

It is important for you to know that:

- Your participation in this study is entirely voluntary.
- You will not benefit directly from the study, but you will be helping others through the information that you provide.
- Any information you provide will be kept confidential. Your name will not be linked to any information nor used in any report.
- You may decline to participate, or you may terminate your participation at any time, without stating any reason. Your withdrawal will not affect your access to health care services.
- Before agreeing to participate, it is important that you understand what the study is about and what will be required of you.

Purpose of the study

Falls in older people are not always accidental. A number of risk factors cause older people to fall. Some sustain injuries and/or loose their independence. Some of these risks factors can be reduced or reversed, thus reducing a risk of falls. We would like to find out which of these risk factors are common among older people in this community and investigate how they may cause older people to fall.

Description of the study

It is anticipated that 528 people age 65 and older will participate in the study. If you agree to participate, you will be asked questions about your health and factors that may put you at risk of falling.

You will also undergo tests to measure the strength of your leg and arm muscles, your blood pressure and eye sight. Your waist and hip measurements will also be taken.

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What will your responsibilities be?

You will spend about an hour and a half to two hours with the interviewer in your home, who will ask you questions, which you must try to answer to the best of your ability. You will be allowed short breaks, if this becomes necessary.

Will you benefit from taking part in the study?

Should any illness be identified, you will be referred to an appropriate department for investigation and management of the condition.

Are there any risks or inconvenience involved in taking part in the study?

There should be no risks involved in your participation. The interviewer will be close to you at all times as you perform the tests. However, you may be inconvenienced in that the interview and the test will take up some of your time.

Who will have access to your information?

The information collected will be treated as confidential and kept safely. You will not be identified in any way or in any report on the study. Thus you will remain anonymous. Only the fieldworker carrying out the research, the researcher, her supervisors and a statistician will see the information.

Will you be paid to take part in the study?

No, you will not be paid for taking part in the study and neither will you incur costs in doing so. Only if you are for some reason referred for further management may additional costs be involved. The researcher will have no control over the management of any condition once you have been referred.

This study has been approved by the Human Ethics Research Committee at the University of Cape Town and will be conducted according to international ethical guidelines and principles, South African Guidelines for Good Clinical Practice and the Medical Research Council (MRC) Ethical Guidelines.

Is there anything else that you should know or do?

- If you have any questions or if you encounter any problems, you should contact Dr Kalula at telephone number 021 406 6517 or 083 516 0961.
- You may contact the Human Ethics Research Committee at telephone number 021 406 6338 if you have any concerns or complaints that have not been adequately addressed by the researcher.
- You will receive a copy of this information sheet and your signed consent form for you to keep.

Principal Investigator: Dr Sebastiana Kalula
Institute of Ageing in Africa, L51 Old Main Building,
Groote Schuur Hospital, Observatory 7925

University of Cape Town

Declaration by the study participant

By signing below, I (name and surname) ……………………………………………. agree to take part in a study entitled "Prevalence and risk factors for falls in older people in an urban community in South Africa."

I declare that:

☐ I have read, or had read to me this information sheet and the consent form, and it is written in a language in which I am fluent and comfortable.

☐ I have had a chance to ask questions and all my questions have been answered adequately.

☐ I understand that taking part in the study is voluntary and I have not been pressured to do so.

☐ I may choose to leave the study at any time and will not be penalised or prejudiced in any way.

Signed at (place) ………………………………on (date)…………………..……..2008

……………………………………………

Signature of participant

Where participant chose to have a guardian present:

………………………………………………….

Name and surname of guardian/next of kin

…………………………………..

Signature of guardian/next of kin

For the participation of (name and surname) ……………………………………………

Relationship ……………………………………..

Declaration by the interviewer

I (name) …………………………………………… declare that:

- I explained the information sheet and consent form to the participant.
- I encouraged the participant to ask questions and took adequate time to answer them.
- I am satisfied that the participant (and/or the guardian or next of kin, as indicated) understands all aspects and requirements of the study adequately.

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ANNEXURE 5

UNIVERSITY OF CAPE TOWN

Health Sciences Faculty
Research Ethics Committee
Room E52-24 Groote Schuur Hospital Old Main Building
Observatory 7925
Telephone [021] 406 6338 • **Facsimile** [021] 406 6411
e-mail: lamees.emjedi@uct.ac.za

09 April 2008

REC REF: 126/2008

Dr SZ Kalula
Medicine

Dear Dr Kalula

PROJECT TITLE: PREVALENCE OF AND RISK FACTORS FOR FALLS IN OLDER PEOPLE IN AN URBAN COMMUNITY IN SOUTH AFRICA

Thank you for your letter to the Research Ethics Committee dated 08 April 2008.

It is a pleasure to inform you that the Ethics Committee has **formally approved** the above-mentioned study

Approval is for one year until the 15 April 2009.

Federal Wide Assurance Number: FWA00001637.
Institutional Review Board (IRB) number: IRB00001938

This serves to confirm that the University of Cape Town Research Ethics Committee complies to the Ethics Standards for Clinical Research with a new drug in patients, based on the Medical Research Council (MRC-SA), Food and Drug Administration (FDA-USA), International Convention on Harmonisation Good Clinical Practice (ICH GCP) and Declaration of Helsinki guidelines.

The Research Ethics Committee granting this approval is in compliance with the ICH Harmonised Tripartite Guidelines E6: Note for Guidance on Good Clinical Practice (CPMP/ICH/135/95) and FDA Code Federal Regulation Part 50, 56 and 312.

Your comments to the queries raised are noted with thanks.

Please note that the ongoing ethical conduct of the study remains the responsibility of the principal investigator.

Please quote the REC. REF in all your correspondence.

Yours sincerely

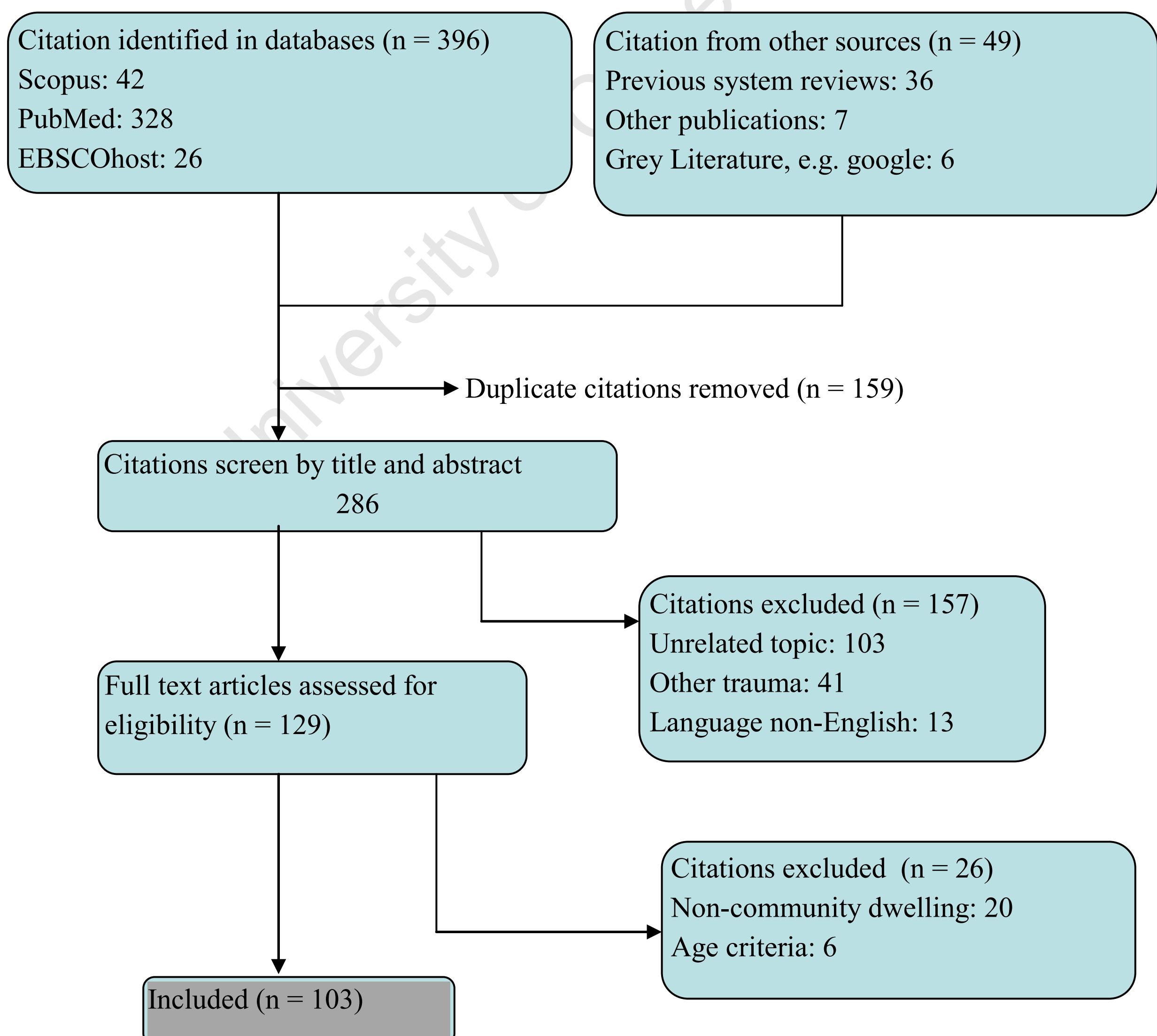
PROFESSOR M BLOCKMAN
CHAIRPERSON, HSF HUMAN ETHICS

Annexure 6

Literature review: Database search and search methods

A search of the relevant literature was conducted using the following databases: PubMed, Scopus, EBSCOHost (Medline, CINAHL, Health source: Nursing/Academic edition, Academic Search Premier and Africa-wide information) for the period 1986 – July 2012. The search was conducted according to title, abstract and key words using the filters Human and English. Titles were scanned for relevance, then abstracts and full papers examined if relevant. Key references from full papers were searched electronically and manually. The outcomes of the search are reported in diagrams below.

A. Citations identified in databases: Fall prevalence and incidence



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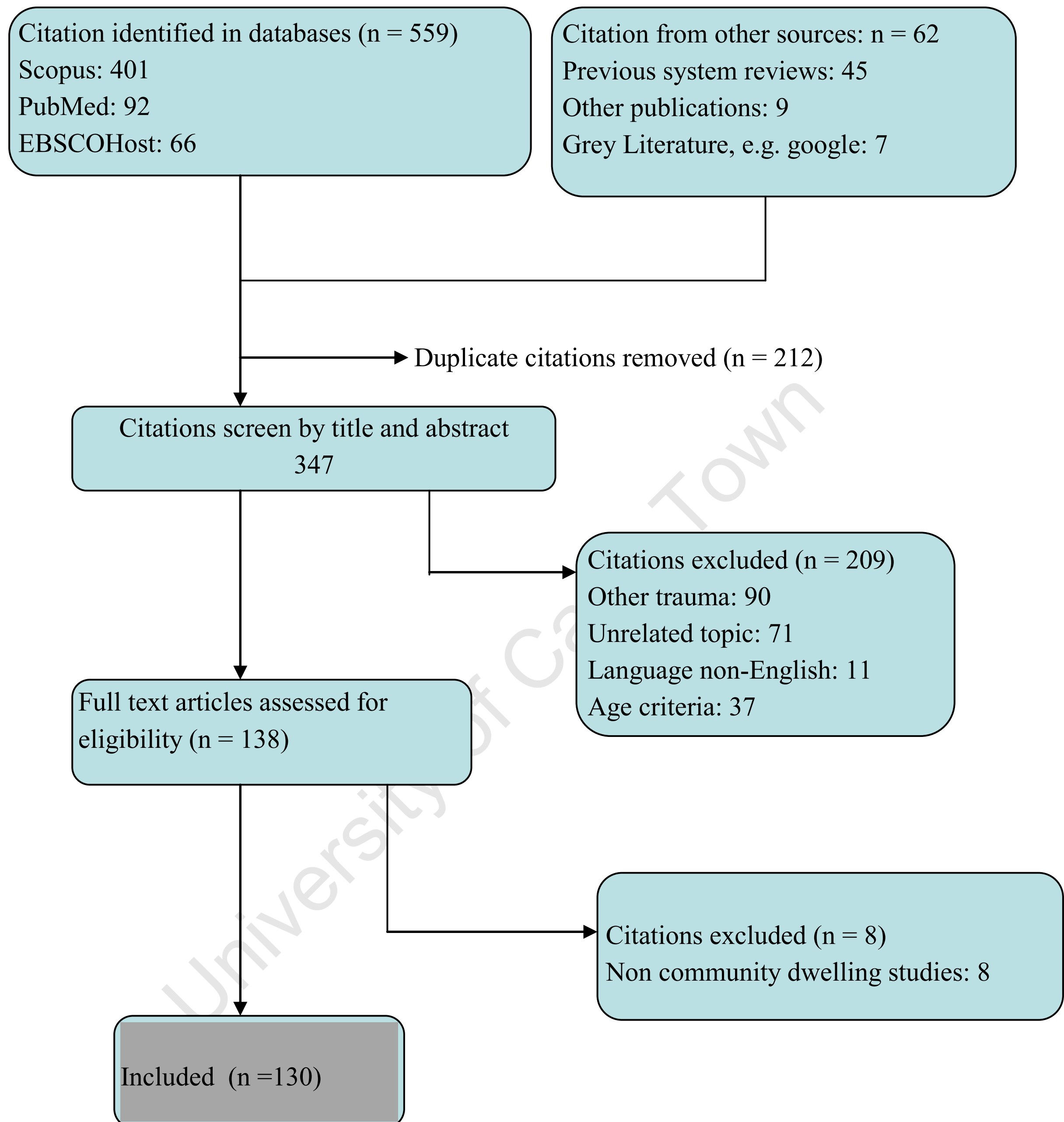
B. Citations identified in databases: Risk factors for falls



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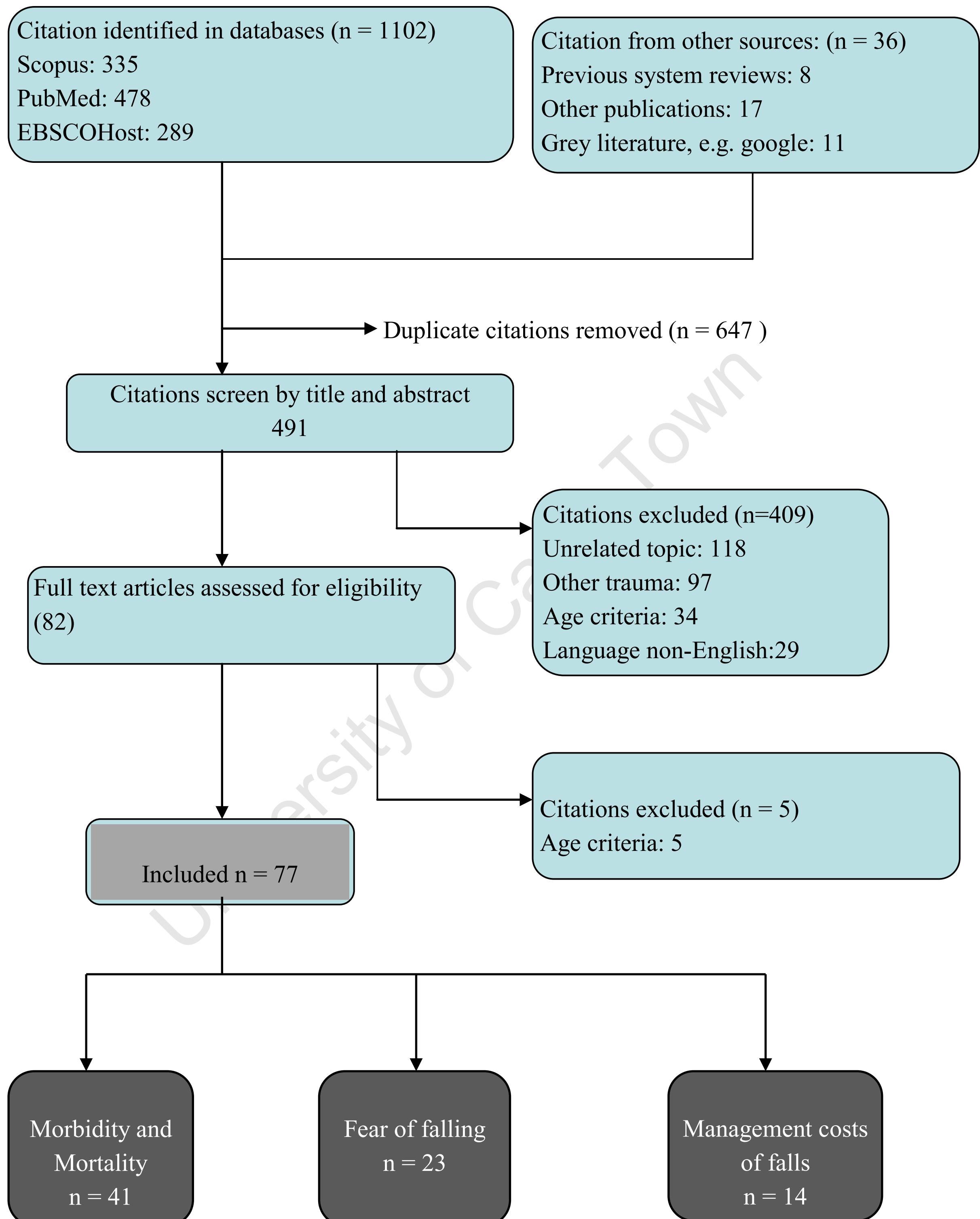
C. Citations identified in databases: Consequences of falls



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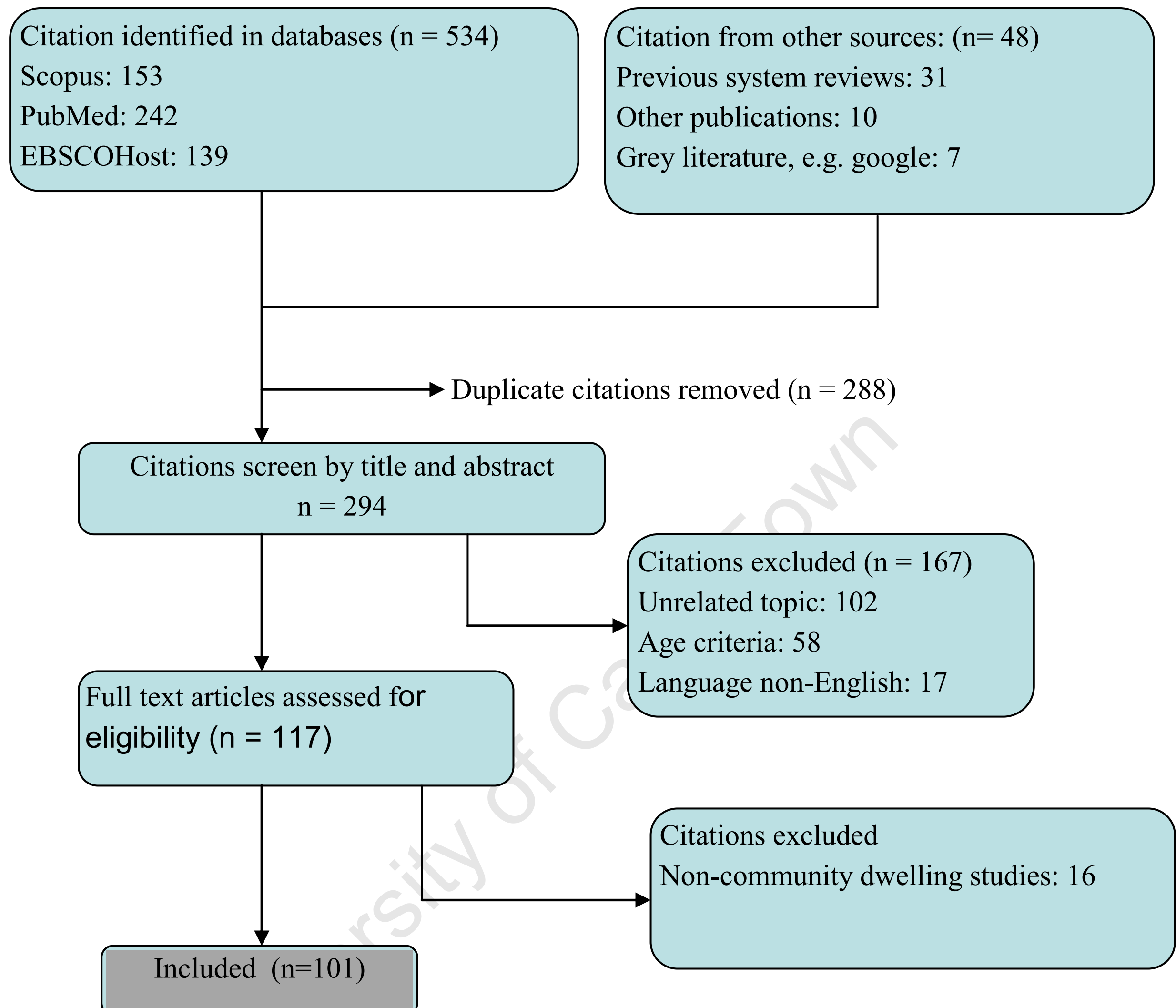
D. Citations identified in databases Interventions to prevent falls



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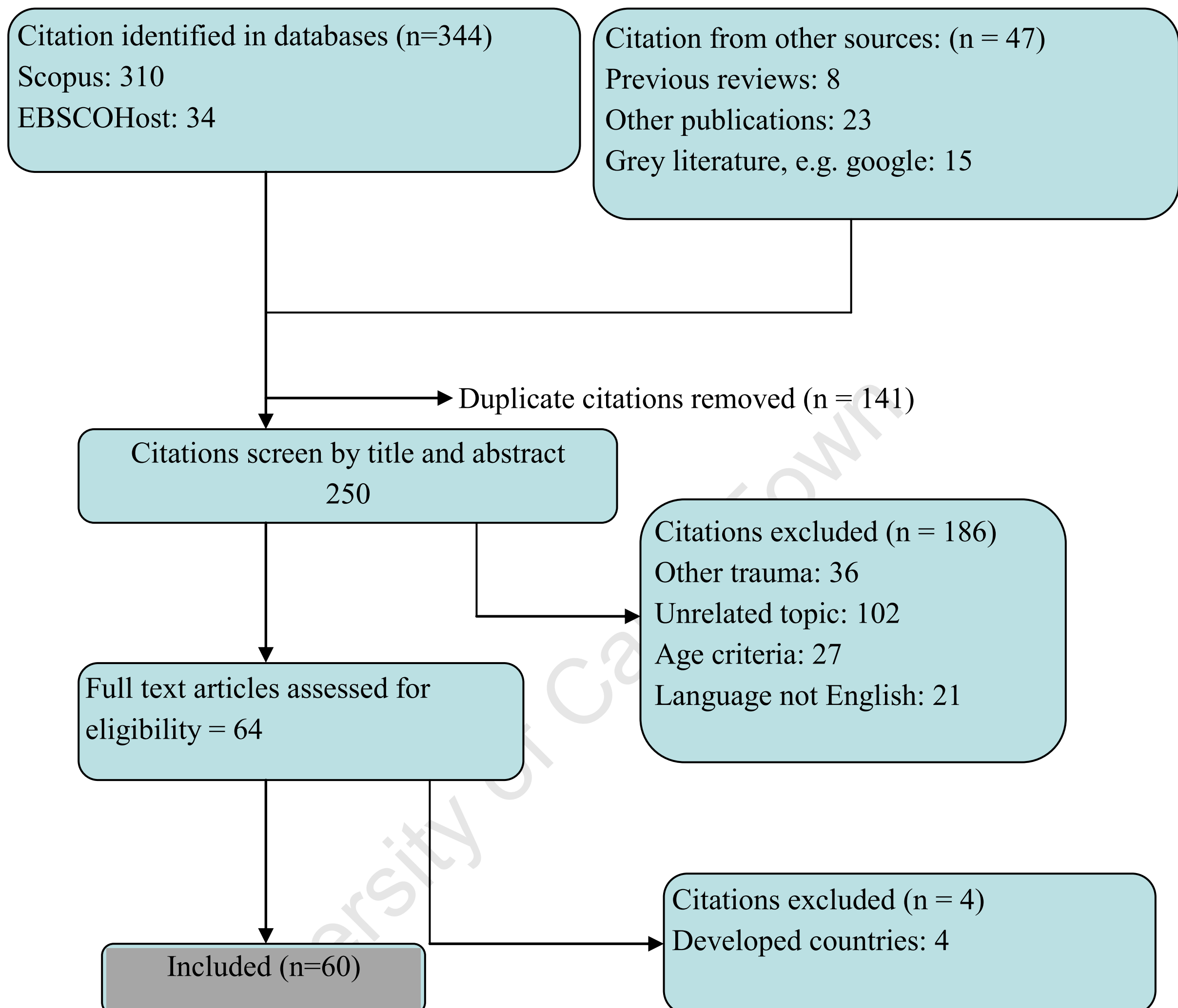
E. Citations identified in databases: Falls in developing countries



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