Factors contributing to non-occupational falls from ladders in men 50 years and over.

Katherine Myra Schaffarczyk

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Abstract

Background
Research into factors contributing to falls from ladders in older men in the non-occupational setting is limited, yet falls in this cohort are increasing with significant morbidity and mortality.

Aim
To explore the epidemiology of non-occupational falls from ladders in older men presenting to a major trauma centre; identify key influences on older men's decisions and behaviour around ladder climbing; and explore the impact of ladder falls and participant perspectives on injury prevention strategies.

Methods
A sequential mixed methods approach was used. Eligible participants included men aged 50 years and older who were admitted to hospital following a non-occupational ladder fall between February 2011 and December 2013. A retrospective review of the Trauma Registry and medical records was undertaken. Qualitative in-depth interviews were conducted with a sample of men and/or their spouses. The Late Life Functional Disability Instrument (LLFDI) was administered to men interviewed to determine pre and post fall function.

Basic descriptive analysis was undertaken on the registry and medical record data. Thematic analysis of interview data was used to identify factors contributing to ladder falls and their impact using the socioecological (SE) model. Narrative analysis was used to extend the thematic analysis.

Results
Eighty-six men were identified (range 50-86 years, mean age 64.7 years), 27% of whom had severe trauma (Injury Severity Score ≥12). Most commonly injured regions included: upper limb (37%), head (30%), lower limb (28%), and spine (27%). Median length of stay was 4 days.

Fourteen interviews were conducted with 19 participants (men=12, spouses=7). Pre-fall factors and post fall impacts were identified in the individual, interpersonal and community domains of the SE model and in the organisational domain post fall.

Interviewed men demonstrated a decrease in post fall LLFDI scores at 4-27 months post event compared with self-reported pre-fall scores, despite seven having minor trauma (ISS ≤12) on admission.

Conclusion
Ladder fall injuries cause marked morbidity even in 'minor' trauma. The impact of these injuries is extensive, affecting the individual, their interpersonal relationships and the community. Multiple strategies developed by key stakeholders aimed at the individual, family, organisations and community are needed for effective prevention.

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To my husband and my children; thank you for your tolerance, patience and understanding.

And, to the most important people of all: the men and their spouses who agreed to be interviewed for this research. It was your honesty and openness in sharing your story and your passion to make a positive change to ladder safety that enabled this research to achieve its objective.
Preface

Looking at George (pseudonym), I struggle to understand how falling one metre from a ladder can cause such severe injury. As an experienced trauma nurse clinician and educator, I have nursed many patients who have sustained traumatic injury. But it is the fact that this mechanism of injury is potentially preventable, that makes my understanding of George’s case more difficult to process.

Aged in his 70’s, George has sustained injuries to his head, spine, chest, abdomen and extremities. Complications have included pneumonia, sepsis, deep venous thrombosis, a skin pressure injury and anaemia. He has required surgery to his spine and fractured extremity and the formation of a tracheostomy to help him breathe.

I reflect on the clinical scenario in front of me. How and why did this happen? How can such a potentially preventable incident occur? What is my role as a trauma nurse in the prevention of ladder falls?

George spent almost three months in hospital, more than one week of which was in the Intensive Care Unit. He went on to a specialised rehabilitation unit. He required further surgery to his abdomen. On discharge home with his wife, George was mobilising with the assistance of a walker. He was surrounded by support from his wife, family and rehabilitation staff and was positive about his future.

And so my research journey began, with George’s story being my primary catalyst. This is the story of many men just like George.
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<tr>
<td>ABF</td>
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<td>AIS</td>
<td>Abbreviated Injury</td>
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<td>CAT</td>
<td>Computer adaptive test</td>
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<tr>
<td>CoF</td>
<td>Coefficient of Friction</td>
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<td>DIY</td>
<td>Do-it-yourself</td>
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<td>ISS</td>
<td>Injury severity score</td>
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<td>LLFDI</td>
<td>Late Life Function and Disability Instrument</td>
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Chapter 1 Introduction

1.1 Rationale

In theory, a workman should know that every unsecured ladder is liable to slip: in practice, he needs to be reminded of this unpleasant truth and reminded at frequent intervals. *Sir George Barnett, H.M. Chief Inspector of Factories, 1952 Annual Report, cited in Hepburn (1958), page 155.*

Falls from ladders are not a recent phenomenon as Sir Barnett’s quote illustrates. Falls from ladders remain a problem today in the workplace, and increasingly, in the home. Falls in the non-occupational context (defined as those that occur whilst undertaking unpaid work such as “do-it-yourself” home maintenance) have been less of a focus of research then those in the occupational setting (that is, falls that occur whilst working for an income), despite the notable increase in these cases among older men in Australia (Bradley, 2007). Falls in the non-occupational setting are reported to be associated with activities such as home renovations, maintenance and gardening (Cassell & Clapperton, 2006). Ladder fall mechanisms are varied and include slipping off the ladder rungs, the ladder sliding to the side, the ladder collapsing (due to its poor condition) and the ladder slipping on the surface from which it is erected (Pesonen & Hakkinen, 1988). The outcomes of ladder fall related injuries are significant, with a high rate of associated morbidities and in some cases, mortality (Diggs et al., 2005).

Evidence of the importance of non-occupational ladder falls in the Australian context has been provided by a number of studies in recent years. For example, of 776 major trauma cases resulting from ladder falls in Victoria for the period January 2005 to December 2013, 74.2% (n=576) occurred in the domestic setting (Oxley, Ozanne-Smith, O'Hern, & Kitching,
Of the 89 deaths due to ladder falls reported to the Victorian Coroner between January 2001 and December 2012, 78 deaths (87.6%) occurred in the home (Oxley et al., 2014). A similar result was found by Miu (2015) in New South Wales (NSW) where of the 496 cases of major trauma resulting from ladder falls over a five year period (2010-2014), the majority of patients (n=222; 44.8%) were undertaking non-occupational activities at the time of the fall. Non-occupational ladder falls also accounted for the most deaths (57.1%) among the major trauma group (Miu, 2015). There is a gender bias, with over 90% of all ladder fallers being male (Miu, 2015). While the incidence of ladder fall related injuries in men within the non-occupational context is of concern, there remains limited literature exploring the predisposing factors and motivators as to why men climb on ladders and fall (Sherrard & Day, 1995).

There are work, health and safety (WH&S) regulations and standards surrounding ladder use in the occupational context, but these do not apply within the non-occupational setting (Cassell & Clapperton, 2006). Further, as some have argued, it would be very difficult to enforce any regulations and standards aimed at controlling domestic ladder usage (Bedi & Goldbloom, 2008). Strategies other than legislation to prevent ladder falls in the non-occupational setting are required, and to highlight the dangers of working from heights on ladders in the non-occupational setting (Kent & Pearce, 2006).

This thesis details a recent study that focussed on men aged 50 years and over (defined as 'older men'). At 50 years of age it was considered that men may start to plan for retirement (Australian Bureau of Statistics, 2016), and begin to repair or renovate their homes in preparation for older age, thus putting themselves at risk of a ladder fall. The study aimed to identify the factors contributing to ladder falls in older men in the non-occupational setting,
to understand the physical and psychological impact of these falls and to provide knowledge to inform injury prevention strategies.

1.2 Research questions

This study will seek to answer the following research questions:

1. What is the epidemiology of non-occupational ladder falls among older men (aged 50 years and over) presenting to a major trauma service in Australia?

2. What are the key influences on older men’s decisions to climb a ladder and their ladder climbing behaviour?

3. What are the impacts of a non-occupational ladder fall on the older man, his spouse, family and the wider community?

4. Informed by the epidemiology, other injury prevention approaches and the perspectives of older men and their spouses, what are possible prevention strategies?

1.3 Context and setting of this research

The research study reported in this thesis was undertaken in New South Wales (Australia) at a hospital which is also a tertiary referral centre and adult major trauma service. The hospital is the largest within its Local Health District (LHD) and provides health care to people from several local government areas (Demography Unit New South Wales Department of Planning and Infrastructure, 2013). In 2011 the estimated resident population living within the LHD was 846,001 of which 109,284 were men aged 50 years and over (HealthStats NSW).

As a major trauma service, the hospital has the capability of providing full specialist services to critically injured patients from initial resuscitation, to rehabilitation and discharge (Royal
Australasian College of Surgeons, 2009). The hospital also receives critically ill patients from regional trauma services for definitive care following initial assessment and stabilisation (Royal Australasian College of Surgeons, 2009).

1.4 Methodological approach used in this research

The focus of this study is on older men climbing ladders in the non-occupational setting, specifically on those who presented to a major trauma service. This section provides a brief overview of the use of mixed methods in public health research, and in this current research. More detail about the quantitative and qualitative components will be presented in later chapters.

1.4.1 Use of mixed methods in public health research

The complexity of most public health problems requires researchers to draw on a spectrum of data, often informed by the use of qualitative and quantitative methods (Baum, 1995; Tariq & Woodman, 2013). Baum (1995) argues that neither quantitative nor qualitative methods can stand alone if we are to understand the richness of communities and what might be able to be done to make these communities healthier. This argument is also supported by Creswell (2011) who argues that the behavioural and humanistic side of any research study can often not be answered fully by quantitative research. Further, a mixed methods approach enables the identification of relationships between the two data sets to corroborate and contrast findings (Morse & Niehaus, 2009).

This need to contrast and explore relationships between administrative data (from the medical records and trauma registry), and data obtained from interview was the case in this study, and given the research questions a mixed methods approach provided the best design to answer both the behavioural and epidemiological questions of interest. An understanding of the
scope of the problem at the hospital level required a quantitative approach, with the qualitative data providing insights into the patients’ and spouses’ experience. A mixed methods approach provided a greater depth of understanding into the behaviour, thought processes and actions of the men prior to and at the time of their fall and the impacts and consequences for their lives after the fall (Bazeley & Kemp, 2012; Fetters, Curry, & Creswell, 2013; Hesse-Biber, 2010).

It was evident in the review of the literature (see Chapter Two) that quantitative studies had identified the scope of the problem of older men climbing ladders in the non-occupational setting. However, there was a lack of qualitative data on why these men are climbing and falling, as well as their perspectives and those of their spouse and partner on the impact of their fall on their lives. Thus, in-depth interviews with these men and their spouses became a major aspect of the current study, to complement the quantitative data available from patient records.

Contributions from both qualitative and quantitative research have also been argued as important to inform public health programs and policies that address complex social and health issues (Jack, 2006). In the context of injury prevention research, a mixed methods approach can provide a richness and add depth and explanation to quantitative data (Frattaroli, 2014). A mixed methods approach has therefore been chosen for this study of non-occupational ladder falls in older men with most of the studies to date only reporting quantitative data (Miu, 2015; Vallmuur, Eley, & Watson, 2016); with very few collecting qualitative data (Ackland et al., 2016; Oxley et al., 2014).

A mixed methods approach is defined by Bazeley and Kemp (2012, p. 55) as: -
research in which more than one paradigmatic or methodological approach, method of data collection, and/or type of analysis strategy is integrated during the course of undertaking the research, regardless of how those approaches or methods might individually be classified, and with a common purpose that goes beyond that which could be achieved with either method alone.

A mixed methods approach provides a key mechanism for triangulation (Hesse-Biber, 2010), with the results from two or more data types and sources being compared and contrasted (Mays & Pope, 2000). Data source triangulation was used in this study, drawing on three data sources: patients and spouses (from interviews) and medical records. To achieve the goals of data source triangulation, information derived from the various sources should be integrated, that is, all sources used together, during the analysis and result preparation phases (Bazeley & Kemp, 2012). Methods triangulation, which is the combined use of various methods as described by Ritchie (2001), was also undertaken in this study, through the use of a semi-structured interview, a validated instrument to measure functional ability (Late-Life Function and Disability Instrument) and the review of medical records and the hospital trauma registry. The benefits of triangulation are numerous. Triangulation allows for the comparison and convergence of perspectives to therefore identify any corroborating or conflictive accounts in different sources or collected via different methods (Fossey, Harvey, McDermott, & Davidson, 2002). Triangulation addresses the issue of internal validity by using more than one method of data collection to answer the research question (Barbour, 2001) and ensures a comprehensive approach to address the research questions and a more reflexive analysis (Pope & Mays, 1995).

Carter, Ritchie, and Sainsbury (2009, p. 110) summarise the importance and value of using mixed methods research in the public health setting.
Public health, we believe, needs both epidemiology and qualitative research. Without epidemiology we cannot answer questions about the prevalence of an association between health determinants and outcomes. Without qualitative enquiry, it is difficult to explain how individuals interpret health and illness in their everyday lives, or to understand the complex workings of the social, cultural and institutional systems that are central to our health and wellbeing.

This quote emphasises the need for synergy of both quantitative and qualitative methods in public health research. The quote also recognises the unique role each of these methods have in understanding the issues and challenges in public health from a more holistic approach.

In the current study a mixed methods explanatory sequential design was chosen (Creswell, 2011). This sequential design is useful when qualitative data collection follows quantitative data collection to provide some possible reasons for the quantitative findings and to extend the exploration of factors in the pre-fall and impacts in the post fall context. This sequential design involved the use of data from the medical record and hospital trauma registry in the first stage to examine falls in terms of injury, location, height fallen, season of fall, activity being undertaken and other variables of interest. In-depth semi structured interviews followed in a second stage to explore in more depth the factors related to the fall and the impact on the patient and their family. The quantitative data highlighted areas for further investigation in the qualitative interviews. The qualitative findings were used to extend understanding of the reasons behind the falls, the injuries sustained and their impact.

1.5 Ethical considerations

Ethics approval was obtained from the Local Health District Human Research Ethics Committee (HREC Ref # LNR/12/323), with ratification from the University of New South
Wales Human Research Ethics Committee (HREC Ref # 12526). Site specific research governance approval was obtained from the Research Governance Officer of the Local Health District (SSA Ref # LNRSSA/12/395).

1.6 Thesis structure

This chapter has provided a brief introduction and rationale for the research, and outlined the aim and research questions to be addressed within the thesis. The overall methodological approach used in the study has been outlined.

Chapter 2 provides a review of the literature addressing the scope of the problem of ladder falls at the global level and within Australia. Falls will be defined in the first instance, then the epidemiology of ladder falls will be presented. The burden of injury will be considered, before reflecting on the impact of the ‘do–it-yourself (DIY)’ trend. DIY in the home setting refers to activities within and around the home, such as decorating, building or repairing, that are undertaken by the home owner, rather than paying for a professional to undertake the task (Cambridge Dictionary, 2017); DIY has established itself as an emerging issue among older people (Ashby et al, 2007). The normal physiological changes seen with aging are discussed in relation to safe ladder climbing for the older population. A number of tools for measuring injury outcome are introduced, and these include the Abbreviated Injury Scale (AIS), the Injury Severity Score (ISS), and the Late Life Function and Disability Instrument (LLFDI). The chapter concludes with situating the research within the Public Health Model approach to injury prevention.

In Chapter 3, a description of the various types of ladders, and the Australian and New Zealand Standards which govern their use and manufacture are outlined. The principles of
safe ladder use are discussed including the angle of inclination, the three-point rule of contact and surface friction.

Chapter 4 presents the quantitative component of the study which is a review of the medical records and hospital trauma registry data of older men who had been admitted following a non-occupational fall from a ladder. Patient demographics, ladder and fall related variables and injury and hospital variables will be presented. Medications used by patients will also be explored. The cost of these falls will be discussed and the functional impact of the fall in terms of pre and post fall LLFDI scores will be presented for a subsample of patients. The chapter concludes with a discussion of the findings in relation to the other published literature.

Chapter 5 presents the qualitative findings from in-depth interviews with a sample of older men who had been discharged following hospital admission for a non-occupational fall. Some spousal interviews were also undertaken. The interviews aimed to understand pre-fall factors and post fall impact. The socio-ecological model is used as a framework for presenting these findings. Key narratives are first used to provide a conduit into the participants’ stories, experiences and thoughts followed by a discussion of key themes across all the interviews in the pre-fall and then in the post-fall context. The chapter also explores the injury prevention strategies recommended by participants and considers how these strategies might be used into the future. The chapter concludes with a discussion of the findings in relation to the other published literature.

Chapter 6 is a synthesis of both the quantitative and qualitative findings of the study, where findings are contrasted and compared where relevant and useful to inform the research questions. The recommendations for injury prevention initiatives and for future research are
outlined. The implications for public health policy and the limitations of the study are discussed.
Chapter 2 Non-occupational ladder falls in older people — a review of the literature

This chapter provides an overview of the literature on ladder falls with a focus on non-occupational falls from ladders in the older male population. Falls are defined generally and as related specifically to ladders. The epidemiology of ladder falls is then discussed in the global and Australian setting and in relation to age and gender. Trends, mechanisms, causes and outcomes of ladder falls are covered. Given the focus of the thesis is on falls in older men, a very brief outline of the normal physiological changes that occur with age (and medication use) is provided and the effect of these changes on ability to safely climb a ladder is reviewed. Injury severity scaling and the Late-Life Function and Disability Instrument which are used in this thesis are introduced. To conclude, the research undertaken within this thesis is placed within the Public Health Model to assist in conceptualising where this work is situated within a structured approach to injury prevention.

There are a number of authors cited throughout this literature review who have published their research over two decades ago. These papers have been included in this literature review as they are frequently cited in the ladder fall literature (Björnstig & Johnsson, 1992; Faergemann & Larsen, 2000; Häkkinen, Pesonen, & Rajamäki, 1988; Jüptner, 1976).

2.1 Ladder fall definitions

The World Health Organisation (WHO) defines any fall as an event which results in a person coming to rest inadvertently on the ground or floor or other lower level (WHO, 2012). Falls related to ladders may be categorised into falls from ladders, that is the separation of the hand and or foot from the ladder, or falls with ladders, such as the ladder tipping over or collapsing (Pliner, Campbell-Kyureghyan, & Beschorner, 2014). Some researchers have classified
ladder falls in line with their underlying cause, that is, physical failure of the ladder or its supporting surface, improper usage of the ladder and improper ladder selection (Campbell & Pagano, 2014; D. Miller, Andersen, Malmstrom, Miller, & Wolinsky, 2006). The International Statistical Classification of Diseases and Related Health Problems (ICD-10, 2016), which is a coding system for hospitalisation and mortality data, classifies falls on and from ladders (W11) within the category of falls (W00-W19).

2.2 Epidemiology of ladder falls – a global problem

The literature on the epidemiology of both occupational and non-occupational ladder falls indicates that this problem is widespread and reported across the world. The literature spans a number of decades and is from various countries including; Australia (Bedi & Goldbloom, 2008; Cassell & Clapperton, 2006; Diggs et al., 2005; Kent & Pearce, 2006; Mitra, Cameron, & Gabbe, 2007; Miu, 2015; Queensland Trauma Registry, 2010; Tsipouras, Hendrie, & Silvapulle, 2001; Vallmuur, Eley, & Watson, 2016), Canada (Driedger, Gupta, Wells, Dixon, & Ball, 2016), India (Jagnoor et al., 2012), Japan (Nosaka et al., 2015), New Zealand (Kool et al., 2010; Kool, Ameratunga, Robinson, & Jackson, 2007), Scandinavia (Arnold, Budde, & Wolf, 1989; Björnstig & Johnsson, 1992; Faergemann & Larsen, 2001; Häkkinen et al., 1988; Jüptner, 1976; Krogsgaard, Danborg, Kristensen, & Jensen, 1987; Lindblad, Terkelsen, & Lindblad, 1988; Pesonen & Hakkinen, 1988), United Kingdom (Hepburn, 1958; Muir & Kanwar, 1993; O'Sullivan, Wakai, O'Sullivan, Luke, & Cusack, 2004), and the United States of America (Bloswick & Chaffin, 1990; D'Souza, Smith, & Trifiletti, 2007; Diggs et al., 2005; Goldsmith, 1985; Knox, Van Bree, Kenner, & Wilkinson, 2010; Mickalide, 2007; B. Miller, 1997; Partridge, Virk, & Antosia, 1998; Stevens & Vajani, 2004; Tichon, Baker, & Ojalvo, 2011)
### 2.3 Incidence of falls from ladders in Australia

In Australia, there were 41,092 hospitalisations from falls from ladders over a ten-year period from July 2002 to June 2012 (Vallmuur et al., 2016). Of these falls, non-occupational falls accounted for 80% of hospitalisations (33,545 of the 41,092 ladder falls between July 2002 and June 2012) (Vallmuur et al., 2016).

Three Australian studies have been recently published between 2014 and 2016, all of which provide an overview of the current status of ladder falls in this country. In 2014, a study was conducted in Victoria by Oxley et al (2014) to establish the incidence of ladder falls over a ten-year period (2004-2013). For Emergency Department presentations, the rate per 100,000 population increased with age, peaking at 55-59 years of age then declining with increasing age. In regards to hospital admissions, the rate was 56 per 100,000 for those aged 55 years and older, compared to 11 per 100,000 for those aged 54 years and below. These rates are notably higher than the findings of Bedi and Goldbloom (2008) of 29 per 100,000 per annum for males aged over 65 years of age who presented to Victorian Emergency Departments some years earlier (between 1997 and 2002) following a non-occupational ladder fall, indicating an increase in incidence over time. Data from the Victorian Emergency Minimum Dataset indicates that between 2004 and 2013, there were 20,293 ladder related injury Emergency Department presentations, with 91.8% being fall related (Oxley et al., 2014). Data from the Victorian State Trauma Registry indicates there were 776 ladder fall major trauma cases between 2005 and 2013 (Oxley et al., 2014). Of these, 576 (74.2%) occurred in the domestic setting, with the majority of fatalities (94.7%) being non-occupationally related (Oxley et al., 2014).
A study in New South Wales by Miu (2015) reported 8, 496 hospital admissions across the state due to falls from ladders between 2010 and 2014 (average 1, 699 admissions per year). An increase was noted between 2010 (1, 542 admissions) to 1, 809 admissions in 2014. Age-standardised rates of hospital admissions due to falls from ladders over 2010-2014 increased with age group (5 year intervals), peaking at 154 admissions per 100, 000 people aged 65-69 years of age, before dropping back to around 120 admissions per 100, 000 people in the older age groups. In regards to major trauma cases as a result of a fall from a ladder, there were 496 cases, with most patients undertaking non-occupational activities when injured following the fall from the ladder. The category of non-occupational ladder falls also accounted for the most deaths in the major trauma group (Miu, 2015).

Vallmuur et al. (2016) reviewed data from the National Hospital Morbidity database from the Australian Institute of Health and Welfare from July 2001 to June 2012 using ICD-10-AM principle external cause code of W11 Fall on or from ladder. There were 41, 092 hospitalisations due to falls from ladders within this ten-year period, with a rise from 3, 374 in 2002/3 to 4, 945 in 2011/12. There was an increase in the number of hospitalisations in the non-occupational fall group, with approximately 50% of these men being over the age of 60 years. Injuries to the upper and lower extremities were the most common injuries seen in both the occupational and non-occupational falls groups. In regards to injury severity, ladder falls in older men resulted in more severe injury and death. Older fallers had a longer length of hospital stay regardless of whether the fall was occupational or non-occupational in origin. Where place of fall was specified, the majority of non-occupational falls occurred at home.

The incidence of ladder injuries in the non-occupational setting may be even higher than what is known from existing data, as many people who fall in this setting may not present to the hospital for treatment, but rather to their local doctor or medical centre for treatment of minor
injuries therefore not being captured in hospital data. Thus, the number of falls and fatalities in the non-occupational setting is likely to be underestimated, and it is has been suggested this may be by as much as 20% (Bedi & Goldbloom, 2008; Mitra et al., 2007).

Older men are falling more so than women. In New South Wales, those who sustained major trauma from both non-occupational and occupational falls were mostly male (92.5%), aged 60-64 years (15.3%) (Miu, 2015). Vallmuur et al. (2016) report the number of men falling from ladders in Australia also rose from 28.3 per 100,000 in 2002/3 to 33.8 per 100,000 in 2011/12, with the age standardised rate increasing by 4.5% annually for men and 6% for all those aged over 60 years. The age specific rate for men peaked at 78.8 per 100,000 for men aged 60 years and over. These findings highlight the magnitude of the problem of older men falling from ladders in Australia and the need to focus on this population in reducing ladder falls.

2.4 Trends in ladder falls

It is clear from the literature that falls from ladders are increasing both in Australia and globally. For example, there was a 51% increase over a sixteen-year period (1990-2005), with just over two million people treated in Emergency Departments for unintentional injuries from climbing a ladder in an American study (D'Souza et al., 2007). Nearly all (97%) of these falls occurred at home. Further, a Danish study of 1,462 consecutive non-occupational ladder or scaffold fall injuries between 1988 and 1997 noted an association between an annual increase in incidence with an increase in age, especially in the 65-69 year age group (Faergemann & Larsen, 2000). Similarly, in a study of hospital treated ladder injury cases (both occupational and non-occupational) in Victoria between 2002 and 2004, the admission rate for ladder falls increased by 40% between the period 1994-1997 and 2001-
2004 (15.8 admissions per 100,000 population to 22.2 admissions per 100,000 population) (Cassell & Clapperton, 2006). Australia-wide, nearly 14% more ladder fall cases were hospitalised in 2004-2005 compared to 1999-2000 (Bradley, 2007). Further, a study by Miu (2015) on falls from ladders in New South Wales (both occupational and non-occupational), found an increase in the annual average number of cases with severe trauma as a result of a ladders fall, with numbers increasing from 74 patients with severe trauma in 2010 to 109 in 2014 (Miu, 2015).

Length of hospital stay was found to increase with age in a study of ladder related injury incidents in Australia (Bradley, 2007). Further, a retrospective review of patients who presented to the Emergency Department of the Austin and Repatriation Medical centre in Victoria with injuries resulting from ladder related events between January 1994 and December 1997, found that injury severity increased (as measured on the Injury Severity Score) with age (Tsipouras et al., 2001).

2.5 Mechanism, causes and height of ladder falls

Loss of balance (Häkkinen et al., 1988; Jüptner, 1976) and poor placement of the foot leading to slipping of the user (Björnstig & Johnsson, 1992; Bloswick & Chaffin, 1990) are common mechanisms of falls from ladders. Other causes identified in the literature include incorrect ladder placement (Partridge et al., 1998), use of defective ladders (Pesonen & Hakkinen, 1988), using a ladder when another tool should be used (D. Miller et al., 2006) or ladders breaking (Björnstig & Johnsson, 1992). The overturning, tipping, sliding and overbalance of the ladder were also attributed to causing falls from ladders (Häkkinen et al., 1988; Krogsgaard et al., 1987; Lindblad et al., 1988). Climbing without someone holding the ladder has also been identified as an issue in one study (Partridge et al., 1998).
Activities at the time of falling from ladders in the non-occupational setting noted in the literature likely reflect activities commonly undertaken in this setting (that is, exposure). These included painting, undertaking repairs, removing snow from the roof, retrieving items out of the attic, cutting down tree branches, cleaning windows and gutters (Björnstig & Johnsson, 1992) and decorating (Muir & Kanwar, 1993). The installation of Christmas lights has also been reported as a common activity leading to a fall from a ladder in a Canadian study (Driedger et al., 2016).

There is also seasonal variation in ladder falls in the non-occupational setting, again, likely reflecting exposure. For example, non-occupational falls from ladders in Denmark were found to occur primarily in Summer and Autumn, with nearly half occurring around the weekend (Faergemann & Larsen, 2000). The majority of non-occupational falls from ladders in Australia also occur on a weekend (Tsipouras et al., 2001). In Scandinavia, the majority of the non-occupational falls were found to occur during Winter (removing snow from roofs) and Summer, with an even distribution of these falls across all days of the week (Björnstig & Johnsson, 1992).

The height fallen from the ladder varies between studies. A range of 0 to 6 metres and a mean of 2 metres for falls from ladders in the non-occupational setting in Australia was noted by Cassell and Clapperton (2006), with 66% of all patients falling greater than one metre in the non-occupational setting in a Danish study by (Faergemann & Larsen, 2000). An average fall height of 3.3 metres was found in a study from the United Kingdom for both non-occupational and occupational falls from ladders (Muir & Kanwar, 1993). Of the sixteen deaths reported in a Victorian study of both occupational and non-occupational falls from ladders by Mitra et al. (2007), all patients had fallen greater than one metre in height. Most falls in those patients who sustained major trauma and were admitted following a fall from a
ladder in New South Wales were between 1 to 5 metres (Mui, 2015). In a study of cases of non-fatal ladder related injuries treated in Emergency Departments in America between 1990 and 2005, people were more likely to need hospital care as the height fallen increased (D'Souza et al., 2007).

2.6 Outcomes from falls and injury types

2.6.1 Non-fatal outcomes

Extremity injuries, including fractures, are commonly sustained by ladder fallers (Arnold et al., 1989; Lindblad et al., 1988; O'Sullivan et al., 2004; Stevens & Vajani, 2004). Injuries to the head are also common, with increasing head injury severity likely related to increasing age (Dinh, Stark, & Bein, 2012). In patients admitted to hospital in Victoria, injuries to the trunk were most common in those patients who had fallen at home (Cassell & Clapperton, 2006). In a study of falls from ladders in the New South Wales population between 2010 and 2014, 46,353 injuries in 8,496 patients were identified classified by body region (Mui, 2015). The most common injuries were to the head (20.6%), thorax (13.5%) and abdomen, lower back, lumbar spine and pelvis (13.5%) (Mui, 2015). These findings indicate that injuries are occurring to vital organs and regions of the body: the head – injury to the brain, thorax (chest) – injury to the heart, lungs and major arteries and veins, abdomen and pelvis. Injuries to these regions of the body can cause life threatening injuries (American College of Surgeons Committee on Trauma, 2012).

A study more than two decades ago but widely cited, found many patients experienced ongoing symptoms long after their discharge from hospital such as pain, reduced movement, sensory loss and anatomical defects (Björnstig & Johansson, 1992). This prospective twelve month study of trauma registry data and patient interviews in Sweden found that one third of
patients still had persisting symptoms more than a year after their fall from a ladder (both occupational and non-occupational setting) (Björnstig & Johnsson, 1992). These persisting symptoms had a significant effect on their leisure time activities (Björnstig & Johnsson, 1992). Loss of work has also been identified as a consequence of injuries as a result of falls from ladders (Björnstig & Johnsson, 1992). Of those patients who were entitled to receive sickness benefits, two thirds received this benefit for an average of 57 days (Björnstig & Johnsson, 1992). Increasing severity of injury was associated with both age and height fallen (Björnstig & Johnsson, 1992). A more recent study retrospective observational study undertaken over three years in Ireland of patients with ladder injuries, identified that the longest duration of disability was associated with injuries to the foot (O'Sullivan et al., 2004), with the median duration of disability and unemployment being six weeks for all injuries. The findings of these studies suggest that the impact of the fall from a ladder can persist well after hospital discharge and impact on various aspects of the patient’s life. This may be associated with the severity of the injury sustained, the age and/or pre-existing health of the patient. However, few studies were identified that examined the long-term impacts on patients post discharge to home, with no studies found in Australia.

2.6.2 Burden of injury in Australia

The burden to the Australian health care system from ladder falls is significant. For example, Oxley et al. (2014) state the cost to be AUS$18.3 million dollars for the three-year period of 2010 to 2013 for hospital admissions from “home” ladder fall injury in Victoria. The average hospital cost for each admission was $7,666, with a range of $666 to $187,009. The mean length of stay per patient was 6.2 days, with admissions accounting for almost 15,000 hospital bed days. In New South Wales, the estimated cost to the health system was AUS$51.8 million dollars over the five-year period 2010 to 2014 for the 8,496 patients
admitted across New South Wales following a ladder fall (Miu, 2015). The majority of these patients (86.8%) were classified as “Emergency” on admission (meaning treatment was required within 24 hours of diagnosis of injury (Miu 2015)). The average injury severity score for all ladder fall patients who sustained major trauma was 20, indicating severe trauma. In regards to the demands on Intensive Care Services by patients who sustained major trauma, the average number of ventilation days (patients requiring ventilatory support) was 4.8 days and an average length of stay in the Intensive Care Unit of 1.3 days. Overall, the length of stay was 6.5 days for ladder fall major trauma patients, which is in line with Victorian data (6.2 days) for all “home” ladder fall patients (minor and major trauma patients). The need for ongoing rehabilitation for major trauma patients after discharge from the acute care hospital was significant, with 79 patients (16%) being discharged to a rehabilitation facility (Mui, 2015).

2.6.3 Fatal outcomes from ladder falls in Australia

In a retrospective study in South Australia of patients following a fall from a ladder, scaffold, building or tree between July 2000 and December 2003, thirteen deaths were noted of which eight occurred at home. Of these eight deaths, six were the result of a fall from a ladder (Kent & Pearce, 2006). In two studies from Victoria, twenty deaths from non-occupational falls from ladders were noted between 1997 and 2002 (Bedi & Goldbloom, 2008) and sixteen noted between 2001 and 2005 (Mitra et al., 2007).

Driscoll et al (2003) reviewed fatal incidents from home duties and common injury scenarios. Coroner’s files across Australia between 1989 and 1992 were reviewed. Of the 296 cases reviewed, the most common activity at time of death for men was home maintenance (which included home improvement). More men than women were identified for most activities. Home maintenance was the predominant activity for nearly all age groups less than 75 years.
of age in the incident reports. Ladders were involved in 18% of all fatal incidents involving unpaid workers in domestic situations. Common scenarios that repeatedly resulted in death usually included males using ladders not adequately braced, ladder slippage, or loss of balance by user.

Data from the Australian Bureau of Statistics from 2001 to 2010 for W11 (falls on or from ladders) as cause of death, indicate that most deaths were male, with peak periods in deaths between 2001-2003, 2006-2008 and 2010 (Australian Bureau of Statistics, 2005). Data sourced from the Australian National Coroners Information System (NCIS, 2010) provides additional information on ladder falls. The NCIS reported that people 50 years and over made up the majority of deaths after falling from ladders; 32% of ladder fall deaths were in people aged 70-79 years of age; 96% were male; over 85% of ladder fall deaths occurred whilst undertaking non-occupational activities and 34% of ladder fall deaths occurred during home maintenance activities (National Coroners’ Information System, 2010).

Of the 222 patients admitted with major trauma who fell whilst undertaking non-occupational activities in the report on ladder falls in New South Wales between 2010-2014 by Mui (2015), over half of these admitted patients died (57.1%). In both the non-occupational and occupational falls from ladders in this study, the head was the most common single system injury sustained by patients (77.1% of all deaths). For all ladder fall admissions (minor and major trauma) in patients 55 years and over (n=5,331), there were 48 deaths (1.2%), all male. In those patients 55 years and over who sustained major trauma, there were 32 deaths (9.4%), again all male (Mui, 2015).
2.7 Normal physiological changes with aging and the implications for ladder use

Normal physiological changes occur to the human body as it ages. These changes may contribute to the older man’s ability to safely climb a ladder and to the injuries sustained from a fall. It is important therefore in the context of non-occupational falls from ladders in older men, to consider what these physiological changes are, and how the impact of physical trauma or injury to the older human body can affect overall recovery. Therefore, a very brief discussion of the normal aging processes which may affect the ability of the older person in the safe use of ladders is presented.

2.7.1 Visual changes

A decrease in the size of the visual field and visual acuity are seen in the older person (Smith & Gove, 2005). These changes impact on the ability to detect details and contours of objects. Poor colour discrimination and decreased peripheral vision is noted especially when divided attention is needed (Smith & Gove, 2005). Glare is also an issue caused by the increased opacity of the lens in the older eye; and light entering the side of the eye can result in a blurred image (Haigh, 1993).

2.7.2 Musculoskeletal changes, posture and balance

There is a loss of absolute bony volume (spongy and compact) associated with ageing, which may lead to fractures from quite minimal trauma. Joints, which aid in both the function and movement of the body, are affected in up to 80% of people aged 65 years of age and over (P. Timiras & Navazio, 2007). Changes in strength, body mass, coordination and individual biomechanics increase the risk of slipping off ladders in the older population (Pliner et al., 2014). There is decreased power in the lower extremities, less ability to lean forward and a greater body sway when standing (Cefalu, 2011). Hand function is also important to consider
as there is a decrease in hand, finger and thumb strength, dexterity, precision, coordination, joint mobility and sensitivity (Haigh, 1993). Especially significant to ladder use, there is a decrease in grip strength and grip endurance with age (Haigh, 1993). There is a decrease in the amount of force that can be exerted and in the length of time that concerted pressure can be maintained. A person greater than 65 years of age can achieve only 75% of previous strength and endurance (Haigh, 1993). If muscle strength decreases, a reduction in accuracy of movement may result (Haigh, 1993).

Posture (the bearing of one’s body that provides a stable framework for movement) and movement (the ability to change posture and position) are controlled by the central nervous system, skeleton, skeletal muscles, joints and the cardiovascular and endocrine systems (PS Timiras & Maletta, 2007). There are a number of age related changes to posture and movement which have been identified (Woollacott, 1993). These include changes to sensory systems contributing to balance, vision and muscle strength; these may affect the control of balance and the ability to integrate balance adjustments into voluntary movements, which can impact the ability to climb a ladder safely.

Alterations in movement and posture lead to imbalance and hence a greater falls risk (PS Timiras & Maletta, 2007). With ageing, skilled motor movements are slowed and gross movements related to the maintenance of posture and gait are affected (PS Timiras & Maletta, 2007). Speed of movement and contraction of specific muscles may also be affected (PS Timiras & Maletta, 2007). Peripheral changes such as decreases in muscle mass and nerve conduction and increased muscle rigidity, all contribute to decreased mobility (PS Timiras & Maletta, 2007).

Yang & Ashton-Miller (2006) investigated experimentally how humans step up and onto rigid and laterally compliant structures. The results indicated that age differences were
significant especially in the duration of balance recovery and controlling lateral centre of mass movement. Older males used greater push off forces of the trail foot when transferring onto a raised structure. This may be due to reduced lower extremity proprioception in the elderly and reduced rates of muscle force generation. Older males had an extended balance recovery time from age related sensory and/or motor delays (Yang & Ashton-Miller, 2006). These findings led the authors to suggest that older ladder users should be advised not to hurry stepping onto or balancing on compliant raised structures such as stepladders.

Many people climb a ladder to gain access to things that are high off the ground. This may therefore involve the need to look and reach upward whilst standing on the ladder (Tichon et al., 2011). Row and Cavanagh (2007) considered the reaching upward motion and the reaching forward motion in the context of dynamic balance. They found older adults had less confidence in their ability to reach upward which decreased their ability to maintain control of their posture during movement, compared to reaching forward. This may indicate the need to encourage older ladder users to use a taller ladder to avoid reaching overhead (Tichon et al, 2011).

2.7.3 Neurological and reflex changes; dizziness and vertigo

There are several changes to the neurological system related to the ageing process. Cognitive changes to memory, attention, perception and decision making are noted (Glisky, 2007). According to DiGiovanna (1994), there are a number of changes to reflexes as a result of aging within both the central and peripheral nervous system. Changes include a longer and weaker reflex response. Most of the work in climbing a ladder is done by the lower extremities (Armstrong, Young, Woolley, Ashton-Miller, & Kim, 2009). There is decreased power to the lower extremities leading to less ability to lean forward and greater body sway when standing (Cefalu, 2011). Slower reaction times to the fall may also lead to impact with
the ground primarily with the torso and head (Con et al., 2014). A decline in muscle strength and mass can be linked to a decrease in the number of motor neurones, which reduces the number of cells that can be stimulated in a muscle (DiGiovanna, 1994). In the specific context of ladder falls, there may be an increase in reaction time and a decrease in the speed of movement. This therefore makes it more difficult to grasp a handrail for instance to try and overcome the fall. In older adults, there is normal acquisition of procedural skills in both the motor and cognitive domains. These procedural skills are retained across the lifespan. With high levels of expertise, there is often little slowing of skilled performance with age although some individual components of the skill may decline (Glisky, 2007). The previous occupation then of the ladder user may have some relevance here (DiGiovanna, 1994).

Dizziness and vertigo are caused by the ear’s decreased ability to detect to and respond to changes in speed, gravity and head rotation (DiGiovanna, 1994). Dizziness can be defined as feeling unstable, whilst vertigo can be described as a spinning feeling of body or environment (DiGiovanna, 1994). Both feelings are unpleasant. More importantly though in the context of ladder falls, both of these conditions can increase the risk of falling due to the loss of balance (DiGiovanna, 1994). Additionally, aging reduces the information from the eyes, skin and proprioceptors in the muscles and joints, all of which assist the ears in maintaining balance and posture (DiGiovanna, 1994).

2.7.4 Respiratory and cardiovascular changes

All aspects of the respiratory system that are involved with gas exchange are affected detrimentally by age, leading to a drop in the maximum rate of gas exchange (DiGiovanna, 1994). The system overall is less efficient which directly effects the ability of the older adult to perform physical activities (DiGiovanna, 1994). In the context of exercise and getting up and down a ladder, ventilation may be inadequate and dyspnea (shortness of breath) may
ensue, with the body unable to compensate sufficiently to the increase in metabolic demands (P. Timiras & De Martinis, 2007). The maximum rate of exercise a person can perform as they age, decreases. This can be compounded by the presence of pre-existing cardiac disease (DiGiovanna, 1994).

2.8 Pharmacology, the elderly and falls risk

The normal physiological changes of aging, alterations in metabolism (e.g. decreased renal elimination of medications), chronic illness and the increased use of medications (including polypharmacy), places the older person at a higher risk of developing adverse reactions and medication interactions (M. Timiras & Luxenberg, 2007), which may impact their ability to use a ladder safely. Polypharmacy is defined by the World Health Organisation (2014) as "the administration of many drugs at the same time or the administration of an excessive number of drugs". Quantitatively, polypharmacy can be defined as five or more medications taken in 24 hours (Bryan, 2012). Renal elimination of medications is a significant issue, given that there is a combination of a decrease in renal blood flow, renal mass and glomerular filtration rate (M. Timiras & Luxenberg, 2007) which leads to an increased risk of adverse drug reactions and increased sensitivity to the drug (Mangoni & Jackson, 2004). For example, the use of psychotropic medications may be detrimental for older people climbing ladders, as the elderly are more susceptible to the side effects of these drugs and to the effect of the medication, given the elderly’s less central nervous system reserve (M. Timiras & Luxenberg, 2007). Ladder falls can lead to many injuries including head injury, fractures and internal organ injury. The use of anticoagulants can further complicate these injuries, predisposing people to further bleeding (Holleran, 2015). The use of vasodilators should be used cautiously in the elderly due to the increased risk of postural hypotension, caused primarily due to a decrease in the function of baroreceptors (M. Timiras & Luxenberg, 2007).
which may put an older person at risk when climbing a ladder. Polypharmacy is also a cause of orthostatic hypotension (P. Timiras & Navazio, 2007); and is associated with a higher risk of adverse drug reactions (Sergi, DeRui, Sarti, & Manzato, 2011).

In summary, ladder use is more dangerous with age due to reduced flexibility and mobility, slower reaction time, poorer balance and chronic health problems. Any functional impairments make home maintenance harder with age (Ashby, Ozanne-Smith & Fox, 2007). There is also a decrease in stamina with age; this being defined as the ability to perform vigorous activity for more than a few seconds (DiGiovanna, 1994). Coupled with other co-existing medical conditions, this may increase the burden of the physical activity of ladder climbing for the older user. The combination of medication use, comorbidities and physiological changes with age, means that even a ‘low’ impact fall, can lead to significant physiological insult. Low pulmonary and cardiac reserves will also influence the patient’s response to the injury (Holleran, 2015), and decreased recuperative powers often associated with ageing (Driscoll et al, 2003), may slow and limit recovery.

2.9 Injury severity scaling

In relation to injury, severity is a comparative term used in regards to a number of criteria such as mortality risk, the need for critical care management or risk of complications (Seguí-Gómez & Lopez-Valdes, 2012). In order to study the magnitude, distribution and determinants of injury, classification by type and severity is vital (Stevenson, Segui-Gomez, Lescohier, Di Scala, & McDonald-Smith, 2001). In the clinical environment, injury severity measures can be used in a number of applications such as triaging, clinical guidelines and the evaluation of trends and interventions over time (Seguí-Gomez & Lopez-Valdes, 2014). Severity measures may also describe long term functional outcomes and costs (Seguí-Gomez...
The need for accurate injury coding is vital for epidemiological, research and outcome evaluation purposes (Long et al., 1994).

The Abbreviated Injury Scale (AIS) and Injury Severity Score (ISS) are used in this thesis as measures of injury severity and will be explained in the following section. Table 2.1 summarises and compares the key features of these scoring systems.

### Table 2.1. Key features of the AIS and ISS injury scales (Seguí-Gómez & Lopez-Valdes, 2012).

<table>
<thead>
<tr>
<th>Dimension</th>
<th>AIS</th>
<th>ISS</th>
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<tbody>
<tr>
<td>Population</td>
<td>All</td>
<td>All</td>
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<tr>
<td>Injury nature</td>
<td>All</td>
<td>All</td>
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<tr>
<td>Injury mechanism</td>
<td>Impact, penetrating, blast</td>
<td>Impact, penetrating, blast</td>
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<td>Goal</td>
<td>Predict</td>
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<td>Outcome</td>
<td>Death and others</td>
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<td>Injury</td>
<td>Person</td>
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<td>Anatomical</td>
<td>Anatomical</td>
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<td>Expert judgment</td>
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<tr>
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<td>Evaluation and planning, biomechanics</td>
<td>Evaluation and planning, triage</td>
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#### 2.9.1 Abbreviated Injury Scale (AIS)

The AIS was developed in 1969 by a joint committee consisting of the American Medical Association, the Association for the Advancement of the Automotive Medicine (AAAM) and
the Society of Automotive Engineers. These groups identified the need for a comprehensive and scientific scale to assist in evaluating injury (severity and types) by motor vehicle collision investigators (Gennarelli & Wodzin, 2006; Stewart, Cowan, & Thompson, 2011). The first scale was published in 1971 (Segui-Gomez & Lopez-Valdes, 2014) with subsequent refinements. The 2005 scale will be used in this thesis (Association for the Advancement of Automotive Medicine, 2005).

The AIS is an anatomically based, consensus derived, global severity scoring system that classifies each injury by body region according to its relative importance on a 6-point ordinal scale (Association for the Advancement of Automotive Medicine, 2005). It ranks the severity of individual injuries only, not the combined effect of multiple injuries (Mackenzie, Shapiro, & Eastham, 1985). The AIS is within a dictionary format, which contains a six-digit unique numerical identifier for injuries to nine body regions: head (cranium and brain), face (including eye and ear), neck, thorax (chest), abdomen and pelvic contents, spine (cervical, thoracic and lumbar), upper extremity, lower extremity, pelvis and buttock and external (skin) and thermal injuries (Association for the Advancement of Automotive Medicine, 2005). At the end of the 6-digit number (after the ‘dot’) is the AIS severity code which ranges from 1 (minor) to 6 (maximum, currently untreatable).

In the event that an injury is unable to be determined, that is, it is a very minor injury requiring no medical intervention (such as a scratch to the skin), an AIS of 9 is assigned. As a result, an ISS (see below) is unable to be calculated and a score of 99 is given (Stevenson et al., 2001).
2.9.2 Injury Severity Score (ISS)

The ISS is an anatomically based ordinal scale, with a range from 1 to 75 (Stevenson et al., 2001). The ISS is a method of combining the separate AIS scores for each patient’s injuries into a single measure of overall injury severity. It was developed to predict mortality but it can also be correlated to other health outcomes such as length of hospital stay and cost (Linn, 1995). It can be used for retrospective comparison of overall injury data between populations in different times and places, due to its simplicity and widespread use (Linn, 1995). The ISS can also improve the ability to evaluate the care provided to patients, by comparing the mortality experience of varied groups (Baker, O’Neill, Haddon Jr, & Long, 1974).

The ISS describes the anatomical damage in the three most severely injured body regions. The less severe injury is not considered in the case of two or more injuries occurring in the same body region (Sacco, MacKenzie, Champion, Davis, & Buckman, 1999). It cannot be used to predict the possible loss of quality of life nor the clinical course of a patient during treatment (Linn, 1995).

The ISS is determined by rating each injury with the AIS, then adding together the squares of the highest AIS rating for each of the three most severely injured body regions (Baker & O’Neill, 1976). Any patient with an AIS score of 6, regardless of other injuries sustained, is assigned an ISS of 75 (Sacco et al, 1999). Whilst an ISS of 16 defines major trauma in some trauma centres (Boyd, Tolson, & Copes, 1987), a score of 12 and above defines major trauma at the hospital from which data were drawn for this thesis. Six body regions are considered in the ISS; head and neck, face, chest, abdominal and pelvic organs, extremities and pelvis, and external structures (Seguí-Gómez & Lopez-Valdes, 2012). Thus, the ISS is a summary measure of trauma to single or multiple body regions (Copes et al., 1988).
There is an apparent inconsistency in how the ISS is treated by researchers. In a review of the ISS, Stevenson et al. (2001) found that most researchers treated the ISS as a continuous, normally distributed variable, although it is positively skewed and not continuous (that is, certain values between 1 and 75 are not possible). Transformations of ISS data do not alter skewness (Stevenson et al., 2001). Further, Stevenson et al. (2001) found measures of central tendency obscured important differences in injury severity between different data sources. While other researchers reportedly used various categorical classifications (such as binary categories), Stevenson et al (2001) noted inconsistencies in regards to the number of categories and selected cut off points, leading to their call for a consensus on a clinically meaningful categorisation of the ISS for comparative purposes. However, they acknowledge that there is no simple solution, as meaningful categorisation varies from study to study depending on each set of data and context.

2.10 Late-Life Function and Disability Instrument (LLFDI)

The LLFDI was used in this study during the interview process to measure participant self-reported functional status in the pre-fall and post fall context. This section provides the reader with an introduction to the LLFDI.

2.10.1 The original LLFDI

The measurement of functional limitations and disability are important in clinical practice and rehabilitation research (LaPier & Mizner, 2009). The LLFDI was therefore developed to assess and be more responsive to meaningful outcomes of function and disability (Jette et al., 2002).

The original LLFDI was developed in 2002, utilizing Nagi’s disablement model and the World Health Organisation’s International Classification of Functioning, Disability and
Health (ICF). The original LLFDI assessed functional limitations (inability to perform discrete physical tasks) and disability (inability to participate in major life tasks and social roles) (Beauchamp, Schmidt, Pedersen, Bean, & Jette, 2014). The 32 item function and 16 item disability components were designed as two distinct, independent scales (Dubuc, Haley, Ni, Kooyoomjian, & Jette, 2004). The functional component rates task difficulty and is further categorised into upper extremity and basic and advanced lower extremity function. The disability component rates task difficulty and frequency and is further categorized into social and personal participation (LaPier & Mizner, 2009). The LLFDI is a patient-report measure, rather than a measure of observed physical performance (Bean, Ölveczky, Kiely, LaRose, & Jette, 2011). It has demonstrated significant concurrent and predictive validity with no apparent floor or ceiling effects (Sayers et al., 2004). Moderate to high test-retest reliability has also been shown (Gibson et al., 2010).

The LLFDI was specifically developed to assess the function and disability of older adults living in the community. Whilst it provided very good discrimination in patients with moderate levels of ability, it provided relatively less discrimination for those patients with lower or higher levels of ability (Jette et al., 2012). This was due to practical restrictions precluding the inclusion of items to assess extreme levels of ability (Jette et al., 2012). Another limitation of using the LLFDI in the clinical setting was the long administration time/cost and subsequent response burden to the patient (LaPier et al, 2009).

2.10.2 LLFDI –CAT (computer adaptive test)

The LLFDI-CAT was developed in 2012 to specifically overcome limitations of the original LLFDI, as well as to provide a more sensitive, precise and comprehensive measure of the two domains of activity limitation and participation restriction. The number of items increased,
with 141 activity limitation items and 55 participation items, with the retention of 48 of the original 64 items (Jette et al., 2012).

This revised instrument was designed using item response theory (IRT) and computer adaptive testing (CAT). IRT allows researchers to develop quantitative scales that are sensitive to smaller functional change often seen in the older patient (Jette, Haley, Ni, Olarsch, & Moed, 2008). IRT methods can also be helpful in developing improved health outcome measures over time (Fayers, 2007; Hays, Morales, & Reise, 2000).

CAT instruments require a comprehensive item bank that contains items representing low to high levels of ability. A computer algorithm selects items based on prior responses, thus tailoring the administration of the instrument to the patient. The LLFDI-CAT demonstrated good validity and reliability in field testing as well as being acceptable to older adults (McDonough et al., 2012). The revised instrument addressed issues identified with the original instrument (a traditional, fixed-form test), providing improved precision across the continuum of functional ability, from low to high and a reduction in administration time and response burden (Jette et al, 2012).

The LLFDI-CAT consists of two domains (and two subdomains within each: activity limitation (basic mobility and handling and daily activities) and participation restriction (social roles and instrumental roles). Age and gender are inserted prior to execution of the instrument. The LLFDI-CAT will stop when a standard error of 3 is achieved for the domain score or a maximum of 10 items have been administered to improve test reliability (Jette et al, 2012). Examples of each sub domain are as follows. See Table 2.2.
Table 2.2 Examples of sub domains (Jette et al, 2012)

<table>
<thead>
<tr>
<th>Sub-domain</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic mobility and handling</td>
<td>Standing, lifting and carrying</td>
</tr>
<tr>
<td>Daily activities</td>
<td>Self-care, grooming and household chores</td>
</tr>
<tr>
<td>Social roles</td>
<td>Interpersonal relationships, social engagement, community participation</td>
</tr>
<tr>
<td>Instrumental roles</td>
<td>Ability to fulfil personal, social, financial and occupational responsibilities</td>
</tr>
</tbody>
</table>

The application of CAT to the LLFDI has been demonstrated to reduce the time required for administration whilst also maintaining accuracy, precision or sensitivity to change. It provides a way of addressing the need for accuracy in clinical assessment and the equal need for practicality of administration (Jette et al, 2008).

2.11 The Public Health Model

The Public Health approach to injury prevention was chosen to situate the research undertaken in this study within the processes necessary to develop and disseminate preventive action to reduce non-occupational ladder falls in older men. (Figure 2.1).
The first step of the public health model for injury prevention defines the injury problem, by accessing data to identify the importance of the issue – this first step in the area of falls from ladders in the non-occupational setting has been the focus of much of the research to-date. The second step identifies the risk and protective factors, and identifies the most strategic causes of the problem, which are both substantively important and amenable to change. The review of the literature undertaken for this study has demonstrated that non-occupational falls from ladders is a significant and growing problem, and one which predominantly affects older men (Oxley et al, 2014; Miu 2015; Valmuur et al, 2016). However, research to address the second and later steps in the public health model is still in its infancy with few studies to inform action. The research which will be presented in this thesis will focus on the population
of older non-occupational ladder fallers admitted to a hospital in NSW to further describe the incidence and outcomes of falls, and to identify potential risk and protective factors using medical records. The identification of risk and protective factors is further investigated in qualitative interviews with a sample of men following discharge from hospital (addressing the types of questions posed in step two of the model). These interviews also sought to understand the situation and motivators to older men climbing ladders, thus moving the field of study towards step three of the model, providing insights to inform the development of injury prevention strategies to reduce the incidence of falls from ladders in older men in the non-occupational setting. After injury prevention strategies have been developed, they must be tested and evaluated using good scientific methodology and those which are shown to be effective disseminated or adopted widely (step four). These final steps of the public health model are outside the scope of this thesis.

This chapter has provided an overview of the current literature related to ladder use in general as well as within the specific context of non-occupational falls from ladders in older men. The scales used within the thesis have been introduced and the thesis focus and contribution has been situated within the Public Health Model approach to injury prevention. The next chapter will provide an introduction to ladder types, the Australian and New Zealand standards that govern their design and manufacture and the inter relationships between man, environment and ladder in the safe use of ladders.
Chapter 3 Ladders

This chapter provides a brief overview of various types of ladders, and the necessary considerations required in the safe use of ladders: surface/coefficient of friction, angle of inclination, the three-point rule of contact, and other considerations that impact on safe ladder use. The Australian and New Zealand Standards that govern the design and development of ladders, and which provide guidance on safe ladder use are also presented.

3.1 Types of ladders

There are two broad categories of ladders, fixed and portable. Fixed ladders can be either permanently attached to a structure for access (Hsiao et al., 2008) or temporarily attached to structures as in the construction industry (Goldsmith, 1985) to provide access for maintenance and operation of equipment. Fixed ladders are more stable than portable ladders (Armstrong et al., 2009). For the purposes of this thesis, fixed ladders will not be discussed further given their primary use in construction/workplace settings. Portable ladders include stepladders and straight and extension ladders that are leaned against a structure. Stepladders can be used as temporary work platforms while straight and extension ladders can be used for a variety of purposes in the building, construction and maintenance settings (Hsiao et al, 2008).

Ladders are manufactured from various materials; aluminium, wood or fibreglass (Goldsmith, 1985). Aluminium ladders are light weight making them easy to transport. The open shapes of these ladders can predispose them to metal fatigue causing twisting, folding or bending under stress. Aluminium ladders can also be insufficient in providing sufficient grip to the ground (Goldsmith, 1985). Wood and fibreglass ladders are safer than aluminium as these ladders are non-conductive to electrical current and are stronger due to their rigid and solid
composition (Goldsmith, 1985). Wooden ladders can also weaken if not stored properly (Goldsmith, 1985). Fibreglass ladders were originally developed for electrical utilities (Etherton et al, 2007) due to the good insulating properties of fibreglass (Beyer, McCarthy, & Wood, 1994). Fibreglass ladders are stronger than ladders made from wood and aluminium and do not absorb water, hence will not corrode (Etherton, Ronaghi, & Current, 2007). Fibreglass ladders have a higher degree of stiffness than other manufacturing materials hence requiring a lower COF at the bottom of the ladder. As a result, the ladder is more stable (Chang et al, 2005). Fibreglass tends to be more expensive than aluminium and heavier, hence potentially making the ladder more difficult to control and the impact greater should it fall striking a person in its fall path (Beyer et al, 1994). Etherton et al (2007) state that fibreglass is steadily replacing aluminium and wood in residential ladders and is holding a significant market share in industrial ladders.

3.1.1 Stepladders

A stepladder is a self-supporting portable ladder that is non-adjustable in length, with flat steps and a hinged design (American Ladder Institute, 2016). Stepladders (Figure 3.1) continue to be a major cause of injury both in the home and at work (Clift, Navarro, & Thomas, 2002) with the most common mechanism of injury associated with the sideways tipping of the ladder (Axelsson & Carter, 1995). Older stepladders are less rigid and tend to be more compliant in a lateral direction, meaning that the ladder is more prone to tilting sideways (Yang & Ashton-Miller, 2006). This tendency of the ladder to tilt sideways places demands on the user’s ability to balance in order to stabilise the ladder (Yang & Ashton-Miller, 2006), further hindered by the narrow step width of the stepladder which limits the ability to stabilise the faller’s body in the event of the person slipping (Tichon et al., 2011). Other common mechanisms of injury include failure of the stepladder due to railing and
bracing failure (bending/twisting/breaking due to lack of strength for force imposed) and unstable conditions such as an uneven surface, weight shift of the person climbing the ladder, leaning a stepladder against the wall, and standing on the top of a stepladder (Goldsmith, 1985). The implications of excessive twisting in stepladders can be significant, as this can cause the ladder to shift leaving only three legs in contact with the ground (Seluga, Ojalvo, & Obert, 2007) thus causing the step ladder to tip over (Van Bree, Knox, Smith, & Eganhouse, 2010).

Attention to stepladder design and labelling has been suggested (Clift et al., 2002) including wider construction at the bottom of the ladder to reduce sideways falls (Björnstig & Johnsson, 1992). Injuries on stepladders occur often because there appears to be a mismatch between the expectations of the stepladder by the user and the safety recommendations displayed on the ladder (Clift et al., 2002).
3.1.2 Single/straight ladder

Portable straight ladders (Figure 3.2) are common tools used to ascend or descend a temporary location (McIntyre, Smith, & Jackson, 1983). They are used for a variety of reasons and by users of varied ability, the combination of which leads to ladder related incidents (McIntyre, Smith, & Jackson, 1983). A common fall scenario seen with straight ladders is that the ladder slips out while in use and slips away from the vertical surface leading to a fall (Young & Woglater, 2000). This mechanism occurs when the required friction exceeds the available friction at the ladder shoe and floor surface (Chang, Chang, & Matz, 2005). The risk of sliding at the base increases as the angle of inclination decreases and as the load moves up from the base (Pesonen & Hakkinen, 1988).
3.1.3 Extension ladder

Extension ladders (Figure 3.3) come in various lengths and require a supporting structure for it to be placed against (Goldsmith, 1985). Many injuries due to the misuse of straight extension ladders result from user failure to recognise the limitations of the ladder (for example, standing on the top rung, and over extending his reach) and the failure to adjust the ladder to a safe angle of inclination (Bloswick & Crookston, 1992). These failures are often exacerbated by the substantial heights these ladders can reach and the inherent instability that can occur as a result of this (Lewis, 2004). Other failures of extension ladders occur due to unstable conditions, insufficient friction due to unsafe ladder shoes, and potential failure of extension ladder locks that hold the upper and lower sections (Goldsmith, 1985). Therefore, it is important to ensure that all extension ladder locks are locked together before use (Bjornstig and Johnsson, 1992). Safety could be improved by getting someone to hold the...
ladder (Lewis, 2004) and avoid climbing above the fifth or sixth step from the top and leaning sideways (Bloswick & Chaffin, 1990).

![Diagram of an extension ladder](http://www.americanladderinstitute.org/?page=Ladders101)

**Figure 3.3. Diagram of an extension ladder.** Reproduced with permission from the American Ladder Institute. http://www.americanladderinstitute.org/?page=Ladders101

3.2 Principles and considerations around the safe use of ladders

There are three key principles that are well described in the literature that are pivotal in the safe use of ladders. These will now be discussed with some further considerations also addressed.
3.2.1 Surface/coefficient of friction (COF)

The coefficient of friction (COF), a value of the relationship between the force of friction between two surfaces is dependent on the subject, and ladder weights/length and subject location on the ladder (Chang, Chang, & Matz, 2005). A faster climbing speed increases the normal and shear forces, as well as the required COF, therefore increases the potential for a slip at the base of the ladder (Chang, Chang, Matz & Son, 2004). When considering the COF given different human factors when climbing a ladder, the smaller and less rigid a surface is to stand on, the greater the risk of loss of balance of the climber and the more difficult to make a recovery (Tichon, Baker & Ojalvo, 2011). A portable ladder will slip at the bottom of the ladder when the required friction to support human activities on the ladder exceeds the available friction at the interface (Chang, Chang, Matz, & Son 2004).

Ladder shoe and floor surfaces, the applied normal force, and the contaminants (water, soil, oil) affect the available friction at the ladder shoe and floor interface (where the ladder shoe touches the floor). The probability of a slip incident on dry surfaces is much lower than that on oily floor conditions due to a higher available friction coefficient on dry surfaces. Plywood and concrete provides greater friction than a steel or plastic floor (Pesonen & Hakkinen, 1988). Other surfaces discussed in the literature include ice, snow, sliding carpet (Bjornstig & Johnnson, 1992), ceramic tiles, grass and timber (Cohen & Lin, 1991). Rubber feet on the bottom of the ladder are recommended as they are visible to the ladder user when they wear out (Lewis, 2004).

In a normal standing position, there is pressure on the heel and ball of foot. When up a ladder, the pressure distribution is reversed, especially with narrow steps which provide a smaller base of support. Therefore, the shoes worn by climbers should be thin hard soles which have better stability than thick soft soles (Tichon et al., 2011).
3.2.2 Angle of inclination

From an injury prevention perspective, the most critical parameter for friction requirement at the base of the ladder is the inclined angle of the ladder (Chang, Chang, Matz, & Son, 2004). There are a number of methods in which to set up and measure the safe inclination angle of the ladder before use. The 4:1 method of setting up a ladder suggests the working length of the ladder should be four times the distance from the ladder base to the wall (Figure 3.4) (Bloswick & Chaffin, 1990; S. Young & Wogalter, 2000). This results in a 75.5-degree inclined angle if done correctly (Chang, Chang, Matz & Son, 2004). This is also known as the quarter length rule, which is the current standard of the American National Standards Institute (ANSI) (Simeonov, Hsiao, Kim, Powers & Kau, 2012) and of the Australian and New Zealand Standards (1892 5: 2000). The ladder angle 4:1 is recommended as a safe angle to set the ladder up on the basis of friction requirements however without any specific instructions or knowledge, homeowners appear to set the angle of inclination according to the length of the ladder that is, the longer the ladder, the steeper the angle of inclination (Irvine & Vejvoda, 1977). Very steep angles decrease the stability of the user toward the top of the ladder, leading to a very high chance of the ladder tipping over (S. Young & Wogalter, 2000). Conversely, ladder users may also have a natural tendency to position their ladder at a suboptimal angle, that is, at less than seventy degrees or at 3:1 (Simeonov, Hsiao, Kim, Powers, & Kau, 2012) that is, too shallow (S. Young & Wogalter, 2000). This means that the ladder is less steep, making the ladder more likely to slip (S. Young & Wogalter, 2000).

There is increased stability at 4:1 but perhaps increased difficulty in climbing the ladder (Simeonov, Hsiao, Kim, Powers & Kau, 2012).
Three further methods for setting the ladder at the correct angle are both derived from the anthropometric (‘human’) perspective. These methods include a method described by Irvine & Vejvoda (1977) whereby the user stands in front of the ladder then takes a position with their toes against the ladder rails and places their arms extended straight ahead. If their hands fall comfortably on the ladder rungs, the ladder is safe for climbing. The fireman method is described by Simeonov et al. (2012) and is a slight variation from the methods of Irvine and Vejvoda. Horizontal outstretched hands hold onto the side rails instead of the rungs. In another method, Bloswick and Chaffin (1990); (Bloswick & Crookston, 1992) recommend the utilisation of a plumb bob to increase the consistency of correct ladder placement. A plumb bob is used typically to ensure things are level. In this instance, the plumb bob is attached to the ladder. When the plumb bob aligns to a predetermined mark on the ladder, the ladder is at the correct slant. Despite these methods, many ladder users do not measure the inclined angle and as such, information on how to set a ladder up may be an important strategy to reduce accident (Simeonov et al., 2012).
Considering both the angle of inclination and friction requirements, Chang, Chang, Matz & Son (2004) investigated the friction requirements for different climbing conditions and found the inclined angle of the ladder to have the most significant effect on the required friction at the bottom of the ladder. The required coefficient of friction (a value of the relationship between the force of friction between two surfaces) increased by 77% on average when the inclined angle was reduced from 75 to 65 degrees. An angle of less than 65 degrees between ladder and ground was involved in 49% of straight ladder accidents (Axelsson, 1995). Normal and shear forces increased as the inclined angle of the ladder decreased. The shear force and friction coefficient increased as the subject climbed higher on the ladder (Chang, Chang, Matz & Son, 2004).

There are three types of labels or indicators on ladders to assist with accurate ladder angular positioning; the anthropometric label, the bubble level indicator and multimodal indicator were compared. The anthropometric label is affixed to the side of the ladder and provides visual cues (both diagrams and text) on how to safely set up a ladder. The limitation with such labels is that the labels provide indirect feedback to the climber due to the position of the labels on the side of the ladder (out of the direct vision of climbers) (Simeonov et al., 2013). These labels and indicators were evaluated for their effectiveness in achieving accurate ladder angulation. The multimodal indicator, an accessory that provides both visual and auditory feedback on ladder position, significantly improved both the accuracy and efficiency of ladder angular positioning (Simeonov, Hsiao, Powers, Kim, Kau & Weaver, 2013). In a similar study, Campbell & Pagano (2014) found that despite study participants studying the instructions prior to setting up the ladder, a wide range of results were identified. There was clear confusion with the instructions on some labels, leading to error. There appears to be a reliance on personal preference and experience.
3.2.3 The three-point rule of contact

The three-point rule of ladder safety is well described in the literature and a crucial aspect of ladder safety for ascending and descending a ladder, but rarely practiced (Logsdon, 2005). At any given time, there needs to be two hands and one foot or two feet and one hand engaged to ensure maximum stability (Logsdon, 2005). Ladder climbing requires whole body coordination to maintain the points of contact using both the upper and lower body (Schnorenberg, Campbell-Kyureghyan, & Beschorner, 2015). A ladder should not be used if the user cannot sustain three-point contact, maintain balance and perform a task.

A number of factors in the climber impact on the contact of the hands with the ladder. Barnett and Poczynok (2001) suggest that the hand grip is affected by gender, age, hand dominance, skin temperature, wearing gloves, posture of arm and wrist, movement of wrist and grip span. To assist with hand grip, ladder rails need to have adequate gripping surfaces with no sharp edges or splinters. (J. Young, Woolley, Armstrong, & Ashton-Miller, 2009) As discussed in Chapter 2, grip strength and the ability to hang onto handholds diminishes with age (Haigh, 1993).

3.2.4 Other considerations

There are a number of other considerations that also impact on safe ladder use. There are implications to the structural integrity of the ladder after a ladder falls over (Van Bree et al, 2009). For example, in stepladders there is usually damage to the spreader bars (hinge members affixed to the sides of the stepladder that facilitate folding), and attempts to straighten these bars may compound the damage (Van Bree et al, 2009). The user needs to ensure that the right ladder is chosen for the job as a climbing tool perfect in one situation will not automatically work in another. Unsafe ladders should be removed and disposed of
(Miller, 1997). Ladders may become unsafe if they have, for example, damaged rails, or become warped, split, rotted or rusted (Cohen & Lin, 1991). Bracing failures due to bending, breaking or twisting also indicate damage to the ladder (Goldsmith, 1985). Loose or bent spreader bars, damage to extension locks, worn non-slip ladder shoes and loose metal parts such as screws, are also signs of an unsafe ladder (Tufts University, 2017).

Certain steps of the ladder are important to consider. The lower ladder steps of a ladder receive the most wear and tear as they are always under load. Further, the confidence of the climber increases as they approach the ground, hence the stride is more forceful, also contributing to the wearing of the lower steps (Eisenberg, 1995). Axelsson & Carter (1995) stated that the final step (bottom step) of a ladder can be hazardous to the individual as the user is unable to easily visually perceive the transition from ladder to surface. The distance of the surface to the bottom rung is consistently less than the standardised distance between the remaining rungs. The authors suggest that the distance between all ladder rungs should be equidistant throughout. Further, ladders are designed for an average man (Dewar, 1977). Tall and short people must therefore modify their movement pattern whilst climbing which may increase the risk of accidents.

The role and position of the foot is important in preventing the climber from slipping off the ladder (McIntyre et al., 1983). The foot is the main supporting load between the ladder and climber and as such, it is vital that the foot stabilises in order to accept the climber’s weight. Any alterations in body angle or failure to control body movement, may lead to the climber slipping (Pliner et al, 2014). Any ladder that constrains a climber’s foot placement and/or restricts toe clearance, will increase the climber’s chance of slipping (Pliner et al, 2014). Improving safety requires supplying information continuously to the ladder climber via the foot, as it permanently adjusts and affects balance (Jüptner, 1976).
Finally, Kines (2003) reports a mistaken impression that no special skill or knowledge is needed to use a ladder. Falls occur even when the situation is perceived as being non-hazardous (low heights for example) and unsafe behaviour is rarely punished but often rewarded (save time and money for example). There needs to be reinforcement of the importance of always having someone hold a straight or extension ladder while it is being used or until it can be safely secured to a fixed object. Multi-tasking causes information processing and behaviour to become complex. The ladder user is dealing with complex biomechanical activity, perceived conflicting goals and so on. The combination of applying skills, rules and knowledge leads to a greater need for mental energy.

3.3 Australian and New Zealand Standards

The Australian and New Zealand standards provide ladder manufacturers with a set of minimal constructional and safety requirements for the design and manufacture of each of the above-mentioned ladder types. A number of Australian and New Zealand standards exist for ladders as follows:

- AS/NZS 1892.1:1996 Portable ladders Part 1: Metal
- AS/NZS 1892.5:2000 Portable ladders Part 5: Selection, safe use and care


Ladder falls continue to rise despite these standards (Bedi & Goldbloom, 2008). The various standards provide the minimum recommended safe practices and requirements for the selection, use and maintenance of portable ladders. The aim therefore is to provide ladder users with the information required to minimise risks to both their safety and the safety of
others whilst working with or near portable ladders (Standards Australia/Standards New Zealand, Portable ladders, 2000). However, the Australian standards relating to ladders are not freely available, and must be purchased from Standards Australia, thus incurring a cost for the householder. Further, education and training on the implementation of the standards are not readily available in the non-occupational setting, and there is no process for monitoring or enforcing the use of the standards in the non-occupational setting.

What is clear from this review, is that the process of using a ladder safely and within recommended guidelines, is complex. This arises as a result of the many factors that need to be considered such as the COF, the three point rule of contact, and the physical parameters such as height and grip strength. Ladder safety is complicated by the debate on what technique is best to use when setting up the ladder and the impact this debate may have on the untrained ladder climber in the non-occupational context.

This chapter has provided an overview of the structural and related human factor considerations in the safe use of ladders. The types of ladders have been presented indicating their standard features and associated safety considerations. The range of factors highlighted suggests that the prevention of ladder falls is challenging.

The following chapter describes the quantitative research undertaken for this study to explore non-occupational ladder falls in older men, utilising data from hospital medical records and the hospital trauma registry, and questionnaire responses from a subsample of participants.
Chapter 4 Quantitative component

This chapter provides the reader with a description of the quantitative research undertaken for this study, and describes the methodology and findings from a detailed review of the trauma and hospital medical records for older men presenting with a non-occupational ladder fall. It also includes an analysis of the questionnaire responses (the LLFDI-CAT) from a sample of men who were interviewed following their injury. Finally, the chapter concludes with a discussion of the findings in relation to other published literature. This chapter addresses the following research question:

*What is the epidemiology of non-occupational falls among older men (aged 50 years and over) presenting to a major trauma service in Australia?*

4.1 Methods

4.1.1 Study inclusion and exclusion criteria

This study sought to identify all males aged 50 years and over, who had fallen from a ladder in the non-occupational context (that is, whilst undertaking unpaid work such as ‘do-it-yourself’ home maintenance) with injuries such that their names were listed on the hospital trauma registry. The hospital trauma registry contains clinical and demographic data on all patients (including detail of injury, injury severity score and mechanism of injury) admitted to the hospital with an injury under the care of a Specialist Consultant. Patients who were admitted under the care of a Specialist Consultant and subsequently discharged from the Emergency Department without being admitted to a ward, were eligible for inclusion in the study, as such patients are included on the hospital trauma registry. Males who were admitted under the care of an Emergency Medicine physician or not admitted (in both cases, thus not included on the hospital trauma registry) were excluded. Males who had fallen in
the occupational setting were also excluded from the study. Participants were de-identified at the time of data entry by the researcher by use of a unique study number.

4.1.2 Data collection

Identification of eligible patients was made through a review of the hospital trauma registry for the period February 1, 2011 to December 31, 2013. Patients who fell were identified from the hospital trauma registry using code W11 (fall from a ladder) from the Australian Modification of the International Classification of Diseases (ICD10-AM). Patient medical records were then reviewed to identify patients meeting the inclusion criteria.

Quantitative data were gathered by retrospective reviews of the hospital trauma registry and from patient medical records. Data extracted from the hospital trauma registry included medical record number, age, Injury Severity Score (ISS), length of stay in the Intensive Care Unit (if applicable), injury codes, body regions injured and injury severity (Abbreviated Injury Scale [AIS] for each individual injury sustained), and outcome of admission (survived or deceased).

For each patient, the number of injuries per body region was determined, as well as the total number of injured body regions and the total number of injuries overall. There are nine body regions in total as per the AIS (Stevenson et al., 2001); head, face, neck, chest, abdomen, spine, upper extremity, lower extremity and external (for example abrasions, bruises and lacerations to the skin). In addition to this, the number of injuries per severity category for each body region were collected from the hospital trauma registry. The highest severity score overall was then recorded for each body region.

Data extracted from the medical record (which included the ambulance report where relevant) included height fallen, the reason for climbing the ladder, the mechanism of injury, location
of the fall (inside or outside), the day of the week of the fall, length of stay, admission
destination, discharge destination, type of ladder used, age of patient, season during which
the patient fell, whether the patient had surgery, ISS and whether certain classifications of
drugs were being taken by the patient at the time of the fall (cardiac, psychotropic, alcohol,
ilicit, other). The categorisation of reasons for climbing the ladder were guided by the
literature (for example, Bjornstig & Johnsson, 1992). Where conflicting documentation
around fall circumstances was evident in the records, for example, differing fall height and
mechanism of the fall, the ambulance report was used. Ambulance paramedics attended the
scene of the fall and were the first to record details of the event from witnesses or the patient
and were best placed to directly observe the position of the ladder and the patient in the
context of the overall scene. Medications chosen for analysis were those identified in the
literature as predisposing the older person to falls or potentially impacting the outcome of a
fall: anticoagulant, antiplatelet, oral hypoglycaemic, cardiac, non-steroidal anti-inflammatory,
and psychotropic (e.g. antidepressant, anti-psychotic or anxiolytic) medications (Holleran,
data complemented and added to the data from the hospital trauma registry.

4.1.2.1 Activity based funding (ABF)
The activity based funding (ABF) was collected in this study to identify the cost of care of
these patients to the health system. ABF is paid to hospitals by the Commonwealth
Government, for the care (or activities) provided to patients (Eager, 2011). The ABF amount
was collected directly from the medical record, but was not available for all patients, as it was
introduced for admitted patient services approximately midway through the data collection
period (that is, July 2012).
4.1.2 Late Life Functional Disability Instrument (LLFDI)

LLFDI-CAT data was only collected from eleven out of the twelve patients who consented to be interviewed (see Chapter 5). Participants answered questions for the LLFDI-CAT for both their pre-fall (as recalled by them) and their post fall (current) functional status.

4.1.3 Statistical analysis

Basic descriptive analysis was undertaken on demographic data and costs, ladder and fall related variables, other risk factors and injury outcomes. Two-sample t tests were used to test for statistically significant differences between patient groups with particular characteristics for normally distributed variables (e.g. age). Non-parametric tests were used to test for statistically significant differences between groups for variables with non-normal distributions (e.g. length of stay and ISS). Specifically, the Mann Whitney test was used where two independent samples were being compared, and the Kruskal-Wallis H test where there were more than two independent samples. The Spearman’s Rank Correlation Coefficient was used to test for association between length of hospital stay and Injury Severity Score, in line with recommendations by Linn (1995) that parametric statistics which assume the continuous and normal distribution of scores should be avoided in the statistical analysis of the ISS. A paired t test was used to examine the relationship between LLFDI-CAT scores before and after the fall, for the subset of patients who were interviewed.

Statistical analysis was undertaken using SPSS version 22 statistical software.
4.2 Results

4.2.1 Study participants

Eighty-six patients who met the inclusion criteria were identified for this study. Patients ranged in age from 50–85 years, with the mean age being 64.7 years. See Table 4.1.

<table>
<thead>
<tr>
<th>Age range, years</th>
<th>Frequency (n)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>50–55</td>
<td>13</td>
<td>15.1%</td>
</tr>
<tr>
<td>56–60</td>
<td>15</td>
<td>17.4%</td>
</tr>
<tr>
<td>61–65</td>
<td>23</td>
<td>26.7%</td>
</tr>
<tr>
<td>66–70</td>
<td>9</td>
<td>10.5%</td>
</tr>
<tr>
<td>71–75</td>
<td>17</td>
<td>19.8%</td>
</tr>
<tr>
<td>76–80</td>
<td>8</td>
<td>9.3%</td>
</tr>
<tr>
<td>&gt; 80</td>
<td>1</td>
<td>1.2%</td>
</tr>
<tr>
<td>Total</td>
<td>N = 86</td>
<td>100%</td>
</tr>
</tbody>
</table>

4.2.2 Ladder and fall related factors

Table 4.2 shows the results of the variables collected from the medical record of each patient for height fallen (categorised into four groups: ≤ 1.5m, 1.6-2m, 2.1-3m and > 3m) and mechanism. Just over half of the patients (59.3%) fell more than two metres. Where specified, the most common single mechanism of falls recorded was a collapse of the ladder (20.8%), followed by the ladder slipping (18.8%). Patient related-factors (patient falling backwards, tripping, sliding on the rung or losing their balance) together accounted for 31.3% of falls.

Table 4.3 shows the results of the variables collected from the medical record of each patient for location of fall, reason for climbing the ladder, day of the week and season in which the
fall occurred. Where the location of the fall was specified within the medical record, most (87.7%) occurred outside of the home. Where the reason for climbing the ladder was specified, most men fell while undertaking general home maintenance, including cleaning and painting (34.7%), gardening (28.6%) or cleaning gutters (20.4%). If no data on a variable was found in the medical record, the variable was recorded as ‘not specified’.

Falls commonly occurred on a weekend, with 22.1% occurring on a Sunday and 18.6% on a Saturday; and one third of falls (34.9%) occurred during the Spring season. Ladder type was rarely specified in the medical record (only available for eight cases), thus severely limiting any results in relation to this variable.

### Table 4.2 Ladder/fall-related variables — height fallen and mechanism (N=86)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Frequency (n)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Height fallen</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤ 1.5 m</td>
<td>18</td>
<td>20.9%</td>
</tr>
<tr>
<td>1.6–2 m</td>
<td>17</td>
<td>19.8%</td>
</tr>
<tr>
<td>2.1–3 m</td>
<td>28</td>
<td>32.6%</td>
</tr>
<tr>
<td>&gt; 3 m</td>
<td>23</td>
<td>26.7%</td>
</tr>
<tr>
<td><strong>Mechanism</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ladder collapsed</td>
<td>10</td>
<td>20.8%</td>
</tr>
<tr>
<td>Ladder slipped on surface</td>
<td>9</td>
<td>18.8%</td>
</tr>
<tr>
<td>Ladder slid to side</td>
<td>4</td>
<td>8.3%</td>
</tr>
<tr>
<td>Patient slid/tripped on rung</td>
<td>6</td>
<td>12.5%</td>
</tr>
<tr>
<td>Patient fell backwards</td>
<td>5</td>
<td>10.4%</td>
</tr>
<tr>
<td>Patient lost their balance</td>
<td>4</td>
<td>8.3%</td>
</tr>
<tr>
<td>Other¹</td>
<td>10</td>
<td>20.8%</td>
</tr>
<tr>
<td>Missing data²</td>
<td>38</td>
<td></td>
</tr>
</tbody>
</table>

¹ Other mechanisms included the ladder flipping over the fence, the patient’s ankle becoming caught between two rungs of the ladder, the ladder being struck by a tree branch, the patient trying to transfer to another ladder; the patient falling forward; the patient overreaching, the patient using an uneven ladder; using a chainsaw whilst on the ladder and the ladder moving (direction not specified).

² How the patient landed is often described (for example, onto head, onto right side) but not the mechanism.
Table 4.3 Fall-related variables (N=86)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Frequency (n)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Location</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inside</td>
<td>8</td>
<td>12.3%</td>
</tr>
<tr>
<td>Outside</td>
<td>57</td>
<td>87.7%</td>
</tr>
<tr>
<td>Not specified</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td><strong>Reason for climbing ladder</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General home maintenance</td>
<td>17</td>
<td>34.7%</td>
</tr>
<tr>
<td>Gardening</td>
<td>14</td>
<td>28.6%</td>
</tr>
<tr>
<td>Cleaning gutters</td>
<td>10</td>
<td>20.4%</td>
</tr>
<tr>
<td>Other¹</td>
<td>3</td>
<td>6.1%</td>
</tr>
<tr>
<td>Renovating</td>
<td>3</td>
<td>6.1%</td>
</tr>
<tr>
<td>Changing light globe</td>
<td>2</td>
<td>4.1%</td>
</tr>
<tr>
<td>Not specified</td>
<td>37</td>
<td></td>
</tr>
<tr>
<td><strong>Day of week</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monday</td>
<td>12</td>
<td>14%</td>
</tr>
<tr>
<td>Tuesday</td>
<td>12</td>
<td>14%</td>
</tr>
<tr>
<td>Wednesday</td>
<td>10</td>
<td>11.6%</td>
</tr>
<tr>
<td>Thursday</td>
<td>9</td>
<td>10.5%</td>
</tr>
<tr>
<td>Friday</td>
<td>8</td>
<td>9.3%</td>
</tr>
<tr>
<td>Saturday</td>
<td>16</td>
<td>18.6%</td>
</tr>
<tr>
<td>Sunday</td>
<td>19</td>
<td>22.1%</td>
</tr>
<tr>
<td><strong>Season</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Summer</td>
<td>12</td>
<td>14%</td>
</tr>
<tr>
<td>Autumn</td>
<td>24</td>
<td>27.9%</td>
</tr>
<tr>
<td>Winter</td>
<td>20</td>
<td>23.3%</td>
</tr>
<tr>
<td>Spring</td>
<td>30</td>
<td>34.9%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>N = 86</td>
<td>100%</td>
</tr>
</tbody>
</table>

¹ Other reasons for climbing the ladder included retrieving a grandchild’s ball from the roof, looking on top of a wardrobe, and retrieving a box off the shelf.

4.2.3 Medication, alcohol and other drug use prior to fall

Table 4.4 shows the number of patients taking one or more medications in a drug class which may be relevant to a ladder fall either in terms of causality or outcome. Cardiac medications
were the most common category of medication being used (n= 43; 50% of patients); followed by anticoagulant/anti-platelet medications (n=18; 20.9%). Around one in ten patients were taking psychotropic medication (n=9; 10.5%) or oral hypoglycaemics (n=9; 10.5%). Only one patient had reportedly consumed alcohol immediately prior to climbing the ladder. There was no documentation in the medical records of any patient taking illicit drugs.

Table 4.4 Drug class, alcohol and other drug use among patients (N=86)

<table>
<thead>
<tr>
<th>Drug class</th>
<th>Frequency (n)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiac¹</td>
<td>43</td>
<td>50%</td>
</tr>
<tr>
<td>Psychotropic²</td>
<td>9</td>
<td>10.5%</td>
</tr>
<tr>
<td>Non-steroidal anti inflammatory</td>
<td>5</td>
<td>5.8%</td>
</tr>
<tr>
<td>Oral anticoagulant/anti-platelet</td>
<td>18</td>
<td>20.9%</td>
</tr>
<tr>
<td>Oral hypoglycaemic</td>
<td>9</td>
<td>10.5%</td>
</tr>
<tr>
<td>Parkinson’s disease medication</td>
<td>1</td>
<td>1.2%</td>
</tr>
<tr>
<td>Opioid analgesia</td>
<td>2</td>
<td>2.3%</td>
</tr>
<tr>
<td>Inhaled glucocorticoid/bronchodilator</td>
<td>3</td>
<td>3.5%</td>
</tr>
<tr>
<td>Alcohol³</td>
<td>1</td>
<td>1.2%</td>
</tr>
<tr>
<td>Other⁴</td>
<td>10</td>
<td>11.6%</td>
</tr>
</tbody>
</table>

¹ Includes drugs to treat hypertension, arrhythmias, hypercholesterolaemia, hyperlipidaemia and angina.
² Includes anti-depressants, anti-psychotics, anti-anxiety medications and benzodiazepines.
³ Only alcohol consumed prior to climbing the ladder was considered.
⁴ Includes drugs from the following classes: proton pump inhibitors, vitamins, antibiotics, oral chemotherapeutics, anti-glaucoma eye drops and diuretics.

Of the 18 patients identified as taking either an anticoagulant or antiplatelet medicine prior to their fall, eight were recorded as having sustained injuries that resulted in bleeding. Two of the three patients on Warfarin (anticoagulant) sustained bleeding related to their injuries (one with a haematoma in the psoas muscle, and the other with a cerebral haemorrhage). Of the fifteen patients taking either Aspirin or clopidogrel (antiplatelet), six had bleeding related to their injuries (a scalp laceration that required stapling followed by a blood transfusion of two units of packed cells, a sub dural haematoma and occipital haematoma to the brain, haematomas to the muscles around the sacrum and pelvis, an intramural haematoma (infra
renal aorta) from a fracture to the femur and a haemothorax from a chest injury). Table 4.5 shows the medication count for each patient. Thirteen percent of patients were on 5 or more medications. However, no reference to polypharmacy as a possible predisposing factor for the fall was noted in the medical records.

Table 4.5 Number of medications being taken by patients (N=86)

<table>
<thead>
<tr>
<th>Number of medications</th>
<th>Number of patients (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>34 (39.5%)</td>
</tr>
<tr>
<td>1</td>
<td>10 (11.6%)</td>
</tr>
<tr>
<td>2</td>
<td>13 (15.2%)</td>
</tr>
<tr>
<td>3</td>
<td>8 (9.3%)</td>
</tr>
<tr>
<td>4</td>
<td>10 (11.6%)</td>
</tr>
<tr>
<td>≥ 5</td>
<td>11 (12.8%)</td>
</tr>
<tr>
<td>Total</td>
<td>86 (100%)</td>
</tr>
</tbody>
</table>

4.2.4 Fall-related injuries

Table 4.6 shows the number of injuries by body region and the total number of injuries sustained. Almost one half of patients (44.2%) had sustained an injury to more than one body region; and around two thirds of patients (62.8%) had sustained more than one injury. Table 4.7 shows the number of injuries sustained per patient across the nine body regions. The upper limbs, head, lower limbs and spine were the most commonly affected body regions, with 37%, 30%, 29% and 27% of patients respectively sustaining an injury to these areas. Multiple injuries to a body region were most common with head, chest, spine and lower limb injuries.
Table 4.6 Number of injuries sustained, by body region and per patient (N=86)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Frequency (n)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of body regions injured</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>48</td>
<td>55.8%</td>
</tr>
<tr>
<td>2</td>
<td>21</td>
<td>24.4%</td>
</tr>
<tr>
<td>3</td>
<td>10</td>
<td>11.6%</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>4.7%</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>3.5%</td>
</tr>
<tr>
<td>Total injuries sustained by patients</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>32</td>
<td>37.2%</td>
</tr>
<tr>
<td>2</td>
<td>13</td>
<td>15.1%</td>
</tr>
<tr>
<td>3</td>
<td>17</td>
<td>19.8%</td>
</tr>
<tr>
<td>4</td>
<td>10</td>
<td>11.6%</td>
</tr>
<tr>
<td>≥ 5</td>
<td>14</td>
<td>16.3%</td>
</tr>
<tr>
<td>Total</td>
<td>N = 86</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table 4.7 Number of injuries sustained, per patient per body region (N=86 patients)

<table>
<thead>
<tr>
<th>Region</th>
<th>Patients (n)</th>
<th>No. of injuries (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Head</td>
<td>26</td>
<td>42.3</td>
</tr>
<tr>
<td>Face</td>
<td>11</td>
<td>72.7</td>
</tr>
<tr>
<td>Neck</td>
<td>3</td>
<td>100.0</td>
</tr>
<tr>
<td>Chest</td>
<td>16</td>
<td>43.7</td>
</tr>
<tr>
<td>Abdomen</td>
<td>5</td>
<td>80.0</td>
</tr>
<tr>
<td>Spine</td>
<td>23</td>
<td>47.8</td>
</tr>
<tr>
<td>Upper limb</td>
<td>32</td>
<td>75.0</td>
</tr>
<tr>
<td>Lower limb</td>
<td>25</td>
<td>48.0</td>
</tr>
<tr>
<td>External</td>
<td>8</td>
<td>100.0</td>
</tr>
</tbody>
</table>
Table 4.8 shows the severity of injuries sustained per patient per body region, based on the AIS. Of the 26 patients who sustained a head injury, 46% had a head injury with an AIS 3 or greater, indicating serious to critical injury. Of the 13 patients who sustained a chest injury, 81% had a chest injury with an AIS 3 or greater, again indicating serious to critical injury. Of the 25 patients who sustained a lower limb injury and of the 23 patients who sustained an injury to the spine, around 40% had an injury of AIS 3 or greater. See Table 4.8.

Table 4.8 Abbreviated Injury Scale (AIS), by body region (N=86 patients)

<table>
<thead>
<tr>
<th>Region</th>
<th>1 minor</th>
<th>2 moderate</th>
<th>3 serious</th>
<th>4 severe</th>
<th>5 critical</th>
<th>9 negligible</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head</td>
<td>6 (23.1%)</td>
<td>8 (30.8%)</td>
<td>10 (38.5%)</td>
<td>1 (3.8%)</td>
<td>1 (3.8%)</td>
<td>0</td>
</tr>
<tr>
<td>Face</td>
<td>5 (45.5%)</td>
<td>5 (45.5%)</td>
<td>1 (9%)</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Neck</td>
<td>1 (100%)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2%</td>
<td>0</td>
</tr>
<tr>
<td>Chest</td>
<td>2 (12.5%)</td>
<td>1 (6.3%)</td>
<td>11 (68.7%)</td>
<td>2 (12.5%)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Abdomen</td>
<td>1 (20%)</td>
<td>4 (80%)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Spine</td>
<td>0</td>
<td>14 (60.9%)</td>
<td>9 (39.1%)</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Upper limb</td>
<td>4 (12.5%)</td>
<td>28 (87.5%)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Lower limb</td>
<td>0</td>
<td>16 (64%)</td>
<td>9 (36%)</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>External</td>
<td>8 (100%)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

The median ISS for the sample was 5.5, with a range of 1-45. As Table 4.9 shows, just over one quarter (26.9%) of patients were classified as suffering major trauma (defined as ISS ≥ 12).

Table 4.9 Injury Severity Scores (N=86)

<table>
<thead>
<tr>
<th>Injury Severity Score</th>
<th>Frequency (n)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 12 (minor trauma)</td>
<td>63</td>
<td>73.1%</td>
</tr>
<tr>
<td>≥ 12 (major trauma)</td>
<td>23</td>
<td>26.9%</td>
</tr>
</tbody>
</table>
The mean age of patients with major trauma was 69 years, compared to those with minor trauma which was 63 years. A statistically significant difference in age between those patients with minor trauma and those patients with major trauma was found (t=-3.038, p=0.003).

However, no statistically significant difference was found between ISS and height fallen (Kruskal Wallis test, \( \chi^2 = 3.403 \), 3 degrees of freedom, p=0.334). See Figure 4.1.

**Figure 4.1 Boxplot of height fallen by injury severity score (N= 86 patients)**

4.2.5 Hospital admission

Table 4.10 shows data relating to patient hospital stay. Of the 86 patients who met the inclusion criteria, 83 patients were admitted to a ward, and 3 patients were discharged home.
from the Emergency Department. Just over two thirds of patients admitted to a ward were admitted to a general ward (66.3%), with the remainder admitted to the hospital’s High Dependency Unit (24.4%) or Intensive Care Unit (5.8%).

Admitted patients who were discharged from the Emergency Department were recorded as having a length of stay of one day (as per the hospital trauma registry). The median length of stay for all patients was four days (range of 1 – 89 days). Amongst patients admitted to a hospital ward (n=83), 37.3% required at least one operating theatre episode for surgical intervention during their hospital admission and 8.4% required more than one. See Table 4.10.

Table 4.10 Distribution of hospital-related variables (N = 86)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Frequency (n)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Admission</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intensive Care Unit¹</td>
<td>5</td>
<td>5.8%</td>
</tr>
<tr>
<td>High dependency unit²</td>
<td>21</td>
<td>24.4%</td>
</tr>
<tr>
<td>General ward</td>
<td>57</td>
<td>66.3%</td>
</tr>
<tr>
<td>Discharged from Emergency Department</td>
<td>3</td>
<td>3.5%</td>
</tr>
<tr>
<td><strong>Length of hospital stay (days)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1–2²</td>
<td>24</td>
<td>27.9%</td>
</tr>
<tr>
<td>3–4</td>
<td>19</td>
<td>22.1%</td>
</tr>
<tr>
<td>5–6</td>
<td>14</td>
<td>16.3%</td>
</tr>
<tr>
<td>7–10</td>
<td>13</td>
<td>15.1%</td>
</tr>
<tr>
<td>11–14</td>
<td>7</td>
<td>8.1%</td>
</tr>
<tr>
<td>15–28</td>
<td>5</td>
<td>5.8%</td>
</tr>
<tr>
<td>&gt; 28</td>
<td>4</td>
<td>4.7%</td>
</tr>
<tr>
<td><strong>Surgical intervention</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 operating theatre episode</td>
<td>31</td>
<td>37.3%</td>
</tr>
<tr>
<td>&gt; 1 operating theatre episode</td>
<td>7</td>
<td>8.4%</td>
</tr>
<tr>
<td>Total</td>
<td>N = 86</td>
<td>100%</td>
</tr>
</tbody>
</table>

¹Nurse:patient ratio, 1:1. ²Nurse:patient ratio, 1:2. ³Includes length of stay < one day
There was a weak to moderate positive correlation between ISS and length of hospital admission (Spearman $r = 0.43; p<0.001$) indicating that patients with more severe injury tended to require a greater length of stay in hospital. See Figure 4.2.

**Figure 4.2 Scatterplot of length of stay (in days) and ISS**

![Scatterplot of length of stay and ISS](image)

### 4.2.6 Discharge destination

**Table 4.11 Patient discharge destinations (N=86)**

<table>
<thead>
<tr>
<th>Discharge destination</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Home</td>
<td>71</td>
<td>82.5%</td>
</tr>
<tr>
<td>Rehabilitation</td>
<td>6</td>
<td>7%</td>
</tr>
<tr>
<td>Another hospital</td>
<td>6</td>
<td>7%</td>
</tr>
<tr>
<td>Deceased</td>
<td>2</td>
<td>2.3%</td>
</tr>
<tr>
<td>Not specified</td>
<td>1</td>
<td>1.2%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>N = 86</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

As shown in Table 4.11, the most frequent discharge destination for patients was home (82.5%), followed by a rehabilitation facility (7%) or another hospital (7%) for ongoing care.
Two patients, both over 75 years of age, died in hospital as a consequence of fall related injuries and complications.

4.2.7 Cost of care

Activity based funding (ABF) was available for 19 out of the 86 patients. See Table 4.12. The average ABF was $32,341.06, with the average cost for severely injured patients (those with an ISS of 12 or greater) being $57,288.06, compared with $14,197.79 for patients with minor trauma.

Table 4.12 Activity Based Funding for selected patients, by ISS (N=19)

<table>
<thead>
<tr>
<th>ISS</th>
<th>Body region injured</th>
<th>Surg. req.</th>
<th>ICU adm.</th>
<th>Length of stay (days)</th>
<th>ABF ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Minor abrasions</td>
<td>No</td>
<td>No</td>
<td>1</td>
<td>800.88</td>
</tr>
<tr>
<td>2</td>
<td>Laceration scalp and elbow</td>
<td>No</td>
<td>No</td>
<td>1</td>
<td>766.43</td>
</tr>
<tr>
<td>4</td>
<td>Fractured humerus</td>
<td>No</td>
<td>No</td>
<td>2</td>
<td>2,582.38</td>
</tr>
<tr>
<td>4</td>
<td>Fractured clavicle</td>
<td>No</td>
<td>No</td>
<td>6</td>
<td>11,358.08</td>
</tr>
<tr>
<td>4</td>
<td>Scalp laceration and haematoma, chin laceration, lung contusion</td>
<td>Yes</td>
<td>No</td>
<td>3</td>
<td>19,038.81</td>
</tr>
<tr>
<td>5</td>
<td>Scalp laceration, # cervical spine</td>
<td>No</td>
<td>No</td>
<td>2</td>
<td>10,437.69</td>
</tr>
<tr>
<td>8</td>
<td>Vertebral #s</td>
<td>Yes</td>
<td>No</td>
<td>6</td>
<td>29,994.23</td>
</tr>
<tr>
<td>9</td>
<td># Pelvis</td>
<td>No</td>
<td>No</td>
<td>5</td>
<td>13,556.00</td>
</tr>
<tr>
<td>9</td>
<td>Complex # elbow</td>
<td>Yes</td>
<td>No</td>
<td>4</td>
<td>19,789.76</td>
</tr>
<tr>
<td>9</td>
<td>Multiple rib #s, multiple lung injuries</td>
<td>No</td>
<td>No</td>
<td>14</td>
<td>21,240.22</td>
</tr>
<tr>
<td>9</td>
<td># Femur</td>
<td>Yes</td>
<td>No</td>
<td>15</td>
<td>26,611.19</td>
</tr>
<tr>
<td>12</td>
<td>Vertebral #s, shoulder dislocation</td>
<td>No</td>
<td>No</td>
<td>4</td>
<td>10,698.50</td>
</tr>
<tr>
<td>13</td>
<td># Clavicle, multiple rib #s, haemo- and pneumo-thorax</td>
<td>No</td>
<td>No</td>
<td>14</td>
<td>11,358.08</td>
</tr>
<tr>
<td>13</td>
<td>Vertebral and radial #s</td>
<td>Yes</td>
<td>No</td>
<td>10</td>
<td>14,071.57</td>
</tr>
<tr>
<td>13</td>
<td>Intracranial injuries; facial, skull #s</td>
<td>No</td>
<td>No</td>
<td>11</td>
<td>14,081.76</td>
</tr>
<tr>
<td>ISS</td>
<td>Body region injured</td>
<td>Surg. req.</td>
<td>ICU adm.</td>
<td>Length of stay (days)</td>
<td>ABF ($)</td>
</tr>
<tr>
<td>-----</td>
<td>-------------------------------------------------------------------------------------</td>
<td>------------</td>
<td>----------</td>
<td>-----------------------</td>
<td>---------</td>
</tr>
<tr>
<td>13</td>
<td># Scapula, multiple rib #s</td>
<td>Yes</td>
<td>Yes</td>
<td>8</td>
<td>17,022.63</td>
</tr>
<tr>
<td>22</td>
<td>Multiple intracranial injuries, # cervical spine, # clavicles, multiple rib #s, ear lobe laceration</td>
<td>Yes</td>
<td>Yes</td>
<td>33</td>
<td>228,827.69</td>
</tr>
<tr>
<td>25</td>
<td>Intracranial injuries, skull #, multiple rib #s</td>
<td>No</td>
<td>Yes</td>
<td>28</td>
<td>62,462.13</td>
</tr>
<tr>
<td>27</td>
<td>Vertebral #s; multiple rib #s; pelvic and femoral #s</td>
<td>Yes</td>
<td>Yes</td>
<td>19</td>
<td>99,782.11</td>
</tr>
</tbody>
</table>

ISS = Injury Severity Score. ICU adm. = intensive care unit admission. Surg. req. = surgery required. # = fracture. ¹ Total ABF = $614,480.14

4.2.8 Late Life Functional Disability Instrument-CAT (interviewed patients only)

Figure 4.3 Mean LLFDI-CAT scores pre-fall and post fall for Activities of Daily Living and participation (N=10)

![Graph showing mean LLFDI-CAT scores pre and post fall for ADL and Participation](image)

Figure 4.3 shows mean LLFDI-CAT scores pre and post fall for 10 of the patients who were interviewed. Post fall scores were determined at between 4 and 27 months post event. There was a statistically significant decrease in function post-fall for both the activity (t = -4.041, p value = 0.002) and participation domains (t = -4.125, p=0.002).
4.3 Discussion

The quantitative component of this study addresses the following research question:

What is the epidemiology of non-occupational falls among older men (aged 50 years and over) presenting to a major trauma service in Australia?

The findings presented in this chapter illustrate the considerable impact of ladder falls in the non-occupational setting among men aged 50 year and over. These men presented with a wide range of minor and major traumas to the study hospital. Around one third of patients required admission to the high dependency or intensive care units of the hospital and just over one quarter of patients were considered to have suffered major trauma as a result of their fall. Data on functional disability measured by the LLFDI-CAT four or more months after the fall from the subset of interviewed participants shows statistically significantly lower post-fall levels of function, compared to reported pre-fall levels, indicating problems following injury which persist long after discharge.

Age was associated with injury severity and severe injury was incurred even in patients who had fallen from lower heights (<1.5 m). Most participants were on medication, some of which could have predisposed them to a fall (for example, psychotropic medication), or exacerbated the outcome. For example, a number of patients on anticoagulant or antiplatelet medications suffered bleeding associated with their fall.

4.3.1 Characteristics of ladder falls and fallers

The mean age of patients in this study was 64.7 years, with the oldest ladder climber admitted for care being 85 years of age. These results highlight the fact that older men are undertaking activities and behaviour that place them at risk of sustaining severe injury. There was a
statistically significant difference in mean age between patients with major and minor trauma according to the ISS, suggesting that as the age of these men increased, so did the severity of injuries sustained. This relationship may be reflective of the normal physiological changes associated with ageing and their impact on the body’s ability to manage stress associated with injury (Driscoll et al., 2003), the presence of disease (Holleran, 2015), or the effect of medication use (for example, polypharmacy and drugs such as anticoagulants) (Bryan, 2012). These results are in line with the findings of a larger study of hospitalised ladder injuries (occupational and non-occupational) in New South Wales, which found that the majority of those who sustained major trauma (from all ladder falls) were over 50 years of age, primarily between the ages of 60 -64 years of age (Miu, 2015).

The current study also found that just over half of all patients fell from greater than two metres, indicating that older men in the non-occupational setting are climbing significant heights in order to undertake DIY renovations and maintenance activities in the home. These results therefore suggest a need to highlight the danger of climbing ladders and, where financial burdens exist, to provide community assistance to carry out such jobs for older people.

The mechanisms of fall identified in the medical record in this current study were mostly due to ladder collapse and ladder slips on surfaces, and fewer (31%) being reported as due to the climber slipping, tripping, losing balance or falling backwards. Other research has found that falls in both the occupational and non-occupational setting are often ladder related, but also due to the climber, for example wrong placement of the climber’s foot, tripping, slipping on a rung, reaching out too far (Björnstig & Johnsson, 1992) and loss of balance (Häkkinen et al. (1988); Jüptner (1976). Ladder collapse has been reported as often due to the use of homemade wooden ladders or too heavy a load for the ladder to maintain (Björnstig &
Johnsson, 1992). Additionally, the ladder may collapse due to the folding mechanism (safety clasps) not functioning or being insufficiently stable (Björnstig & Johnsson, 1992). Ladder slips are often due to a failure to apply the general ladder safety principles of ensuring the surface is safe to place the ladder and that the angle of inclination is correct (Björnstig & Johnsson, 1992). Additionally, slipping at the top of the ladder can be due to no fastening devices being applied at the upper end of the ladder (Björnstig & Johnsson, 1992).

The literature reports that in non-occupational falls from ladders, men are typically involved in activities including painting, cleaning gutters, undertaking repairs, and cutting down tree branches (Björnstig & Johnsson, 1992), (Tsipouras et al., 2001) and decorating (Muir & Kanwar, 1993). The current study found similar activities being undertaken. There were no cases of falling whilst hanging Christmas lights in the current study, which was a common reason for climbing a ladder reported by a Canadian study on ladder falls whilst hanging residential Christmas lights (Driedger et al., 2016). This difference in the current study may be due to fewer people engaged in this activity in the southern hemisphere, or perhaps because the activity is less hazardous in the warmer Christmas climate with no slippery, icy surfaces in Australia. Similarly, falls from ladders due to removing snow from the roof is commonly reported in the northern hemisphere literature (Björnstig & Johnsson, 1992) but was not in the current study.

The greatest number of falls in current study occurred on weekend days (Sunday (22.1% of falls) and Saturday (18.6% of falls)) which is in line with another Australian study by Tsipouras et al. (2001) who examined the records of one hundred and sixty three patients who presented post ladder fall (non-occupational and occupational) to the Emergency Department of the Austin Hospital in Melbourne from 1994 to 1997. This suggests that the
weekend remains a popular time for home maintenance even in the older population who may have retired from weekday work.

Not surprisingly there is a seasonal difference in fall incidence when comparing studies from the southern and northern hemispheres. For example, a Danish study by Faergemann and Larsen (2000), which focused on non-occupational falls from ladders or scaffolding, found most falls occurred in Summer then Autumn in Denmark. The current study by comparison found most falls occurred in Spring followed by Autumn. This result may reflect the high temperatures seen in Australia in Summer which likely limit outdoor activities, and the preference for undertaking gardening and the ‘Spring clean’ in the Spring months in Australia.

4.3.2 Medication usage

The high percentage (60%) of older men in this study who were on at least one medication was not unexpected. Medication use is known to increase with age (Georgetown University Health Policy Institute, 2002; Georgetown University, 2002). Medication use reflects the presence of a chronic condition which may predispose a person to a fall (for example, Parkinson’s disease, orthostatic hypotension (P. Timiras & Navazio, 2007); medications may have adverse side effects themselves, such as drowsiness (Nobili, Garattini, & Mannuccio Mannucci, 2011), or result in increased likelihood of adverse outcomes following injury. For example, there is significant risk post fall with anti-coagulants, such as excessive bleeding (Bajorek, 2011), especially in the context of head trauma. Certainly, bleeding was an issue of concern in this study with some participants sustaining severe injury as a result. In addition to these risks, the reversal of anti-coagulant effects post trauma often requires the use of blood products with their own inherent risks (Pandey & Vyas, 2012) of an immunological, non-immunological or infectious cause (Folsch & Cassens, 2009). Furthermore, not all new
anti-coagulant medicines currently available are reversible or easily reversible (Battinelli, 2011).

Whether or not the medication (or the condition it was treating) increased the risk of falls from a ladder or the outcome from the fall in the current study cannot be known, as the study was cross-sectional. However, the findings from the medical records highlight the importance of considering the potential risk of medication (and the underlying medical condition) to older ladder climbers, and of considering strategies to raise awareness about the side effects of medication (and underlying medical conditions) to promote safe ladder climbing or discourage it, where necessary. The findings of this study suggest that further research is warranted to explore the role of medication use (and the underlying medical condition) in the cause and outcome of ladder falls in this age group.

4.3.3 Ladder fall related injuries

The most common injuries sustained in this study were to the upper limb, head, lower limb and spine, which is in line with findings in other studies in the literature (Arnold et al., 1989; Dinh et al., 2012; Lindblad et al., 1988; Miu, 2015; O’Sullivan et al., 2004; Stevens & Vajani, 2004). The relationship between injury severity score (ISS) and height fallen was not statistically significant in the current study with severe injury being found even in those who fell from less than 1.5 metres. These findings are different to that of an Australian study of all ladder fall presentations at a tertiary trauma centre (Tsipouras et al., 2001), where the ISS increased significantly with an increased height fallen (p<0.05). However, 22% of the ladder falls in the Tsipouras et al. (2001) study occurred in the occupational setting. Whilst some participants in this current study assumed that falling from the first rung (or a low height) would not cause severe injury with long term functional disability, this current study indicates that severe injury is certainly possible from this height in the older population. These
findings are consistent with an American study by Con et al (2014), where despite older people falling off ladders from a lower height, more severe injury was sustained compared to younger patients. More specifically, Muir and Kanwar (1993) identified that falling from a small height from a stepladder may lead to serious injury compared to a straight or extension ladder. The role of ladder type in ladder falls could not be determined in the current study due to limited data on ladder type being recorded in the medical records.

4.3.4 Cost of ladder falls – Activity Based Funding (ABF)

The average ABF allocated for the care of the nineteen patients (minor and major trauma cases combined) for which data were available was just over $32,000. This amount was considerably higher than reported in Oxley et al. (2014) ($7,666). The differences in the findings may be to some extent due to the inflation of medical costs over time; or to the broader age range included by Oxley et al. (2014) in their study (for example, older patients may on average require more costly intervention and/or ongoing rehabilitation which may be reflective of their comorbidities and age or simply different injury patterns). Further, a true reflection of costs may not have been achieved in this current study, due to the small number of patients for which ABF data were available.

The average cost for patients with minor injury (ISS <12) was just under $14,200 indicating that the health care costs for even minor trauma were considerable. What the ABF does not include was the cost of care for those patients who chose to be transferred to a private hospital (n=6) for continuing inpatient care or rehabilitation, or the cost of ongoing outpatient rehabilitation (that is, treatment received after discharge from hospital, n=6). Thus, these ABF figures are an underestimate of the true health care costs of falls from ladders among older men in the non-occupational setting. There are further costs which are also excluded from the ABF such as loss of income, and loss of productivity (for both patient and spouse).
as well as psychological costs (depression, self-harm, fear, agitation, altered self-image and socialisation).

Oxley et al (2014) estimated that the cost of hospital admissions from home ladder fall injury over a three-year period for Victoria was $18.3 million, equating to $6.1 million dollars per annum or $7, 666 per admission. In New South Wales, the cost of all ladder falls (not just home ladder fall injury) over a five-year period was estimated to be $51.8 million dollars for the healthcare system, or $10.4 million dollars per annum or $6, 097 per admission (Miu, 2015).

4.4 Limitations

The quantitative component of the research presented relied on the use of administrative data which were largely clinically focussed, rather than focussed on the details of the events surrounding the ladder fall. The data collected and summarised in this chapter were thus limited by omissions and incomplete documentation evidenced by missing data in the tables presented, particularly in regards to the ladder mechanism, reason for climbing the ladder and the location of the fall (inside or outside). In line with McKenzie et al. (2008) and Cunningham et al. (2014), the ambulance report which was included in the medical record, was often found to be the best source of information about the external cause or mechanism of fall.

Other research has identified a number of reasons for poor documentation in trauma care, including that the medical record of the trauma patient can be excessively lengthy and complicated due to the complexity of trauma patient care (Curtis, Bollard, & Dickson, 2002). There is also a lack of knowledge among clinicians of the level of detail of documentation required for coding of injury and external causes (Cunningham et al., 2014; Curtis et al.,
Further, the main role of the attending health professional is to treat the patient, hence data collection may not be seen as a priority (Cunningham et al., 2014). Education of staff around the importance of completing all data fields on the trauma data collection form is suggested by this current research. The future implementation of electronic medical records may provide an opportunity for the introduction of mandatory reporting fields on the trauma admission form.

In addition, self-reporting bias may have occurred whilst the patient was in hospital. Patients may have chosen not to disclose their contribution to the fall to clinical staff and this includes alcohol and illicit drug use at the time of the fall. This may have been to avoid embarrassment and/or to avoid the facts being documented in the medical record. The choice to blame the ladder may have been preferred by some patients.

The study excluded patients who presented to the Emergency Department with minor injuries and were not admitted to hospital, which means that the sample represented only those with injury severe enough to require admission to hospital. A medical record review of all cases coded as ICD10-AM W11 was undertaken to gather data for this study. While a careful review of the medical records was undertaken, the possibility of errors in data extraction must be acknowledged. Finally, this study has been unable to determine incidence rates of ladder falls (that is, falls per 100,000 population per annum), since as a tertiary referral hospital, patients are drawn from a wider area than the local health district, making the denominator difficult to determine.
4.5 Summary

This chapter has presented findings from data extracted from the medical records of 86 older men who were admitted to a major trauma service in a tertiary referral hospital in Sydney over a 35-month period following a non-occupational ladder fall.

The quantitative component of this study has provided some insight into the causes and outcomes of ladder falls in men aged fifty years and over who were admitted to a major trauma service in a large tertiary referral hospital in Sydney. The results have highlighted the significant trauma sustained from falls even at a low height. The results have also suggested that further research is warranted to explore the role of medication use as a causal factor in the outcomes of falls in this age group. The cost of non-occupational ladder falls to the health sector is considerable, highlighting the importance of prevention. Further, the need for additional education of clinicians to improve the accuracy and completeness of documentation about the fall event is suggested.

The following chapter will present the qualitative component of this study drawn from in-depth interviews with participants and their spouses at home. These interviews were conducted with a sub-sample of the participants included in the medical records review who were willing and available for interview.
Chapter 5 Qualitative component

5.1 Introduction

This chapter provides the reader with a description of the qualitative research undertaken in this study, and describes the methodology and findings from in-depth semi structured interviews with older men who had fallen from a ladder in the non-occupational setting. The chapter also includes an analysis of the themes gained from the interviews and an overview of the socio-ecological model and why it was chosen for conceptualising the qualitative findings of the study. The results are presented followed by a discussion together with key literature to contrast and corroborate findings. The research questions addressed in this chapter are:

What are the key influences on older men’s decisions to climb a ladder and their ladder climbing behaviour?

What are the impacts of a non-occupational ladder fall on the older man, his spouse, family and the wider community?

Informed by the epidemiology, other injury prevention approaches and the perspectives of older men and their spouses, what are possible prevention strategies?

5.2 Methods

5.2.1 Sampling and recruitment

The sample for the qualitative research component of this study was drawn from the identified eligible patients identified for the quantitative research; with the aim being to recruit a sample of both patients and their spouses. A combination of both convenience
sampling and opportunistic sampling was used. Convenience sampling in this study allowed the researcher to access individuals who were willing to be interviewed (Liamputtong, 2013) while opportunistic sampling allowed the researcher to sample those available during the data collection process (Holloway, 2002).

Given that this study was time-limited, willingness and availability to participate in the interview was the key factor leading to how many men and their spouses were interviewed. The sample size aimed for was between 10-20 males and their spouse, a number which would be likely to provide a diversity of experiences and data that would inform the research questions, as argued by Liamputtong, (2013). The focus of the sampling approach was to maximise quality (in regards to depth of data provided) rather than quantity of participants, in line with Liamputtong (2013). The men and spouses who responded were expected to be highly motivated to share their experiences as no remuneration was offered. This motivation would therefore be likely to result in rich data. Rich data from a smaller number of participants is a key goal of exploratory qualitative research (Creswell, 2011) as was the case in the current study.

Patients and their spouses were each invited via a letter to participate in an in-depth, semi-structured interview. Interviews were selected as a method of data collection in order to gain insight into the lives and experiences of participants (Fossey et al., 2002; Sofaer, 2002). The letter explained the purpose of the research and what was required of the participant in line with recommendations by Britten (1995) and ethical requirements. If participants and/or spouses were known to the researcher to be deceased, a letter was not sent. Participants were asked to contact the researcher by phone or by email if they were interested in participating in the research. A participant information and consent form (PICF) was then mailed to those who responded. The PICF included an outline of what the study involved, the duration of
interview, confidentiality assurance and a statement that refusal to participate in the study would not affect future treatment. The researcher then contacted the patient and/or spouse with a phone call approximately 3-4 days later; if the patient and/or spouse was happy to proceed, a convenient time and place was made for interview, such as at the hospital, at the participant/spouse’s home or at another venue of their choice. At the time of the interview, written consent was obtained for all participants.

Patients were excluded for selection for interview if they were likely to have had no recollection of the fall event, that is, their medical records indicated that they were not orientated to time and/or person and/or place at the time of admission and/or discharge (indicated by a score of less than or equal to 14 on the Glasgow Coma Scale (Teasdale, 2014)). This was the case for one patient out of the 86 patients identified for the quantitative research who was also still in a rehabilitation facility. Patients who had post traumatic amnesia after the fall but were now clear of this amnesia, were included. One patient was from a non-English speaking background and did not speak English; this patient was excluded. Where the next of kin of a patient was not the spouse or a next of kin was not provided, a letter was not sent. One patient was the carer for his spouse; a letter was not sent to this spouse.

5.2.2 Context and setting

The participants interviewed in the qualitative component of this study were patients from the same hospital used in the quantitative component of the study which is described in the previous chapter. Some participants were interviewed at the hospital however most interviews were in their homes or in a location convenient to them in urban Sydney.
5.2.3 Interview as method

Interviews were chosen as a method of data collection as interviews can be flexible in their approach (semi-structured) to increase the chance of capturing information of importance to the participants, not that predetermined by the researcher (Carter et al., 2009). Whilst there was some structure to the interview, the use of a semi-structured approach allowed for more in-depth probing of answers in response to interviewee perspectives shared and the focus of their stories (Ellis, 2013). The interview schedule was sometimes modified during the interview (questions re-worded, re-ordered or clarified) to further investigate participant responses (Tong, Sainsbury, & Craig, 2007). This approach allowed for a free dialogue for the collection of narratives and enabled deeper exploration of unexpected themes (Ritchie, 2001).

An interview guide was used for each interview to ensure that key topics were covered as well as to provide some prompts and probes as required Rabionet (2011). The topics were informed by the literature and research supervisors (with expertise on injury prevention, qualitative design and trauma management) who were consulted during the development of the questions (Rabionet, 2011). The topics of the interview questions for the male participants included a recounting of the fall, safety measures (if any) in place at the time of the fall, the impact of the fall on himself and his family, recurrent ladder use post fall, the participant’s perception of risk taking behaviour at the time of the fall, the participant’s knowledge of the ageing process and the potential impact on safe ladder use and the advice the participant would give to men their age who wish to climb a ladder (see Appendix 1).

The topics of the interview questions for the spouse included their understanding of what happened at the time of the fall, the impact the fall has had on the spouse, what the spouse believed led to the fall, how the spouse is feeling about what happened, the spouse’s thoughts
on potential injury prevention strategies for older men climbing ladders and how her husband is now and whether there have been any ongoing issues since hospital discharge (see Appendix 1).

The focus of the interview was reviewed early in the interview process, after it was identified through reflexivity and speaking with supervisors, that the emphasis placed on the questions was too directed towards the mechanism of the fall rather than towards the patient story (or experience) and factors relating to the fall. Changes were subsequently made to the interview schedule reflecting the dynamic process of interviewing in qualitative research (Carter et al., 2009).

Developing an atmosphere of trust was a focus of the field researcher and adequate time was given to the interview to encourage participants to ‘open up’ and share their perspectives (Ritchie, 2001). Whilst the quantitative method of this study explored the epidemiology of ladder falls in older men, the interviews explored the attitudes, beliefs and views of the men and their spouses, which were important factors in obtaining data to answer the research questions of how and why they are using ladders and their assessment of risk. Each interview was audio recorded and then transcribed soon after the interview was completed. Each transcript was de-identified. A reflective diary and field notes were also completed after each interview. Field notes were used to describe and record the experiences and observations of the researcher as well as key reflections. The field notes were written while engaged in the setting and added to immediately afterwards as required and recommended by experts in the field (Fossey et al., 2002). These notes captured what was unable to be captured by audio recording, such as facial expressions, body movements, emotions as well as the field researcher’s emerging ideas about the data and its meaning.
At the conclusion of the interview, the LLFDI was administered to each male participant. Men were asked to complete the instrument twice in reference to their pre-fall status (as recollected) and current post fall status. The LLFDI uses both the Activity Limitation Scale and the Participation Restriction Scale to assess functional outcome. Scores from the two completed instruments were then saved (using the patient’s study number) for future analysis. Men continued to be audio taped whilst completing the LLFDI with the researcher. This ensured that any additional information that was gained during this process was captured. Photographs were also taken during the interview process primarily to capture and record the location/setting of the ladder fall and the ladder in use at the time of the fall. Another aim of taking photos was to assist the reader in placing the narratives into some context by providing a visual representation of the ladder and fall setting (Streubert, 2011). Photographs have been argued to add value to data collection, analysis and reporting and provide a medium for portraying a particular concept or experience (Hansen-Ketchum & Myrick, 2008).

5.2.4 Thematic analysis

An inductive approach was used initially for the main analysis which included the identification and mapping of primary themes. An inductive approach is a process of coding the data without attempting to place the data into any pre-existing coding framework (Braun & Clarke, 2006). Once the transcripts were initially coded by hand, NVIVO 10 (QSR International) was used to code and compile the data into a form that was logical and manageable to the researcher using nodes. The use of nodes within NVIVO assisted with the thematic analysis through organisation of the themes into categories, managing the data, deciphering and synthesising the data and making meaning of it in relation to the research questions (Bazeley & Jackson, 2013). NVIVO provided the researcher with the ability to
systematically store, code and retrieve written data that allows for precise and purposeful manipulation (Ritchie, 2001).

The coding was re-visited a number of times in NVIVO to identify any patterned responses and meanings within and across the transcripts (Braun & Clarke, 2006). The research questions were re-visited frequently throughout the analysis phase and data examined in relation to the research question with quotes chosen where they were particularly illustrative in addition to references to the whole data set (Braun & Clarke, 2006; Blignault & Ritchie, 2009). Issues and questions arising from the data analysis were regularly discussed with the supervisory team and considered in relation to what the study was seeking to investigate. This iterative approach to analysis is said to promote reflexivity (Ritchie, 2001), which is one method of raising self-awareness of the perspective that the researcher brings to qualitative inquiry (Patton, 2001). Key themes that were coded were then further conceptualized into two main overarching categories: factors that contributed to the fall, and the impact of the fall. The process was then repeated to establish themes relating to injury prevention strategies as discussed by the participants. Relational diagrams were used to further inform the organisation of the findings. The reflective diary and field notes completed after each interview were used during the analysis process to clarify points from the transcripts and to assist recall of details from the interviews.

Throughout the analysis, negative cases or experiences that appeared to contradict the emerging explanation of the phenomena being studied were paid particular attention and are included in the findings where relevant. Attention to negative cases increases the credibility and rigour of the analysis (Pope & Mays, 1995). In the final stages of the thematic analysis, particular attention was paid to quotes that highlighted or encapsulated clearly the themes that were coded and many of these appear in the thesis qualitative findings chapters.
5.2.5 Use of narratives in the analysis and reporting of findings

As the transcripts were analysed thematically and the findings section of this thesis begun, the importance of the reader being able to hear the voices and detailed stories of some of the participants through their stories became a prominent concern to the researcher and her supervisors. The use of an approach that gave larger excerpts from the participant experience was therefore chosen to complement and extend the thematic analysis and give a richness to the reader not achieved through thematic analysis alone.

Narrative analysis usually takes the perspective of the teller (in this case the participant) who takes the listener (in this case the researcher and the reader) to past times, to what happened and to the moral point of telling the story (Larsson & Sjöblom, 2010). The use of narratives can also assist the researcher to make sense of the participant experience (McCance, McKenna, & Boore, 2001) as the narrative is concerned with the individual, how that individual feels, how their experience eventuated and how the participant has evaluated their experience (Sandelowski, 1991). The narratives chosen in the presentation of the findings in the thesis in the two main sections ‘pre-fall factors’ and ‘post fall impacts’ were rich and detailed in terms of reflecting the common themes across most of the interviews. Narratives were also chosen in the thesis, in keeping with the researchers’ desire to tell the whole story of these men (Riessman, 1990). In this study, some aspects of the participant narrative were unexpected, which added to the diversity of the data as well as providing additional insight into the participant and their story beyond brief quotes primarily used in thematic analysis. The encapsulated themes in the narratives are then identified across the whole data set with reference to the men by pseudonym in the discussion that follows using the socio-ecological framework as an interpretive frame.
5.3 Reflexivity and self as instrument

Reflexivity is one method of raising self-awareness of the perspective that the researcher brings to qualitative inquiry (Patton, 2001). Reflexivity involves being aware ‘in the moment’ of what is influencing the researcher’s internal and external responses. Concurrently, reflexivity is being aware of the relationship of the research topic and participants to the researcher (Dowling, 2006). By disclosing the researcher’s training and experience to the reader (Patton, 2001), credibility is added to the study (Dowling, 2006). Reflexivity encourages the researcher to be aware and conscious of the social and cultural origins of their own perspective as well as those of the participants and readers (Patton, 2001). This section therefore explains my background and as such, what factors influenced my interaction with participants and the interpretation of the data.

When this study began, I had been a Registered Nurse for twenty years. My clinical background is in Emergency and Trauma nursing, having worked both as a Clinical Nurse Specialist and Clinical Nurse Educator in a major Sydney tertiary referral trauma centre for eight years. Since then, I have been in the role of Nurse Educator, with an initial primary focus on Neuroscience and Trauma nursing. A recent expansion of this role now includes the more generic clinical divisions of Surgery and Anaesthetics and Critical Care and Medicine.

The primary aim of nursing the trauma patient in the Emergency Department, is to work within the trauma team to identify and treat life threatening injuries and then transfer the patient to the next most appropriate clinical area. It was not until I moved into the Nurse Educator role, that I was able to gain an understanding and appreciation of the impact of traumatic injury on both the patient and their significant others. The impact of injury can be devastating in so many aspects, from physical, emotional, social to financial. It was at this
time that my interest in injury prevention began to be aroused. What is the role of the trauma nurse within the challenging area of injury prevention and how can I make a difference?

In 2015, nurses were again ranked as the most ethical and honest profession in Australia, with 92% of people surveyed considering it as the most trustworthy job (Kimmorley, 2015). This trust is facilitated and fostered via a range of strategies including open communication, demonstrating interest and empathy and maintaining confidentiality. These strategies were adopted in interviewing participants in this study, but were done so as a matter of routine practice for me as a nurse. Being heard and understood are also important to the patient within this patient – nurse relationship, as well as the nurse’s openness to actively listen to and engage with the patient (Rørtveit et al., 2015). In my experience of interviewing participants in this study, some participants shared very intimate and painful experiences with me. This may be attributable to my position in the nursing profession and the trust that comes with that role. It may also be attributable to the fact that participants appreciated someone listening to their experience and story and the interest shown by the researcher in a confidential environment. During the process of interviewing and analysis of the data, discussion with my supervisors prompted reflexivity. I was able to reflect on the focus of my interview questions with guidance from my supervisors who were able to provide that ‘external’ perspective. This feedback enabled me the understand the importance of stepping ‘outside’ of the foci of your study periodically, as being constantly ‘inside’ the foci of your study can hinder your view of the ‘bigger picture’.

In my current role, I see patients after they have fallen from a ladder in the acute phase of their treatment. My ability therefore to educate and raise awareness of the need for safe ladder use in the community setting is limited as to the strategies, for example distribution of an information pamphlet to patients. This meant I was very open to the participant’s
suggestions and the literature as to alternate ways to raise awareness and how they may apply in the hospital context and broader community.

To conclude, Seifert (2011) suggests that the public are starting to further appreciate nurse led initiatives that result in improved health care. This may also have contributed to the participant’s willingness to be interviewed in recognising their opportunity to also contribute to improved outcomes from ladder falls.

5.4 Socio-ecological model

Following on from an inductive approach described in section 5.2.4, the socio-ecological model was used to provide a framework to assist in understanding and interpreting the qualitative data and presenting the findings in this chapter. As described by McLeroy, Bibeau, Steckler, and Glanz (1988), the socio-ecological model states that behaviour is determined by five primary factors or levels of influence – see Figure 5.1.
Figure 5.1. The socio-ecological model. Adapted from the Centers for Disease Control and Prevention

Individual factors relate to the individual’s characteristics including their knowledge, skills, attitudes and self-concept; Interpersonal groups and processes include both formal and informal social networks and support systems thus includes the role of family and friends on an individual’s behaviour; Institutional or organisational factors, include the social institutions with formal and informal rules with which individuals interact. Community factors include the influences on an individual arising from the community in which he lives, for example, social norms. The final level of influence on behaviour is that of public policy, which includes the influence of government action or inaction and all levels of government and associated legislation and regulation.
The socio-ecological model was chosen as a framework in this study to assist in organising the qualitative findings and identifying the levels of influence and impact. Thinking about the findings in this framework can also help inform strategies that could be implemented at each level, and key stakeholders that would need to be consulted and engaged in the process of creating change to reduce falls in the non-occupational setting.

The socio-ecological model recognises that health is not only influenced by a myriad of personal factors, but also the environment. The model emphasises the dynamics between environmental or situational factors and the individual, rather than focusing on one factor alone (Stokols, 1996). The socio-ecological model also allows for an inter-disciplinary approach to the development of health promotion programs (Stokols, 1996). The ability to focus on multiple levels of influence within the socio-ecological model broadens the options for interventions (Sallis, Owen, & Fisher, 2008). However, Sallis et al. (2008) caution that without supportive environments and public health policies, individual motivation and skill to change a behaviour can be difficult to achieve.

5.5 Results

This chapter details the findings from the participants and participant spouses interviewed using narratives, participant stories and key quotes to illustrate these findings. In reporting the findings, the term ‘many’ refers to many of those interviewed, as opposed to the total sample of 86 patients, or the wider population of men aged over 50 who fall from ladders at home. The findings are presented in the pre-fall and post fall context using the socio-ecological model as an organising framework. This section concludes with an overview of ideas for promoting ladder safety suggested by participants.
5.5.1 Participants

A total of fourteen interviews were conducted over twelve months as part of the qualitative study component. There were interviews with twelve male participants and seven spouses (two with the spouse only and five with the spouse and partner participant), ranging in duration from forty-five minutes to over two hours. The men were part of the 86 participants in the quantitative component of the study who agreed to be interviewed. Tables 5.1 and 5.2 show the demographic and injury data for interviewed male participants. Participant spouses who were also interviewed appear in the third column of Table 5.1.

Interviews were conducted either with the participant only, the spouse only or both the participant and their spouse (see Table 5.1). Interviews were undertaken either within the hospital, in the participant’s home or at another location convenient to the participant (see Table 5.1). The Late Life Function and Disability Instrument (LLFDI-CAT) was administered to all but one participant (due to participant preference and poor mobility) with a pre-fall and post fall rating requested. In this last case, a telephone interview was conducted and the Late Life Function and Disability Instrument (LLFDI-CAT) was not used due to the patient’s non-English speaking background and the difficulties in administering the instrument over the telephone. All interviews were audio recorded and then transcribed verbatim with the consent of the participants. Written consent forms were signed and retained by the researcher. All names used in this chapter are pseudonyms to protect the participant’s identity.

The sample in the qualitative study is not representative of all men aged 50 years and over who have fallen off a ladder in the non-occupational context, however the sample included in the interview study does represent a diverse group of men. The range of ages was between 52 and 83 years of age (mean age of 65 years) as shown in Table 5.1, and height fallen
ranging from between 1 and 4 metres (Table 5.2). Further comparative details with the overall sample population are available in Appendix 2.

The number of months from time of fall to time of interview captured men who had recently fallen (less than twelve months), to men who had fallen at one, two and three years prior to interview, the range being 4 to 37 months (mean 13.25 months) as shown in Table 5.1. This range in months from fall to interview provided an opportunity to gain insight into the impact of the fall both early and late into the recovery process. There was also diversity in the time since fall to interview between the five men who were interviewed with their spouse, ranging from four to twenty-five months. Again, this provided for insight into the diverse experiences of the spouses at various times post injury.

As shown in Table 5.2, there were two participants who had sustained major trauma (ISS ≥ 12), with a range for all participants of being ISS of 1 to 13. The majority of participants (n=9) required a surgical episode (75%) with 50% (n=6) requiring more than one surgical episode. Two patients required admission to a dedicated rehabilitation facility, and two patients required readmission for complications resulting from their injuries.

Whilst all but one patient sustained a bone fracture, there was a diverse range of anatomical locations of these fractures. These locations ranged from the upper limb, lower limb, back, chest and pelvis. This provides some insight into the difficulties and issues that may have been experienced by participants post injury from a range of perspectives: mobility, respiratory and upper limbs.

In the remainder of the results section the qualitative findings are divided into two sub-sections, the first focusing on the factors that led to the fall and the second section on the post fall impacts. In each section, key narratives are first presented. These narratives were
selected as they best highlighted the key factors or themes identified in the data. These narratives are then followed by a presentation of the key themes across the data drawing primarily from the narratives together with the experiences of other participants where useful to complement the narratives or contrast between participants. The themes identified in this study have been considered in relation to the socio-ecological model to extend the interpretation providing interpretive rigour (Kitto et al, 2008). Interpretive rigour aims to produce a plausible and coherent explanation of the phenomenon under scrutiny (Mays & Pope, 1995).

**Table 5.1. Demographic data for interviewed participants (hospital admissions only)**

N=13

<table>
<thead>
<tr>
<th>Interview type</th>
<th>Pseudonym</th>
<th>Spouse pseudonym</th>
<th>Age at time of fall (years)</th>
<th>Interview location</th>
<th>Months from fall to interview</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient only</td>
<td>Max</td>
<td></td>
<td>83</td>
<td>Coffee shop</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>Mark</td>
<td></td>
<td>52</td>
<td>Other</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td>Bert</td>
<td></td>
<td>64</td>
<td>Hospital</td>
<td>37</td>
</tr>
<tr>
<td></td>
<td>Matt</td>
<td></td>
<td>65</td>
<td>Hospital</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Tim</td>
<td></td>
<td>52</td>
<td>Hospital</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Chris</td>
<td></td>
<td>80</td>
<td>Telephone</td>
<td>5</td>
</tr>
<tr>
<td>Patient with spouse</td>
<td>Adam</td>
<td>Kim</td>
<td>66</td>
<td>Home</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>Fred</td>
<td>Bev</td>
<td>62</td>
<td>Hospital</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Tom</td>
<td>Gwen</td>
<td>64</td>
<td>Home</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Rod</td>
<td>Dorothy</td>
<td>59</td>
<td>Home</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Jim</td>
<td>Lucy</td>
<td>71</td>
<td>Home</td>
<td>4</td>
</tr>
<tr>
<td>Spouse only</td>
<td>Mike*</td>
<td>Rita</td>
<td>64</td>
<td>Coffee shop</td>
<td>8</td>
</tr>
<tr>
<td>Interview type</td>
<td>Pseudonym</td>
<td>Spouse pseudonym</td>
<td>Age at time of fall (years)</td>
<td>Interview location</td>
<td>Months from fall to interview</td>
</tr>
<tr>
<td>----------------</td>
<td>-----------</td>
<td>------------------</td>
<td>-----------------------------</td>
<td>--------------------</td>
<td>-------------------------------</td>
</tr>
<tr>
<td>Patient, spouse separately</td>
<td>Bob</td>
<td>Joan</td>
<td>62</td>
<td>Hospital (Bob)</td>
<td>6</td>
</tr>
</tbody>
</table>

* Did not contact the researcher within the study period despite indicating his intention to be interviewed.

### Table 5.2. Injury data for interviewed participants (hospital admissions only) N=13

<table>
<thead>
<tr>
<th>Pt</th>
<th>Fall m</th>
<th>Length of stay (days)</th>
<th>ISS</th>
<th>Injuries</th>
<th>Discharge destination</th>
<th>Operating theatre episode (n)</th>
<th>Ladder type</th>
<th>Readmission location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max</td>
<td>4 1 9</td>
<td>Unspecified; back pain</td>
<td>Other hospital</td>
<td>No</td>
<td>Straight</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mark</td>
<td>2 4 7</td>
<td>Open ankle #</td>
<td>Home</td>
<td>3</td>
<td>Step</td>
<td>Same hospital (3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bert</td>
<td>2 4 5</td>
<td>#Wrist; #elbow</td>
<td>Home</td>
<td>2</td>
<td>Extension</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Matt</td>
<td>2 13 11</td>
<td>#Radius; #pelvis; #lumbar vertebrae</td>
<td>Home</td>
<td>2</td>
<td>Straight</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tim</td>
<td>3 4 2</td>
<td>#Humerus</td>
<td>Home</td>
<td>No</td>
<td>Extension</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chris</td>
<td>1.5 4 1</td>
<td>#L &amp; R tibia</td>
<td>Other hospital</td>
<td>3</td>
<td>Unknown</td>
<td>Rehab. (2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adam</td>
<td>1 4 8</td>
<td># heel</td>
<td>Home</td>
<td>2</td>
<td>Step</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fred</td>
<td>3 5 7</td>
<td># forearm</td>
<td>Home</td>
<td>1</td>
<td>Step</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tom</td>
<td>4 1 6</td>
<td>#lumbar vertebra</td>
<td>Home</td>
<td>Straight</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rod</td>
<td>3 4 8</td>
<td>#L &amp; R ankles (complex)</td>
<td>Other hospital</td>
<td>4</td>
<td>Step</td>
<td>Other hospital/s (2); rehab. (2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jim</td>
<td>2.5 13 8</td>
<td>#Ribs (multiple); #scapula</td>
<td>Home</td>
<td>1</td>
<td>Step</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bob</td>
<td>1.5 9 1</td>
<td>#Femur</td>
<td>Other hospital</td>
<td>1</td>
<td>Step</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mike</td>
<td>2 5 2</td>
<td># cervical vertebra; scalp laceration</td>
<td>Home</td>
<td>No</td>
<td>Step</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5.5.2 Pre-fall factors

5.5.2.1 Narratives

Bob

Bob is 62 years of age and married. He presents as somewhat anxious and tells me he has a long history of depression for which he is medicated. He also had a bi-lateral hip replacement three years ago. At times during the interview, he became emotional whilst talking about the fall and its impact. However, Bob appears to also be a capable and active man, talking about his experience in renovating and home maintenance. He starts his story by stating that he and his wife decided to sell their home. The real estate agent was due to visit the next day. They had just celebrated his wife’s birthday so he was behind in preparing the house for the inspection. He explains that the large tall hedge in the backyard, which sits in a garden box, needed trimming. He tells me he placed one side of the stepladder on the brick work, the other in the box. Bob stated that he normally takes some time to prepare the ladder before climbing but:

“...on this occasion because it was late, I got home from work, I was probably a bit tired, I decided to just go with it the way it was...and I got to the last two little branches if you like, there were only two and I leant to get them...right beside it was concrete...so I should have picked it up and moved it a foot or two then gone up but I didn’t do that...so the balance went slightly and over I went and I landed on concrete. I went sideways...because of the unstable two legs”.

Bob was climbing the ladder whilst home alone. A number of other participants also climbed their ladder whilst alone at home. Bob acknowledges that he should not have climbed the ladder without anyone present and highlights other reasons for the fall;
“I suppose it’s over confidence in my own ability even though I’m getting on...unfortunately you don’t sort of realise that. Just rushing a little. I’ve been up ladders all my life”.

One of the primary safety principles of safe ladder use, is to maintain the three-point rule of contact at all times whilst climbing the ladder. Bob had snippers/clippers in his hands and broke the three-point rule of contact. He also talks about the ladder quality as part of the problem. Bob endeavours to provide a rationale for the behaviour highlighting a desire for self- reflection, which is a common theme across the men’s stories in this study;

“to be perfectly honest, the ladder wasn’t a great ladder...it was sort of broken on one side so that sort of increased the instability a bit of the ladder. I think the reason I still used it...the environment I grew up in with my Dad who had gone through the depression – you always tried to fix things...but I knew it was dangerous. I sort of figured because it wasn’t so high”.

For Bob, the outcome of his fall was a complete revision of his hip replacement.

Max

Max tells me he is too ashamed to have me visit him at his home and asks me if I can pick him up and take him to a local café for the interview. Max is 83 years of age and lives alone in a federation house that is poorly maintained, the reason why he says he doesn’t want me to enter the house. There are broken windows and gaps under the doors. He tells me that the average temperature in the house at night is 6 degrees. He describes himself as a loner. He has an adopted daughter who lives locally and a son who lives interstate. He also has two sisters who he says he can’t see anymore as he can’t afford the cost of fuel to visit them. He tells me that water gets into his boots and the laces are gone. But he says; “Good sole, tread
is still there. Comfortable”. This is some reassurance for me that at least there was some tread for grip on the ladder rungs, even though it clearly didn’t prevent his fall.

He tells me that the roof of his house is an ongoing problem for him as it leaks;

“I have so many loose sheets of iron on my roof…I have to get up every so often and put something on them, bricks or something to hold them down otherwise I’ll have no roof left. I’ll have no roof at all”.

He has subsequently climbed up on the ladder since his fall citing that “I live alone, I have no one to help…what do you do when you’ve got no help?” On the day of the fall, he explains that he placed the ladder against a branch of the jacaranda tree – he was cutting down branches overhanging the roof;

“let’s say I was above the limb, 12 foot, when the tree bounced and the limb bounced up with the weight of release of the leaves, it threw the ladder up off the limb about two foot…the two legs of the ladder bounced up…I managed to catch the limb with my elbow…and I could feel it coming, I knew it was going to hurt. I just had to let go, I couldn’t hold on any longer…so I fell and I hit the ground that hard”.

Max waited twenty minutes for the neighbour to realise he had fallen and render assistance. With a chuckle, he says the ladder ended up on top of him;

“after I fell, I’m looking up at that ladder thinking that bloody thing is going to fall on me and sure enough, it did. I had no longer said it and it slipped off, it was insult to injury, hit me full length, head, shoulders”.

Max was then taken to hospital by ambulance for assessment and then discharged to his local hospital for ongoing rehabilitation. As a result of the fall, he has ongoing lower back pain, requiring strong oral opioid analgesia.
Max describes a number of chronic health problems that may have contributed to his fall. He says he has a history of kidney and prostate cancer; lacks energy; is unable to stand for any length of time and is unable to walk far. However, he continues to climb the ladder despite the impact of these comorbidities on his overall health status. We talked about the possibility of Max getting a handy man in to help with the house maintenance. However, Max cited cost as an issue;

“I’m buying nine lots of medication which is $5.90 at a time...I don’t have a great deal of money left...I make sure my dogs are fed before I eat. I love dogs”.

I spent over an hour with Max that afternoon over a coffee in his local café. He appeared to be lonely and just wanted someone to talk to. He told me his life story. He needed to be kept on track with the interview at times but it was a privilege to just sit and listen to him. This was the first and only participant who lived alone, but his story is likely to reflect the situation of some other older men. Max’s story highlighted the difficulties faced by elderly people who live alone and have no family assistance in maintaining their own homes and the risk of this situation to their health and wellbeing.

**Tim**

Tim is a 52-year-old man who was building his man cave on the day of his fall, some three metres above a concrete floor on his aluminium folding ladder. What immediately captures my attention is Tim’s matter of fact attitude when talking about his fall and his admission of guilt after reflecting on the incident. His main focus in the interview is around what contributed to his fall;

“I’d been using the same ladder in constructing this shed for a period of a month or so beforehand so I’d been up and down it at least twenty times without any previous concerns”.
He tells me he needed to make a cut along the window sill;

“I picked everything up just as it was...went inside (the shed) ...stuck it (the ladder) against the wall, marched up the ladder again...started to make the cut...I had both hands on the angle grinder...I realised the bottom of the ladder was going back out that way”.

In addition to breaching the three-point rule of contact, Tim also failed to assess the surface of the floor prior to climbing the ladder; “the inside surface of the shed is nicely planed concrete, very smooth”. It would appear that Tim also placed the base of the ladder too far away from the wall of the shed; “probably more than a metre and a half. Yeah. Critical”. I ask Tim whether or not he went through any safety checks before climbing the ladder; “No. I put it down and climbed it. There was really no cause for concern I thought”. This statement reflects a task focused approach to the job at hand with little attention to risk and ladder safety. It also appears that Tim was distracted by the angle grinder at the time of the fall; “I was concentrating on the angle grinder cause I didn’t want to be near it”. Tim recognises and reinforces many times that complacency is:

“the biggest risk factor. Definitely. It’s not a complicated business...just didn’t think it through... inattentiveness but that comes off the complacency as well. I think overwhelmingly Katherine, it’s complacency”.

In reflecting on Tim’s experience and comments, it seemed that being familiar with the task at hand and the ladder itself, appears to have contributed to a complacent attitude that resulted in a poor assessment of, and inattentiveness to, potential risk.
5.5.2.2 Main themes

Main themes from the above narratives are organised according to the socio-ecological model into individual, interpersonal, institutional or organisational and community factors (Fig 1). At the individual level, factors identified were complacency, impulsiveness/impatience, distraction and being task focused, having a knowledge deficit, self-beliefs about ability and saving money. The one interpersonal factor identified in the interviews was climbing whilst home alone. This behaviour was particularly relevant to those participants who lived with their spouse, but chose to climb a ladder when the spouse was not home. Finally, values at the community level among older people of that generation, such as getting the job done right and self-reliance was found to be a key theme. Retirement coupled with greater longevity in the community, and the emergence of do-it-yourself (DIY) television programs and promotions were also factors at the community level, encouraging men to do the job themselves. Living alone, which is the case for some older men in the community and is highlighted by Max’s narrative, is the final community level factor identified. In the next section each of these factors will be discussed. Quotes and descriptions of data drawn from the narratives and from other participants are used to corroborate and further illustrate each factor. A number of factors are interrelated which will be highlighted in the following discussion as relevant.
5.5.2.3 Individual themes

Complacency

As with Tim’s story, many of the participants referred to complacency as a reason for their fall. Complacency in the men’s stories was found even when they had previous experience with ladder use in the workplace. This was identified across many interviews. These men appeared to not see the dangers in the home environment and did not apply their previous knowledge of safe ladder use. Confidence in ladder use from previous knowledge of the safe use of ladders in the workplace did not translate to safe use in the home, but rather there was complacency and a lack of any risk assessment at home. Adam was one participant who had
extensive experience in the building industry, which included teaching the safe use of ladders. Fred had also used ladders previously in his work, whilst Mark was still actively using ladders in his work. Whilst many participants may have knowledge of safe ladder use, this appeared to be either insufficient or not used to prevent falls risk in the home environment.

There was also a suggestion that the participants in this study did not see working at a lower ladder height to be associated with a risk of injury, which may have further contributed to a complacent approach to ladder safety. The lack of understanding of the potential for serious injury even from a low fall height is well illustrated by Bob’s story presented at the beginning of this section when he said “I sort of figured because it wasn’t so high...”. This issue was also mentioned by Rita, one of the spouses interviewed.

*Impulsiveness, impatience, distraction and task focus*

A number of the participants shared attitudes that suggested impulsiveness or impatience, for example being unable to wait: for a tradesman (Chris); for their wife to hold the ladder (Jim and Tom); for when they were less tired (Rod). Having just that last final bit of the task to complete – such as the last part of painting a new ceiling – contributed to the fall of Bert, Mark and Rita’s husband. A job was identified as needing to be done and as such, completion of that task became the focus and safety likely a secondary or absent concern. The concept of being task focused also interrelates with a lack of knowledge of safe ladder use and failure to undertake a risk assessment (Jim).

Distraction was commonly identified as with Matt who was thinking about how to cross the skillion roof (which has a steeper pitch and tends to bend), rather than how to stay safe on the ladder. The task in many cases appears to have distracted the participants from ensuring that
basic ladder safety principles were followed. One of the spouses summarises her partner’s impatience and being task focused: “He goes like a bull at a gate”.

Knowledge deficit or lack of application

Throughout the participant stories, a knowledge deficit or a failure to apply existing knowledge was evident. These knowledge deficits relate primarily to the basic principles of ensuring an appropriate non-slip surface on which to place the ladder (Tim, Tom, Bert), ensuring a correct angle of inclination (Matt, Chris), ensuring that the climber does not reach or stretch laterally (Bob, Mike, Jim, Bert, Fred) and ensuring the three-point rule of contact (Tim, Jim). In the case of Rod, there was a knowledge deficit in regards to the slope of the land the ladder was placed on and Rod’s body weight, which affected ladder stability and ultimately made the ladder lift and topple over. For Adam, it was failure to ensure that the clips holding the ladder sides apart were fully locked. In Max’s case, it was failure to adequately secure the ladder. Contributing to Tom’s fall was the inappropriate storage of the ladder outside, which contributed to the degeneration of the ladder shoes (the pads on the bottom of each ladder leg). Clearly, there were more than one contributing factor to the falls such as distraction covered earlier in this section, however a lack of knowledge or application of existing knowledge led to a breach of the basic rules of safe ladder ‘set up’ leading to a fall. Interestingly, many participants (including Adam, Mark, Bob and Bert) with prior knowledge of safe ladder use did not use it for a variety of reasons, including fatigue, the lateness of the day, being task focused and in a hurry.

Tom provided a photo of the ladder configuration that led to his fall (see Photograph 5.1). The angle of inclination could be considered too small, given the steep gradient of the ladder. Tom also acknowledges that the mat was not safe underneath the ladder.
A lack of knowledge of the effects of aging on their ability to use a ladder safely was also evident in many participants’ interviews. When asked about their understanding of normal aged related changes that could affect their ability to climb a ladder safely, many participants had not even considered age as a potential contributing factor to a fall. However, upon reflection after the fall, many participants (including Jim, Matt and Adam) realised the importance of considering their age when climbing a ladder. Up until the time of the fall, Matt had not considered his age, stating that he considered himself to be “ten-foot-tall and bullet proof”. It was not until after the fall that he realises his lack of fitness and agility.

Self-belief

Self-belief in this study refers to an individual’s perceived capability to complete the job at hand regardless of their age and health status. Many participants felt well and considered themselves to be healthy. This added to their self-belief in their ability to climb a ladder and continue to do jobs around the home. Some participants referred to still being active and this
self-belief translating to doing work around the house, including on ladders, despite their advanced age. There were also many references by participants to the notion of feeling invincible, which can be seen as related to this concept of feeling healthy and well (Bert, Bob).

**Monetary**

A number of participants spoke about saving money by doing the job themselves. Receiving the pension could also make it difficult for participants to afford to pay for assistance, as Max’s story highlights. Matt also comments that once one is close to pension age, money does become a factor that needs to be considered. Many participants said they were reluctant to pay for someone to do the job when they felt able to do it themselves, linking the idea of saving money to their self-belief. Again, the inter-relationships between factors is evident. The need to maintain independence also appears strong among the men interviewed.

5.5.2.4 Interpersonal and community

**Living alone or climbing alone**

Climbing home alone was the sole factor identified at the interpersonal level in this study, but it is a critical one to ladder safety. Bob and Max, as described in the narratives, both climbed alone, though for different reasons. Bob may have been impatient even though he lived with his spouse. Other participants also reported climbing alone though they did not live alone.

Max was a person with little choice as he lived alone and also had monetary concerns. His experience is important to highlight as the plight of people living alone was identified as an area of concern by other participants, even though they themselves did not live alone. Adam’s wife also drew the connection to living alone and monetary concerns.
Generational values

Generational factors as a theme here, refer more to the wider views among this generation of men that appear to shape their attitudes and behaviours. This factor operates at the community level and represents a shared system of values likely to be common to many men in the age group of this study.

There were often comparisons and comments made about the younger generation by the male participants, in particular, of their inability to complete jobs to the standard expected of the older generation. The sense of pride and an unwillingness to hand over control to someone else is also evident in some of the men’s stories. Matt indicated that these views may be widely held among Australian men of his generation that have been brought up observing this self-reliance among their fathers.

The role of the male in house maintenance was raised by a number of the participants, reflecting gender stereotypes possibly also related to an older generation’s values and beliefs. When interviewing participants and their spouses, it was apparent that in many of their households the male assumed the role of ‘handyman’. This was seen in the stories of Bob and Joan, Rita and Mike, and also with Jim, Mark, Bert, Matt, Tim, Chris, and Adam.

Retirement and DIY promotion

Fred and Bev both commented that once retired, people have time to renovate their home. However, many retired people may have no experience in renovating as they may never have had the time to do their own maintenance and improvements when employed. However, doing household jobs themselves seemed to make the participants feel more empowered at a time when they no longer get a sense of purpose from their job;

“I’ve noticed with a lot of older retired gentlemen that they feel disempowered, they are no longer the bread winner, no longer the guy that goes to work. So I think a lot
of over 50’s think they still need to do these things so they work on their houses and so forth that at a younger age they wouldn’t have done”.

Fred strongly believes that renovation based television programs may be having an impact on ladder falls in older men; stating that many people who would not have previously considered DIY renovations are now seeing renovations on television and thinking ‘it does not look hard, so I will try it’. Fred stated that these people then go and seek advice from the hardware store but suggests that perhaps they should not be doing the work themselves. Fred also points out an inter-relationship between the generational factors raised by participants and the DIY context, where DIY classes offered by hardware stores encourage men to do more ladder-related works around the house. Bev adds that there is an increased awareness of the added value to renovated houses, which when coupled with the savings from DIY rather than paying handymen become an even stronger incentive to do it yourself.

**Lack of risk assessment**

The individual factors (attitudes), together with the behaviour of climbing alone (interpersonal level) and societal values (self-reliance and DIY in retirement) led to many of the men in this study using a ladder when they probably should have paid someone else to do the work. A failure to assess risk can be linked to all of the individual factors discussed; a knowledge deficit of safe ladder use or a failure to use existing knowledge in the home context, complacency, over confidence, impulsiveness, distraction, task focus and impatience.

**5.5.2.5 Summary of pre-fall factors**

Whilst the majority of pre-fall factors are within the individual component of the socio-ecological model such as complacency and self-belief, the inter-relationship of these factors with interpersonal and community factors is evident, for example living alone and
monetary factors. This inter-relationship assists in understanding the complexity of these pre-fall factors, which rarely stand alone. The similar inter-relationship is also seen in post fall impacts, which is elaborated in the next section.

5.5.3 Post-fall impacts

5.5.3.1 Narratives

Mark

I notice a profound limp as Mark walks towards me. This immediately captures my attention, as it has been 23 months since Mark’s fall of two metres, where he sustained an open fracture to his ankle. I am interviewing Mark at his workplace. He takes me into an office and closes the door. He is of a non-English speaking background and is clearly passionate about ladder safety. He draws diagrams as he speaks to help me understand what he is saying.

Mark tells me that he is a trained carpenter/builder and that his current occupation is that of a building inspector. On the day of the fall, he was working on the renovation to his home and “not the first time I built, not first time, and the ladder using ten times a day, up down up down you know”. It would appear that Mark was in the final stages of the renovation and has climbed the ladder with a hammer in hand and has lost his footing: “it is seconds...you feel like shock...I cannot manage...I’m feeling pain...strong pain”. Mark then graphically describes feeling the exposed bone (fracture point) with his hand while he is on the ground. Mark’s sons call an ambulance and he is transported to hospital. Mark has surgery where his ankle is internally fixated with metal screws and a plate. He also has bruising to his shoulder. The extraordinary post-operative journey experienced by Mark is then uncovered. I am in awe of Mark’s resilience, honesty, openness and strength in being able to recount this with
me in such detail. So, what did happen after his initial discharge and what is he still experiencing some two years after his fall?

Firstly, Mark is still experiencing ongoing pain and swelling in the ankle;

“It’s hard, it’s hard. Now still get numbness, swollen, still to this time, feeling my right leg is heavy. I have a box and lift my leg all the time, like throbbing, all the time, numbness is all the time”.

He also reports ongoing range of movement restrictions; “my ankle is locked to my leg, locked...I cannot bend anymore...locked at ninety degrees”. The implications of this reduced movement of the joint has led to a myriad of yet further restrictions/limitations, including his ability to drive a car;

“Driving, it hurt. Normally I take my wife and boys every two weeks for drive long way...now maximum I can drive is an hour...you ask me why...pain and numbness”.

Mark is also experiencing associated lower back and hip pain. The time he used to spend with his children is also impacted; “I loved tennis with my boys...not anymore tennis with my boys”. He also has big dogs that he can no longer walk. Lastly, Mark inspects worksites as part of his work role, and this has also been affected by his injury.

“Myself is slow especially when have an inspection...I need to walk above steel mesh...before accident like ants, no problem. No problem, nothing stop me. This one when I walk I am scary because the steel mesh when you walk is floppy like that...I get pipe or broomstick or something to hold my body especially steel frame. You know, I need to be slow”.

As a result of his ongoing joint disability, Mark is still having physiotherapy weekly for one hour. Mark also describes the mental health issues that he has experienced after the fall. It
appears that he was experiencing heart palpitations which led to him consult a Cardiologist who after assessment, commenced Mark on anti-depressant medication. However, he remains relatively positive about his life.

“Thank God I can at least work…pushed myself because I don’t like to sit down at home…doesn’t matter I can take the pain but I need to work…if you stop work get sacked…how can you live? Have mortgage, have children, how can you survive? I am slow but at least I can work you know. At least I can walk. Happy I can walk”.

Mark also describes ‘flashbacks’ to the time of the fall on a number of occasions while talking with him. This is in the context of him using ladders since the fall, as part of his work;

“Like when I have an inspection now still using ladder. I check it. But when the ladder I have like depression, scary, I remember [date]. My brain come back to [date] straight away”.

It would appear that the fall has had a negative impact on Mark’s confidence and ability in climbing a ladder. In another context, Mark describes his anxiety;

“When I have shower or walking in wet, heavy rain I am scary because if I slip not anymore, finish”.

The injury has also impacted on his self-image. At his church;

“there are three steps to the alter. You feel shy like people look at you…you need to limp…to twist your hip”.

Mark briefly mentions the impact of the fall on his intimate relationship with his wife;
“it affect my sexuality with my wife...with me it is like different position, you know it is hard to...your feet they are locked, try to push my feet it is pain and it is locked, locked. You know”.

There was also a period where Mark was using a wheelchair; “feeling like depression...give hard work to my wife to push”. Similarly, Mark describes these feelings when having to ask his wife for help to shower when he initially came home from hospital. Mark also states that prior to the fall, he contributed to the care of house/household 50%. Since the fall, this has reduced to 20-30%.

Mark went on to experience a number of surgical and medical complications related to his treatment. After his initial surgery, he experienced worsening pain in the ankle and had a screw removed some three months later. Just 12 months after his initial surgery, Mark was diagnosed with osteomyelitis in the ankle and had all remaining surgical hardware removed. He was commenced on long term antibiotics via a peripherally inserted central catheter (PICC). Mark stated that due to the strength and duration of the antibiotic therapy, he is still seeing his liver specialist every three months for blood tests. Furthermore, Mark developed a deep venous thrombosis in two veins in his arm due to the PICC. He required anti-coagulant therapy (two drug combination) then warfarin for eight weeks.

5.5.3.2 Other men’s stories

Mark is not the only participant to experience surgical and medical complications. Rod fell whilst cleaning his caravan and sustained complex fractures to both ankles. He initially had three surgical episodes for internal fixation of the fractures, and then was admitted to a rehabilitation facility. During his rehabilitation stay he developed an infection which required readmission to hospital for antibiotic therapy. Twelve days later he was transferred back to rehabilitation for another four to five weeks. When I interviewed him, he had been home for
one month. He was able to partially weight bear on his right foot, but was non-weight bearing on the left. He stated that he has “very little feeling in the left foot, it is still numb”. I observe that the left lower leg is very swollen and a poor colour. He is still having physiotherapy twice a week and is working from home. His sleep patterns have been disrupted and he is sleeping in the living room. Since interviewing Rod, I have received further email updates from him. Fourteen months after the interview, all hardware was removed from both ankles. The left ankle was then fused with a rod from the underside of the heel extending through the ankle joint and into the tibia. This has led to no movement in the ankle but he is permitted to mobilise, as able, with a supportive splint.

Chris also fractured both his ankles after falling trying to get a box out of the mezzanine in the garage. He had three surgical episodes within a two-month hospital admission. He then had two admissions to a rehabilitation facility over a period of six to nine weeks. He is still having ongoing problems with wound healing and swelling to his right foot, five months after the injury.

Adam fractured his heel after falling whilst pruning a bush in the backyard. He describes the past years of his life since his fall as “two years of hell”. He has had two surgical episodes, “countless physio” (three times a week for seven to eight months) and is still taking analgesia. He states that he “could not wear shoes...lived in two pairs of crocs up until one month ago”. He also tells me that he has to now purchase two pairs of shoes, one his size and one two sizes bigger for his injured foot. He only wears old socks on the injured leg so “it doesn’t cut in as much”. He is also experiencing decreased sensation to the affected area. Some nights Adam doesn’t sleep. He will not go out shopping anymore due to the pain. He has had to sell his caravan and misses his fishing holidays.
5.5.4 Main themes

As in the pre-fall discussion, the socio-ecological model is used to examine the post fall impacts in this section (see Figure 5.3). The impact of the fall on the individual, their family and on society, including work and the public health care system were identified as the main levels of impact in the analysis of the men’s stories. The impact on the individual was then refined to five key areas; pain, mental wellbeing, guilt, physical and ladder use, as depicted in figure 5.3. Each of these impacts on the individual and their family are discussed below, followed by a discussion of the impact on the public health care system and society more broadly.

Figure 5.4 Post fall factors within the socio-ecological model
5.5.4.1 Individual

Pain

The impact of pain was pronounced and transcended across many facets of the patient’s life, including work, leisure and interpersonal relationships (for example Mike, Rod, Adam, Tom and Mark). The nature of the orthopaedic injuries sustained by many participants (for example Mark and Rod), predictably led to severe pain however it was the prolonged nature of this pain that was often highlighted (for example Chris, Rod, Mark and Adam). The associated disabling effects of the pain were also prolific in regards to mobility and the psychological impact. There was also the need among many participants for prolonged use of analgesia, some for as long as two years post-fall, the injuries being that severe (for example Max and Adam). For some, analgesia required opiates (for example Max). This did vary among participants however, with others requiring very little analgesia (for example Fred and Mike), to the point where their discharge analgesia was hardly used.

The majority of participants had an ISS of less than 12 (indicating minor trauma). What is evident is that the ISS of these patients (refer to Table 5.2), did not correlate with the degree of functional limitations and ongoing disability reported post discharge. This should not be unexpected as the ISS is a clinical tool used as a predictor of acute injury severity and mortality in the acute clinical setting, and for clinical decision making on the immediacy and level of care required. Thus, an injury classified as ‘minor’ in the acute clinical setting does not preclude major long term consequences for the patient in the community.

The effect of pain on participants was multi-faceted, impacting not only on the individual but on interpersonal relationships. This again highlights the cross over between levels of the socio-ecological model. For those participants employed in work, the effect of the pain on their ability to work was twofold. Firstly, there was the impact on the ability to do their usual
job and secondly, the financial impact as with one patient who was a small business owner without income protection insurance. To conclude her interview, Rita touches on the financial burden the fall imposed;

“the impact too is the fact that he was in a brace for 10 weeks and couldn’t work for 10 weeks. And therefore there is no income coming in. It was something that you know affected him – guys feeling they are the bread winners. So that was a bit of an issue. No income protection insurance. Semi-retired. Small business”.

There is also an inter relationship here between interpersonal impact and generational factors (the male as the ‘bread winner’) as illustrated in this quote and discussed in a later section of the post-fall impact findings.

Mental wellbeing
Depression, self-harm, fear, agitation, altered self-image and lack of socialisation, were all factors identified as impacting on the mental being of some participants (for example Mark and Jim). Frustration, in the context of loss of independence, was also experienced by Mike and Tom. Depression was highlighted in Mark’s story.

Fear was demonstrated in various ways. Tim stated that he is now risk averse taking extra time to cross the road. Jim’s spouse reported that she was unable to hang the clothes out on the line without Jim calling out, fearful of being left inside on his own. Jim is seeing a psychologist to assist with this. Jim also describes fear at the time of the fall from the physical effects of his chest injury, which included being unable to breathe and the subsequent sense of panic and worry that he experienced as a result. He even questioned whether he was going to survive which was exacerbated by the fact that he was home alone.
Agitation in a number of participants was reported by the spouses. The spouses reported episodes of irritability and agitation, which in Tom’s case, impacted on the patient’s daughter, who could not understand why “Daddy is so cranky”. Agitation also impacted Rita’s husband Mike, who was renovating their home and was painting on the day of the fall. She says that he was “overstretching...he just needed to get into this corner...he was wearing socks”. Her husband sustained a fracture to his neck and a scalp laceration. He was required to wear a neck brace for ten weeks and was unable to drive, which caused some problems in regards to his independence and created feelings of frustration.

“He was reaching the end of his tether...it was very stressful...he was also getting very agitated and very restless because he was depending on myself and our son...he felt he was putting us out and he felt he was imposing...he had to be driven and it was impacting.”

Irritability is also discussed by Rita and Gwen who commented on the impact of the fall injury on self-image and socialisation for Mike and Tom, who were discharged home with support braces for their spinal fractures; one for the neck and one for the lower spine respectively. These participants were reluctant and indeed refused to attend social events due to these braces being obvious. This was particularly problematic for Tom’s spouse, Gwen. Tom had fallen close to Christmas and there were many family events to attend at this time. Mark, as previously noted, was self-conscious whilst attending church, concerned that people were looking at his altered gait as he climbed the stairs to the alter.

Independence is again identified as a factor in the post fall findings as it was in the pre-fall setting. It has however a different focus in each setting with the emphasis in the pre-fall setting being on maintaining independence in undertaking DIY jobs. This is in contrast to the
post fall fear of losing independence secondary to the injuries sustained and the limitations of these injuries on being able to return to their pre-fall level of functioning.

Guilt

Some participants expressed guilt about the subsequent effects of the fall on their family. A process of self-reflection was also evident in many participants, realising what they had done poorly and the behaviours to change for future ladder climbing. While interviewing Bob, he became emotional and started by talking about some feelings of guilt over the fall and the impact of that on others;

“mentally, the first thing that really got me was you know that I was going to put my family through this upset… I felt so bad and I really did. I was quite emotional. I had ruined all the work of my orthopaedic surgeon… all the work I had done at rehab and all the physios… I was so good you know physically and this is what I’ve done”.

Physical impact

The impact on regular sleep patterns was reported by Jim and his wife which for them, was a significant impact. Jim was unable to sleep, eventually having to take medication to assist with sleep.

“I could be lying there till 2 o’clock in the morning until I finally drift. I was emotional. Calling out. Yelling out. It’s not something I want to relive really”.

The couple also had to swap sides of the bed to facilitate transfers more effectively in and out of bed. His wife was also unable to sleep. Jim eventually moved to another room, however his wife still had difficulties sleeping, listening for him in the other room. The impact was described as emotional by Jim’s wife; “I was walking on egg shells there for a while”. This is another example of factors that are inter-related; in this case, both a physical impact and
interpersonal impact. Another participant, Adam, stated that sometimes he does not sleep at all.

Two spouses also reported weight loss in their husbands. In Adam’s case, this was cited as being linked to strong analgesia and his pain, which made him feel unwell and too sick to eat. Bob’s spouse also noted a change in body shape/frame and that her husband looked skinny.

Reduced mobility was primarily related to three factors; pain, swelling and numbness from lower limb injuries. This reduced mobility had many effects on work (as experienced by Rod and Mark) and leisure activities as well as mechanical movements such as climbing stairs.

Rod lives in a two-storey house and as such, had to transform his downstairs living room into his bedroom.

Activities of daily living were affected for some participants. The greatest need for help by the spouse was early after discharge, with help needed for showering, toileting, dressing, transfers and driving. Fatigue for some participants affected their ability to participate in recreational activities such as lawn bowling.

*Ladder use*

Ladder use was described in two different contexts, recurrent use with no change to the climbing behaviour and technique and changes to ladder use behaviour following the fall. Recurrent ladder use was evident, with some participants continuing to climb ladders after their fall. Some have changed or modified their climbing behaviour, whilst others continue to treat the ladder as they did pre-fall.

In Bob’s case, despite the impact the fall has had, he tells me he is still climbing ladders. He promptly describes his new ladder to me; what appears to be justification for the purchase and evidence that he now has a safer ladder, that he has learnt from the experience and done
the right thing; “it’s one with a locking frame on it… it’s tradesman quality industrial ladder… you get stabilising bars with it which I will do”. I ask Bob if he now does anything differently when he climbs the ladder and again, he is quick in telling me about his improved, safer climbing behaviours despite Joan telling him he is not allowed to climb a ladder.

“I wouldn’t even think about doing what I did before. And if, when I use it, I take quite a lot of time to set it up, make sure it’s absolutely solid and when I’m on it I am so careful… If there was a job that needed the roof or guttering, I wouldn’t hesitate, I’d get someone in, I wouldn’t do it myself”.

For Bob, it appears that the perception of height is a deciding factor in whether or not to hire assistance to do the job, as also seen with Mike. However, Bob has told Joan that he has to get up on a ladder ‘to do some jobs; there are just some jobs he has to do and they involve a ladder’.

Rita’s husband is also still climbing ladders as he reports concern about developing a phobia to ladders if he does not start using ladders again. Mike has also attempted to reassure Rita by assuming a more cautious approach to ladder climbing and ensuring he works “within his means”. Rita explains that the very nature of Mike’s work (home maintenance) makes it difficult for him to not use a ladder. Despite Mike’s reassurance, Rita explains that his behaviour towards ladder use is not consistent; “sometimes I will find him on a ladder with a pair of thongs and other times he’s got his joggers on”.

For Fred and Bev, the ladder climbing rules have changed as Fred explains; “yes, not allowed up it without Bev at the bottom. Well now it is 100%”. Bev further enforces the point; “It is mandatory, don’t you dare go near that ladder without me!” The influence of the spouse in behavioural change is obvious in this example.
Rita, like Bev, has since implemented some ‘rules’ for her husband when climbing ladders. The challenges she describes though are relevant to many of the stories of the spouses interviewed:

“I have said I don’t want you up on the ladder if there’s no one home. And we have discussed that. And at certain times when he’s up on the ladder I am holding the ladder but there are times when he doesn’t want to be disturbing me and he will just do what he has to do – and he says to me you have to understand that I can’t keep calling you to hold the ladder every time to hop on the ladder, it’s impossible. I try not to be a nagging wife. He is a grown man, I leave it up to him, I can only do so much... What do you do? You just can’t stop them and you can’t molly coddle them either can you?”

Changes in behaviour also extended to the neighbours of the participants. Bert talks about his neighbour’s wife, who now insists that her husband help Bert with any task that involves a ladder.

5.5.4.2 Interpersonal

The stress on inter-personal relationships (particularly patient and spouse), was profound and in Mark’s case, infiltrated into the intimate side of their relationship. As seen in Adam’s story, the ability to partake in leisure activities was affected and this was reflected in many participant’s stories. The caravan Adam used for holidaying was sold following, and as a result of, his injury. Many participants described stressed inter personal relationships, with children and grandchildren also being involved in some instances (Rod and Matt). This included the ability to socialise with them and the physical restraints of not being able to pick up and play with the grandchildren due to injury.
This section has described the extent and complexity that the impact of the fall has had on the participants in many facets of their lives including managing pain, poorer mental wellbeing, guilt, physical impacts and changed ladder use behaviour. In the next section, the impact on the spouse, family, leisure and work is elaborated and includes a focus on the perspectives of two of the spouses interviewed separately to their partners.

**Impact on the spouse**

As outlined in Table 5.2, seven spouses were interviewed; five with their husband and two on their own (Rita and Joan). I did not interview Rita’s husband. Both of the women interviewed alone provided significant insight into the stress and impacts of the fall on their relationship with their husbands. What was also evident both in spouse presentation, expression and use of language, was the emotion attached to the ladder fall and its subsequent impacts for these women.

I ask Joan what impact the fall has had on her, Bob and their family. Bob and Joan were in the process of selling their home when the fall occurred. “Big impact this time, really huge impact. Mentally and physically for him, but mentally it was a really difficult time [for Bob]”. She reports that Bob has been fatiguing easier, has lost weight, has been stressed and has voiced to her that he isn’t coping well after the fall. Despite Bob expressing these feelings to Joan, Joan said that Bob continues to “put himself in situations where he thinks he can do something and probably doesn’t think it through”. Joan expresses worry about Bob’s continued ladder use post fall but admits that she “knows he will do it again...he’s a thrill seeker”. These comments and Bob’s current behaviour are reflective of the key themes of lack of assessment of risk, complacency and being task driven identified in the pre-fall themes from the men’s stories. Joan’s experience post fall suggests that changing some men’s behaviour on ladders, even after a fall, will be a challenge for any public health intervention.
Joan also reported experiencing a spectrum of emotions after the fall, from calling Bob an ‘idiot’ at the scene of the fall to experiencing a ‘traumatic’ moment upon seeing Bob in the Emergency Department. These feelings were also described by Rita, Bev and Lucy. These spouses described a sense of possible loss of their husbands as they know them; a possible loss of function, ongoing rehabilitation and the implications of these losses on them as a couple. They all share their feelings that the fall was life changing. This is best illustrated by Rita, who describes ongoing emotional and mental health issues both immediately and long term after the fall for herself;

“...here he is in hospital with a neck brace and I thought am I going to be bringing him back home, is he ever going to walk again, I started thinking the house needs to be modified, how am I going to handle him, I thought how life can change in a split second, not only just his but everyone around him... I was traumatised and I was traumatised for a long, long time after that. Every time he was around and I hear a noise I thought oh no what has he done now and I’d run to him ...yes, I think I was traumatised more so than he was because I found him there unconscious with his eyes rolled back, he wasn’t responding and I just you know... it was really scary, really scary”.

Rod’s wife Dorothy discusses the burden on her since the fall.

“On my side of it, it was the running to and from the hospital. Very, very tiring and then coming home and still having to do stuff, still going to work, that sought of thing. And now at the moment, the fact that he can’t do anything, I am his chauffeur as well and we’re not sure how long it will be till he can drive, so that side of it, the maintenance side of the outside of the house has gone downhill because I can’t do all
that as well as care for him so it has had a significant impact on what was a normal life... going to work, coming home, seeing his grandkids”.

Dorothy then goes on to describe her anger and resentment towards Rod for the impact the fall has had not just on him but on her;

“For me what Rod did that day has not only impacted him and he has been in a lot of pain, but has also impacted me and I don’t have any control over it. Right. It’s not my, it wasn’t my issue, it was his issue but it has gone onto me”.

In speaking with the spouses, further insight has been gained in understanding the broader impact of the fall on the spouse and family. It is evident that this extends beyond the sequelae of the physical injury to include significant emotional upheaval for both the patient and spouse and a burden of care on the spouse in particular.

Impact on work, leisure and family

As previously identified from the men’s stories, the impact of the fall on leisure and work was significant. These factors subsequently impacted on interpersonal relationships within and outside the home. Leisure activities were restricted significantly for Adam and Mark, and for Rod and Matt, their ability to interact with their grandchildren was impacted. For Mark, the fall caused anxiety around his return to work and job security, as well as his confidence in doing his job safely, such as when performing a site inspection. For Rita, there were concerns around financial security after Mike’s fall, given they were business owners with no income protection insurance. Rod had to make alternative arrangements to be able to work from home.
This section has explored the interpersonal impacts of the fall on the spouse and on work, leisure and family interaction. The impact at the organisational and community level of the socio-ecological model is examined in the next section.

5.5.4.3 Organisational and community

The impact at this level of the socio-ecological model was considered in relation to the public healthcare system with time to recovery and multiple surgeries, readmissions and complications identified and to the workforce with lost productivity. The burden on the public healthcare system is significant, especially highlighted by Mark and Rod’s stories, with recurrent hospital admissions, multiple surgical procedures and complications. There is also the issue of lost productivity to the workforce during such protracted recovery from injury as was evident in the stories of Mark, who lost significant time from work and Mike, who was self-employed with no income protection insurance. The participants themselves did not talk about the broader impacts at this level of the model in any detail with their focus more on themselves, their family and work and leisure activities – the more relevant spheres of impact in their everyday lives. Nonetheless this sphere of impact was highlighted in their stories and is an important aspect of the burden of injury and cost of falls which needs to be considered as a further impetus for injury prevention efforts.

5.5.4.4 Summary of impacts

The socio-ecological model provided a useful framework for organising the qualitative findings and identifying the levels of influence and impact of the fall. At the individual level, the impacts identified were on mental and physical health and changes in ladder climbing behaviour. The impacts at an interpersonal level were on the participant’s work, their interpersonal relationships with their family and on their ability to participate in leisure activities. The broader impacts of loss of productivity (due to reduced capacity to work) and
the costs to the healthcare system were impacts identified at the organisational and community levels.

Many of the impacts identified in the qualitative data are inter-related and highlight the many levels of burden from ladder falls in the non-occupational setting, for example, pain impacts on the ability to work, mobilise and participate in leisure activities with family and friends. Interpersonal relationships with the spouses were also impacted by the pain experienced by participants, as well as the guilt, and especially, the alterations to mood (irritability, agitation for example). What is evident across the qualitative findings is that the impact of the fall is significant for these men, their families, work, lifestyles and society. The challenge for public health and injury prevention programs is to identify strategies to reduce the number of falls occurring. Participants were also asked during interview about possible injury prevention strategies from their perspective. This will now be discussed.

5.6 Injury prevention from the participant’s perspective

During the interview process participants were asked for their opinion on what strategies could be used to prevent falls from ladders in men of their age group. Analysis of their responses identified three key issues that they saw as important to address in preventing ladder falls in the non-occupational setting. Firstly, the need for improvements to ladder design and the use of safety accessories, some of which are already available to consumers. Secondly, ladder safety advice at point of sale, which was discussed by some participants, including the role of the sales assistant and possible modalities for delivery of safety information at point of sale. Thirdly, media strategies to promote ladder safety were a focus of their responses with participants providing suggestions on the content and visual and
emotional appeal of advertisements. The varied and practical lessons learnt by participants from reflecting on their ladder falls are also summarized at the end of this section.

5.6.1 Ladder design and safety accessories

A number of recommendations were made by participants to improve ladder design features and the use and sale of safety accessories. The warning label that is attached to ladders was discussed in regards to its prominence and effectiveness by a few participants. Jim suggested that it be “more obvious” and affixed so it is visible as you approach the ladder. Jim also commented on the colour of the label, “*something in yellow and black that stands out more clearly*”. Jim’s spouse Lucy supported this, commenting that eyesight does deteriorate with age; “if you can’t see it properly, you don’t read it”, highlighting the possible need for larger labels as well as larger font size on labels. Fred and Bev also added to the discussion on whether ladder users actually read the safety instructions, with Bev saying “no one reads the instructions. Are you serious? We are talking about men here”. There is an element of scepticism from Bev about the effectiveness of these warning labels. However, there appears to be agreement on the need for warning labels that are clearly displayed and readable for an older age group.

There are a number of accessories available on the market that hook over the guttering and can stop the ladder from sliding sideways. Despite stating that he does not use these accessories, Matt suggests that people would probably use these accessories if the accessories were sold with the ladder for an all-inclusive price. Bert makes a similar comment about the inclusion of safety accessories with the sale of ladders when talking about mandatory tie offs to prevent the ladder from slipping. Bert says that he has been told of a store that sells quality tie offs, however this store “*dealt with tradies rather than the public*”. The comments from
many participants support the idea that safety accessories be sold as part of package with ladders and promoted to all ladders users, not just tradesmen.

In summary, whilst it was felt that improvements should be made in both the design and location of the warning labels, there is still some doubt as to the overall effectiveness of labels. Participants also identified the benefits of using accessories such as tie offs to improve safety and it was suggested by participants that consumers should be made to buy these safety accessories as part of the ladder purchase.

5.6.2 Participant’s design strategies for improved ladder safety

Two participants designed their own ladder improvements based on the mechanism of their fall and their reflections on events leading to their fall. Mark was one of these participants. The premise of Mark’s design improvement is that the width of the rung where he placed his foot at the time of his fall was too narrow. The width meant that only the ball of his foot was able to fit on the rung. He explained that this then potentially affected his balance and hence safety. When Mark fell, his leg slipped downwards between the rungs. He states that this occurred because of the angle of his foot to the narrow rung. He therefore advocates for the rungs to be made wider so that the climber’s foot can be placed more fully on the rung, hence taking more weight. He describes the climber’s foot as then being parallel to the ground as it is now flatter on the rung. Mark also discusses the grooves on the footplate and the importance of keeping the grooves free from paint and dirt, in order to achieve optimal grip.

Mark is not the only participant to mention the design of the step and the potential risk of injury. Tom also suggests that the step should be flat, as he has previously found the rungs “awkward” which affected his footing. The positioning and security of the climber’s feet is also mentioned by Tom, with concerns about his foot going, “straight over the top” of the rung. Conversely, Tom’s stepladder has a cross metal brace so that if he is wearing boots,
actually prevents him from getting his foot through onto the rung. It would appear therefore that the design and width of the rungs may vary between ladder types and their safety may also be affected by the type of footwear the climber is wearing. Both Mark and Tom describe similar concerns about the width of the rungs and the stability of the climber’s feet, which may suggest that this aspect of ladder design requires manufacturing and standards review.

Adam is the other participant who after reflecting on the mechanism of his fall, designed a safety improvement feature. At the time of his fall, Adam was pruning a bush in his backyard. Adam had pruned parts of the bush then moved the stepladder to prune a section in the middle of the bush that he could not reach. He placed the ladder on one side of the bush and pruned the dead foliage, then moved the ladder to the other side;

“Unbeknown to me the two clips had come up on the ladder when I moved it. I climbed up on the ladder, pruned it, took one step to come down and down came the ladder”.

The failure of the clips led Adam to re-evaluate the locking mechanism of the stepladder (see the component bar, Figure 3.1)). The clip mechanism on ladders may be another area of ladder design that could require review.

5.6.3 Ladder safety advice at point of sale

This theme was a topical point for discussion for many participants, each having similar thoughts on the important role of the sales assistant at the hardware store in providing information, education or advice on ladder safety. In particular, Mark reflects on the purchase of the ladder from which he fell, from his local hardware store. Mark feels that cheaper ladders should not be placed for sale at the entrance to the store, as this may make people more inclined to purchase these ladders which despite meeting the required standards, may
not be as robust and strong as more expensive ladders. In support of Mark’s notion, the affordability of ladders for this population was mentioned by many participants who stated they could not afford to pay for a premium ladder, whilst other participants stated that they were simply not prepared to pay high prices for a new ladder.

Jim and his spouse are asked for their thoughts on either listening to the salesman going through instructions at point of sale or watching a video. Jim replies; “I don’t think people will watch a video”. Jim continues by commenting that when you are in a hardware store and ask where the ladders are; “you are told ‘they are over there’, you are more or less by yourself, there is no advice at point of sale”. Matt felt that the salesperson should be more assertive in encouraging people to read and take notice of the instruction booklet accompanying the ladder and to not just disregard it or read it superficially. Mark also felt that the salesperson should explain the safety considerations slowly and demonstrate how to use the ladder safely as; “A lot of people take ladder out of box and never, never, never read the instructions. Believe me, never”.

Both Mark and Jim’s spouse Lucy express concerns over how consumers may respond to ladder safety advice including being dismissive and not seeing their own need for such advice. Mark and Lucy’s concerns are echoed by Matt; “I must admit that I would be the same with someone telling me how to get up a ladder, think you idiot I know how to climb up a ladder”. Lucy also suggests that the gender of the salesperson may also be a factor. Lucy pointed out that “if a woman tries to tell them what they are supposed to do with that particular ladder, I could see them saying I’ve been doing this for years, lady”.

Mark lives in a multicultural region of Sydney which he comments may add to the challenge of injury prevention strategies. Mark suggests that training should be provided to salespeople
about different cultures, to support them in providing advice to older men of different backgrounds whose first language is not English.

In summary, participants agree that there is role for the salesperson in providing advice on safe ladder use at point of sale, with consideration being taken for this information to be provided in the right way to address the challenges of reaching the target audience. Various strategies were proposed including a demonstration on how to use the ladder safely and the importance of a dialogue between salesperson and purchaser preferred over a video presentation. Some challenges identified by participants that may impact on these strategies include the attitude of the consumer towards being told how to use a ladder safely, particularly if delivered by a female salesperson.

5.6.4 Media strategies to promote ladder safety

A variety of methods were suggested for media strategies to promote ladder safety and reduce the number of falls from ladders. Additionally, participants and spouses were clear in articulating the content of these media ‘segments’ and some of the challenges that may be faced in delivering a safety message about ladders to the target group of older men.

Matt and Bob suggested the use of radio as a communication medium, focusing on radio stations that appeal to and are targeted towards the over 55 years’ population. Bob also suggests the use of print media, including specialist magazines such as the bowling club magazines as an example. A number of participants did bowl, suggesting that the strategy of using bowling club publications to promote safe ladder use should be considered. Another interesting suggestion came from Joan, who felt it would have been beneficial for Bob to have received education on safe ladder use whilst an inpatient in hospital. Joan suggests that the content of this education should include an explanation of the need and steps required for a risk assessment prior to climbing a ladder. From my perspective as a trauma nurse, this
strategy would be simple to implement in the hospital setting, perhaps using an information pamphlet for those patients who have fallen, and their spouses.

If using television, Matt, Bert, Tom and Tim all argued that television campaigns should be realistic, honest, “a faithful re-enactment”, “vivid” and “direct” in their message about ladder safety. Many thought the consequences of unsafe ladder use should be highlighted.

Joan and Rita suggested that lifestyle television programs (for example do-it-yourself programs, house and garden programs) that are considered credible and popular with older people should be targeted for discussing and highlighting campaign messages. Joan and Rita support the need to focus the campaign on the outcomes of the ladder fall.

Tim remains matter of fact when offering his opinion on what the television campaign should look like and raises some thoughts on the challenges of undertaking such a campaign. He is asked for his thoughts as to how we are going to fix the problem of ladder falls in men of this age group;

“Tricky. Old farts don’t like to be told how to do things around the house. They have ego problems. Especially when it’s only a couple of feet off the ground as I was. And so getting the message across I think would be tricky.”

The challenge of prevention messages aimed at men is also well summarised by Bert who suggests a focus on the partner may be more effective;

“I guess it’s partly about education, but then it’s getting through to men who think they know everything and probably doing things with limited time. Maybe you need to educate the wives first. Men are difficult creatures. They really are”.

In summary, it is clear that the content of media safety campaigns in the views of the participants should be direct in illustrating and highlighting the physical consequences and
outcomes of unsafe ladder use. A variety of mediums were suggested including print and television however the challenges of getting the message through to the target group were raised by many as a significant issue.

5.6.5 Lessons learnt – practical safety advice from participants

A myriad of general safety ‘tips’ were provided by participants and spouses during the course of their interviews. Many of these are due to the reflective process that some participants undertook after their fall and their obvious desire to provide advice for ‘would-be climbers’ to prevent the same thing happening to other people. Some participants had one piece of advice to provide, other participants had multiple pieces of advice. Their suggestions included use of correct footwear (not socks, bare feet or thongs), not borrowing other people’s ladder, seek assistance as required especially to stabilise (or hold the ladder), have someone assist in taking items up the ladder, ensure the ladder is on a stable surface before climbing, maintain your ladder (for example, keep the ladder out of the weather and remove excess dirt from grooves in ladder rungs), don’t climb home alone and plan and think before you climb.

In summary, the factors identified in this discussion of the participant’s perspectives on injury prevention strategies are based on personal experience and have a practical focus based in the participant’s world view. Their perspectives are informative in helping to understand their mindset on this topic. Though they are not necessarily representative of the views of the target group, the incorporation of these factors could be considered in the overall development of an injury prevention campaign based on existing evidence and theory that underpins contemporary behaviour change strategies. Whilst the views of the participants alone are not sufficient to inform injury prevention strategies, the extant literature will be
discussed in the final chapter together with the insights from the participants reported here where relevant.

5.7 Discussion

There has been scant attention to the factors contributing to falls from ladders in older men in the non-occupational setting and the impact of these falls on them and their significant others after discharge from hospital. The impact on the spouse specifically has not been investigated in any previous studies identified during this research. This study has provided critical insights into the factors related to the fall and the post fall impact from the perspective of those who have fallen and their spouses. The findings are discussed here in relation to the few relevant articles identified on the topic in the current literature.

The interviews conducted as part of the qualitative study component included a diversity of participants which led to a rich corpus of data. The depth and detail in the data collected reflected the willingness of the participants to share their stories and contribute to research that may lead to a reduction in ladder falls among other older men.

5.7.1 Pre-fall factors

The findings were organised in this chapter using the socioecological model (McLeroy, Bibeau, Steckler, & Glanz, 1988) which aided in showing the pre-fall factors beginning with those related to the individual, such as complacency and a knowledge deficit to the key interpersonal factor of climbing when alone then extending to the wider level of the community with generational values and DIY promotion in the media as key factors reported to influence falls in this group of men.

The central theme or behaviour identified in the pre-fall context was a lack of assessment of risks by the men before climbing the ladder. The individual factors that were dominant in a
lack of risk assessment were complacency, high levels of self-belief in ability and being impatient to get the task completed which overrode any attempt by these men to assess for risk. There was also a belief and determination from many participants in maintaining the generational values of their fathers, such as fixing things yourself, hence demonstrating an inter-relationship between individual and community factors. There were also intra-relationships between factors within the community domain. Retirement was felt by some participants to encourage people to engage in DIY activities due to the time they now had to do their own home maintenance and renovations. Concurrently, money was also being saved which related to the monetary factors in the individual domain of the socioecological model. These inter and intra relationships between the domains of the socioecological model in the pre-fall setting provide a unique insight into the different levels of intervention that need to be considered when developing injury prevention strategies for this group.

Whilst there have been no studies addressing the factors contributing to falls from ladders in older men in the non-occupational setting, one study (Ashby, Ozanne-Smith, & Fox, 2007) did consider the over representation of older people in injuries from DIY home maintenance. The study sought to identify why older people undertake DIY maintenance, as well as to identify some safer alternatives and their feasibility. Focus groups were conducted in two Melbourne communities involving 118 participants aged over 60 years of age. The findings identified that older people undertake DIY activities either by choice (for fitness or gaining satisfaction in a job well done) or by necessity. This was due to a number of factors including a lack of knowledge on available resources (such as community services and programs), the challenge of finding a reliable and cost effective private tradesman, fear of being overcharged or having their personal safety compromised due to their vulnerable state. The primary factor though was the lack of knowledge of existing alternatives.
Whilst the focus of the Ashby et al. (2007) study is on the DIY setting in general, there are some similarities with the current study. Individual factors of self-belief and a feeling of accomplishment in getting the job done as well as generational factors (for example concerns in finding a reliable tradesman who could do the job well) were common across the two studies. The plight of those like Max who could not afford to hire a tradesman due to his limited income (pensioner) reflects a theme from the focus group discussions in Ashby et al (2007). The primary difference between the two studies is that this current study has identified some factors of importance specifically related to ladder falls in the DIY setting (as illustrated by the socio-ecological model) not well identified previously.

In addition to the research by Ashby et al. (2007), a 2014 report on injury from falls from ladders by Oxley et al. (2014) included a survey component, where people who used ladders at home were specifically recruited. Recruitment was conducted at hardware stores, via advertisements at Monash University or through ‘word of mouth’. A total of 124 people participated in the study. Data collected included participant demographics, ladder ownership and usage, use of safety equipment, alternatives to ladder use, personal history and ladder fall experience. The survey results found that many people knew of someone who had fallen from a ladder. A small number of participants (13%) stated that they had fallen from a ladder sustaining minor injuries. Unsafe behaviours whilst climbing a ladder such as carrying excessive loads (for example, power tools) and not ensuring their own safety (for example, standing on the top rung of the ladder or positioning the ladder incorrectly) were reported by participants. These sorts of unsafe behaviours were also identified in the current study with participants such as Tim, who carried items (primarily power tools and equipment needed to complete the job) up and down the ladder. The data from the current study though adds much further detail about the factors leading to the fall and areas for intervention. For example, in
the behavioural domain, a lack of assessment of risk, complacency, impulsiveness, impatience, lack of knowledge and distraction contributed to participants ladder falls.

Anecdotal evidence of conversations with patients who were admitted post ladder fall was also reported in a Victorian study on the epidemiology and outcomes of Intensive Care Unit admitted patients for ladder related trauma (Ackland et al., 2016). Three main concerns were identified; patients had limited awareness of the potential morbidity and mortality of ladder falls, domestic ladder users had sub-optimal knowledge of ladder safety guidelines and those patients with knowledge of work, health and safety regulations relaxed these regulations when using a ladder in the non-occupational context. These findings, whilst not just within the non-occupational context, do reflect the findings of this current study. Adam for example, had previously taught students about ladder safety whilst many participants including Mark, Mike and Fred had used ladders in previous occupations. Some participants in the current study also stated that they were ‘surprised’ by the extent of their injuries having fallen from a low level showing, like the Ackland et al. (2016) study, a limited awareness of potential severity of ladder related injury prior to a fall. Ackland et al. (2016) concur that public education is needed to highlight potential outcomes and safety strategies as advocated by the participants in the current study. The current study has addressed one of the major recommendations by (Ackland et al., 2016) in examining the circumstances of the fall to ascertain whether poor ladder quality, poor ladder technique or other factors are contributing to these falls adding important evidence to the literature to understand and prevent falls in older men in the non-occupational setting.

Other relevant studies identified in the literature have considered how home maintenance can impact on an older person’s ability to age in place. This term refers to continued independence at home as one ages (Kelly et al., 2014). In one study by Coleman, Kearns,
and Wiles (2016) undertaken in New Zealand, interviews were conducted with older adults to explore experiences of home maintenance issues that impact on being able to age in place. Whilst the study by Coleman et al had a different focus to the current study and was not specifically focussed on ladder falls, there are some similar findings. For example, participants who were financially strained experienced feelings of distress and isolation about home maintenance like Max’s situation of living alone and having limited funds to seek assistance in the current study. Conversely, other participants in the Coleman et al. (2016) study experienced a sense of control, independence and well-being from undertaking home maintenance which is similar to the experiences of Bob, Matt, Adam and Mark in the current study who each shared their determination to continue to undertake their own home maintenance and maintain their independence.

A second study in the USA focussed on aging in place and home maintenance difficulties by Fausset, Kelly, Rogers, and Fisk (2011), involved surveys and interviews undertaken with 44 older people living independently. This study found home maintenance was described by many participants as being essential to a safe and healthy environment. Furthermore, it was reported that there is predictable maintenance (lawn mowing for example) and unpredictable events such as storm damage that places an increased burden and effort on the older person. Of those home maintenance tasks rated as being difficult, 70% were cleaning or outdoor related (such as cleaning the gutters, painting the exterior of the house). It was also found that men encountered more difficult outdoor tasks than women and reported persevering with harder tasks more so than women. Interestingly in comparison to the current study, over half of those interviewed did outsource difficult tasks, but found this process overly complex and challenging. The authors suggest that home maintenance services should be more readily available to older people with assistance also given to helping to choose a reliable and
trustworthy service provider. In regards to the type of maintenance, whilst the majority of tasks in the current study were predictable, some were also ‘elective’ in nature, with participants choosing to build a man shed (Tim), to extend the house (Mark) or to install a blind (Jim).

Further to the issue of trusting contractors or tradesmen, Peng (2013) in an Australian survey study about renovation experiences of 3000 households and (Gurtoo, Sarup, & Williams, 2010) in a similar study in India of 500 households found trust in contractors to be a major concern among those surveyed. Furthermore, in a study by Williams (2008), interviews with three hundred and fifty households in rural England were conducted to investigate the motives for DIY home maintenance. The findings suggested two groups of people undertaking DIY. The first group were willing to undertake DIY in order to maximise the value of their home (as discussed by Fred and Bev in the current study) and for the feeling of satisfaction and pleasure in completing the end product. Conversely, there were those who were reluctant to undertake DIY home maintenance but needed to due to economic reasons and difficulties in finding and using tradespeople. The findings in the individual domain of the socioecological model in current study about self-belief and monetary factors are supported by these other study findings.

In summary, a number of novel key findings have been identified in this study that have not been reported previously, such as complacency. Other findings such as affordability in paying for outside help have been supported in the literature (Ashby et al, 2007). Whilst DIY home maintenance appears to be a rewarding and satisfying undertaking for some older people, it can also pose significant challenges for other older people. Economic burden and difficulties in finding a trusted service provider are just some of these challenges. Provision
of additional services and support may assist these older people in being able to remain in their own homes. The post fall impact will now be discussed.

5.7.2 Post fall impact

The post-fall impact was evident at the individual, interpersonal and organisational/community domains of the SE model in the current study. The key themes in the post fall setting focussed on the impact of the fall on the individual, primarily physical and mental health concerns, as well as substantial impacts on their spouse and family. There were also impacts at the broader organisational and community levels in regards to loss of productivity at work and the cost to the health care system due to the ongoing effects of these injuries both in the acute and rehabilitation settings.

Many participants interviewed had persisting physical symptoms post fall. Typically, these included pain, reduced movement and sensory loss. A hospital based study in Northern Sweden by Björnstig and Johnsson (1992) identified persisting symptoms in people who had fallen from a ladder one to two years post injury, with loss of work and impact on leisure time activities. The in-depth interviews with participants in the current study were also able to add further insight into the impact of these injuries beyond many previous studies which were predominantly quantitative (Bedi & Goldbloom, 2008; Miu, 2015; Tsipouras et al., 2001). In particular, detailing the impacts identified by Björnstig and Johnsson (1992) of loss of work and reduced participation and enjoyment in leisure time activities. The current study also found many of the men reported persistent numbness, swelling and pain to the lower limbs and feet up to two years post injury.

The impacts of non-occupational ladder fall related injury in the older male population has not been the subject of detailed study in the past and the current study therefore provides critical insights into the extent of the impacts at many levels of the participant’s lives. There
is also no literature that has been able to be sourced that considers the impact of ladder falls on mental health nor on the spouse and other interpersonal relationships making these findings in the current study particularly novel.

The results in the current study are clearly focused on the individual impact which is substantial in both the physical and psychosocial domains. These domains reflect the level of impact that the men and spouses spoke most of in their interviews. Despite this, other aspects of the socioecological model could not be ignored, particularly that of the impact on the health care system which was indicated by a number of the men’s stories and which support the medical records data extracted and presented earlier in the chapter in Table 5.2 and reported in the findings in Chapter 4.

In conclusion to this chapter, the qualitative findings of the study have been able to address an important gap in the literature regarding why these men are falling and the wide-ranging impacts of the falls on them and their family’s lives. The qualitative findings have highlighted why falls occur, the impact on quality of life and interpersonal relationships by going beyond just the administrative data in a medical record or closed responses in a survey which have been the focus of many previous studies. The findings provide critical insights to inform injury prevention which is covered in the final chapter of this thesis.
Chapter 6 Injury prevention, study limitations, recommendations and conclusion

This final chapter presents a summary of the findings of this research and discusses and identifies potential injury prevention strategies utilising the framework of the Haddon’s matrix. Challenges to injury prevention and the implications of the findings for clinical practice are also discussed. Study limitations and recommendations conclude the chapter.

6.1 Summary of key findings

Overall, eighty-six men were identified who met the inclusion criteria. A total of fourteen interviews were conducted with twelve men and seven spouses who responded to a postal invitation to participate in an in-depth interview. This study used a mixed methods approach to explore the epidemiology of ladder falls and to identify factors contributing to falls in men fifty years and over in the non-occupational setting. Data were drawn from medical records and the hospital trauma registry for admitted patients, and from in-depth interviews and application of the LLFDI with a sub-sample of interviewed men (and their spouses). The study also aimed to gain an understanding of the impact of ladder falls on men and their significant others, and to inform targeted injury prevention strategies.

The findings of this study illustrate the considerable impact of ladder falls with respect to acute injuries sustained, with around two thirds of patients (62.8%) sustaining more than one injury. The majority of both head injuries (46%) and chest injuries (81%) were of AIS 3 or greater, indicating these injuries were serious to critical in nature. Around one third of patients admitted to hospital required admission to the high dependency or intensive care units of the hospital and just over one quarter of patients were considered to have suffered major trauma as a result of their fall. Data on functional disability from the subset of
interviewed participants suggests that on average pre-fall levels of function have not been regained even four or more months after the fall.

Whilst there was diversity within the sample of men interviewed, there was commonality in regards to the impact of the fall on their lives. This impact was particularly highlighted by the LLFDI results, which indicated a self-reported decrease between pre and post fall in terms of participation restriction and activities of daily living. The LLFDI results were mirrored by what participants discussed during their interview in regards to their ongoing poor functional outcome post fall, despite nine of these patients having an ISS of less than twelve (indicating minor trauma sustained). These impacts have been articulated and demonstrated within the participant and spouse stories in Chapter 5. What is important to note are the continuing impacts on participants despite the current clinical trauma scoring systems in place suggesting “minor” trauma. What trauma clinicians classify as minor injury based on the ISS, does not reflect the level of ongoing morbidity being experienced by patients in this study, even months after hospital discharge.

There were some misconceptions by participants expressed during the interview process. Many participants, as noted in their narratives, were ‘surprised’ that they sustained injury having fallen from a low height which was also reflected in the complacent nature of participants in thinking they would be safe in only climbing at a low level. This was often seen in those participants who fell from the first couple of rungs or from what they individually perceived or interpreted as a low height. This misconception was supported by the quantitative analysis of ISS and height fallen – there was no statistically significant relationship identified in the sample. This finding suggests that in an older population, severe injury can be sustained with a fall from a low height. Hence, any injury prevention campaign
will need to reinforce that a vigilant approach to safety needs to be taken when using a ladder at a low height.

Medication use was common in this older population. This study suggests that particular medication, such as anticoagulants for example, may be associated with severe injury, such as intracerebral haemorrhage. Men who are taking medications that put them at risk when climbing should be cautioned against using a ladder.

A lack of knowledge of the safe use of ladders was identified from the qualitative findings of this study. Many participants had the mistaken impression that no special skill or knowledge was needed to climb a ladder, similarly noted by Kines (2003). This may also be related to their complacent attitude towards the task at hand. Many participants climbed the ladder without anyone holding or supporting the ladder base which again may be related to climber complacency and lack of knowledge of the potential risks. Therefore, an injury prevention campaign should reinforce the principle that someone has to hold the ladder whilst it is in use or until it is safely secured to a fixed object (Kines, 2003). A number of participants purchased a step ladder post fall, stating that these ladders tend to be shorter and appear to be sturdier. It is however noted from the literature (Tichon et al., 2011), that stepladders can also be dangerous to climb (see Chapter 3). The perception by users that these ladders are safer reflects an ongoing lack of knowledge which needs to be addressed.

This study provided significant insight into the impact of these falls on not just the man but also on their spouse and their interpersonal relationships which has not previously been highlighted in the literature. Emotional and psychological upheaval were key themes for many spouses who experienced a fear of losing their spouse at the time of the fall or having to manage their husband’s potentially severe disability as a result of the fall. Many spouses
had to also manage their husband’s response to the fall, for example, irritability, agitation and self-exclusion from social activities.

In summary, the impact of non-occupational falls in the older male population is significant, in that it affects not just the older man but many facets of his life: interpersonal relationships, work, leisure and physical and mental wellbeing. As identified both in this study and previous research (Miu, 2015; Oxley et al, 2014), injuries in many cases are severe, leading to hospital admission with financial burden on the healthcare system. Many older men experience prolonged physical disability even after ‘minor’ injury.

The findings of this study have identified a number of opportunities for preventing ladder falls in the non-occupational setting. In the next section, these opportunities will be placed within the Haddon’s matrix, a useful framework for the development of a comprehensive injury prevention strategy (Runyan, 1998).

6.2 Haddon’s matrix

The Haddon’s matrix is a tool which was developed to provide an understanding of the origin of an injurious event, and to help identify strategies to prevent its occurrence (Runyan, 1998). It was initially developed for the field of road safety (Haddon, 1980). The rows of the Haddon’s matrix identify prevention activities according to time (in this case, pre-fall, fall and post fall) (Gielen & Girasek, 2001), while the columns identify interacting factors in the individual, the agent and the environment that contribute to the injury process (Runyan, 1998). The Haddon’s matrix promotes a comprehensive approach to injury prevention by encouraging the development of multiple preventive strategies across the time continuum and directed at both individual, the agent, and the environment. Preventive interventions may be categorised as active or passive (Li & Baker, 2012). An active intervention requires some
contribution and input from the individual, for example, the individual must ensure the ladder is placed on a suitable surface before use. Passive interventions on the other hand, protect the individual without any action on their part, for example, an engineering standard which specifies the material from which a ladder may be manufactured. It has been suggested that passive interventions can be more effective than active interventions (Li & Baker, 2012), although both have a role to play. For example, even a ladder which meets approved specifications will not be safe if the user is not educated in how to secure the ladder before climbing.

The social environment was later added by Haddon to his original matrix and refers to cultural norms, the political environment and legal environment to capture the socio-political aspects of the chosen injury (Runyan, 2003). This expanded version is presented and used in this thesis. Since its development, the Haddon’s matrix has been used extensively across a range of different injury mechanisms including residential fires caused by cigarettes (Runyan, 2003), school violence by firearms (Runyan, 1998) and children falling in the playground (Runyan, 2003).

A limited Haddon’s matrix for non-occupational ladder injuries was proposed by Bedi & Goldbloom (2008). See Table 6.1. This representation of the matrix lists primary, secondary and tertiary countermeasures only, and does not consider factors associated with the individual, the agent (in this case, the ladder), or the environment in separate columns as is usual in presenting the Haddon’s matrix.
Table 6.1 Suggested prevention strategies using Haddon’s matrix by Bedi and Goldbloom, 2008.

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Countermeasures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary countermeasures</td>
<td>• Household modifications</td>
</tr>
<tr>
<td>(preventative actions to prevent an event occurring)</td>
<td>o reduce need for ladders (blockage proof spouting/gutters)</td>
</tr>
<tr>
<td></td>
<td>o safety latches/hooks on gutters to attach ladders</td>
</tr>
<tr>
<td></td>
<td>• Ensure competency to climb ladder (visual/physical/balance) or find alternative person to do the job</td>
</tr>
<tr>
<td></td>
<td>• Education regarding correct ladder usage</td>
</tr>
<tr>
<td>Secondary countermeasures</td>
<td>• Personal protective equipment (helmets, wrist guards)</td>
</tr>
<tr>
<td>(actions taken to prevent/reduce injury occurring during an event)</td>
<td>• Safety harness if climbing large heights</td>
</tr>
<tr>
<td></td>
<td>• Padded landing areas</td>
</tr>
<tr>
<td>Tertiary countermeasures</td>
<td>• Inform someone else that ladder is being used. Have emergency phone numbers near the work area</td>
</tr>
<tr>
<td>(actions taken after an event to minimise harmful consequences)</td>
<td>• Personal alarm systems for emergencies</td>
</tr>
</tbody>
</table>

This current study has been able to further build on the Haddon’s matrix as proposed by Bedi and Goldbloom (2008) to create a more comprehensive array of potential injury prevention strategies for this challenging problem in the target group of older men. These additional strategies have been informed by the quantitative data collected from the medical records and hospital trauma registry, combined with the rich and diverse qualitative data provided by participants during their interviews. The socio-ecological model was a useful support in the development of the matrix, as consideration of pre and post fall factors was undertaken across the four domains identified in earlier chapters. The Haddon’s matrix developed from the findings of this thesis (and findings from Bedi & Goldbloom not found in the current study), are shown in Table 6.2 and discussed in more detail in the following section.
### Table 6.2 Haddon’s matrix as informed by this study

<table>
<thead>
<tr>
<th>Period</th>
<th>Personal (older man)</th>
<th>Equipment (ladder)</th>
<th>Physical environment</th>
<th>Social environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-fall</td>
<td>Education to older men to:</td>
<td>AS/NZ standards applied (and enforced) for all ladders sold in Australia.</td>
<td>Create appropriate surface (non-slip, stable, slope).</td>
<td>Create awareness within the community of the danger of climbing ladders in the non-occupational setting through advertising and social media.</td>
</tr>
<tr>
<td></td>
<td>- Assess surface, angle of inclination, height to climb, condition of ladder, correct ladder type for task.</td>
<td>Regular review of AS/NZ standards in line with current research and international standards. Free consumer access to a simplified version of the AS/NZ Standards.</td>
<td>Someone to hold the base of the ladder.</td>
<td>Provide financial assistance (e.g. pension rate) to older people to reduce the cost of hiring a tradesman for activities requiring the use of a ladder or provide ready access to funded community services for eligible older people.</td>
</tr>
<tr>
<td></td>
<td>- Ensure suitable footwear</td>
<td>Maintain ladder in safe working order (condition of ladder shoes, rungs, frame, ensure dirt is removed from grooves in ladder rung).</td>
<td>Someone at home in case of incident, notify person/s of ladder use before climbing. Emergency phone numbers near the work area (Bedi &amp; Goldbloom, 2008)</td>
<td>Ensure gutter hooks, braces and personal safety equipment are included with all new ladder purchases.</td>
</tr>
<tr>
<td></td>
<td>- Use the AS/NZ standards to inform safe ladder climbing practice.</td>
<td>Correct angle of inclination of the ladder before climbing.</td>
<td>Padded landing area (Bedi &amp; Goldbloom, 2008)</td>
<td>Collaborative approach to ladder safety by key stakeholders.</td>
</tr>
<tr>
<td></td>
<td>Educate older men to seek advice from medical practitioner before using a ladder about their medications and pre-existing physical limitations.</td>
<td>Provision of ladder accessories.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Educate General Practitioners to be proactive in providing advice to older men engaging in DIY activities on medical conditions and medications that will preclude ladder climbing.</td>
<td>Label ladder with clear instructions and indications for appropriate usage.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Educate older men to employ a tradesperson if any safety issues are apparent.</td>
<td>Point of sale education and advice on the safe use of ladders.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Compulsory recertification of ladders when being resold (including private sale).</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Period</td>
<td>Personal (older man)</td>
<td>Equipment (ladder)</td>
<td>Physical environment</td>
<td>Social environment</td>
</tr>
<tr>
<td>---------------</td>
<td>-------------------------------------------------------------------------------------</td>
<td>--------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------</td>
<td>----------------------------------------------------------</td>
</tr>
<tr>
<td>During the fall</td>
<td>Use personal safety equipment such as a personal alarm.</td>
<td>Use of ladder accessories such as gutter hooks.</td>
<td></td>
<td>Someone to hold the base of the ladder.</td>
</tr>
<tr>
<td>Post-fall</td>
<td>First Aid</td>
<td>Removal of product found to be defective.</td>
<td>Modify home environment to make future ladder use safer. For example, installation of meshing over gutters to reduce need to clean out gutters.</td>
<td>Provide older ladder user with information on available services or funding to assist with future tasks that require the use of a ladder.</td>
</tr>
<tr>
<td></td>
<td>-Ambulance rapid response</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>-Tertiary referral trauma centre for management of significant injury</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rehabilitation (inpatient and outpatient)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Psychological support (patient and/or significant others) as required (inpatient and outpatient)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Education to reduce recurrence.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
6.3 Prevention

6.3.1 Personal (the older man)

Injury prevention strategies suggested by this study and the work of others (e.g. Bedi & Goldbloom, 2008) listed under the ‘older man’ column of the Haddon’s matrix rely heavily on education as a way to change behaviour and increase awareness. The findings from this current study have provided some insight into the pre-fall factors contributing to an individual’s decision to climb a ladder, and on the post fall impact which may usefully inform messages targeting older men. For example, messages will need to address the fact that older men are complacent about risk, very task focussed, and have a self-belief in their own abilities, all of which lead to poor ladder use behaviour.

Many participants stated that they were not aware of the effect of the aging process on their ability to climb a ladder. Consequently, these participants continued to climb ladders not knowing the potential perils of these actions. Educating older men on this may minimise these misconceptions. A study by Zivotofsky, Eldror, Mandel, and Rosenbloom (2012), found somewhat similarly, that older people did not recognise their own limitations and poorly self-estimated their ability when crossing the road nor were aware of the effect of physical limitations (due to ageing), which contributed to unsafe practice. Zivotofsky et al. (2012) suggested that older people should be educated on the fact that they are no longer as fast as they used to be and that this fact needs to be considered when deciding whether to cross a road.

Highlighting the impact of a ladder fall on the older man’s significant others and friends may be a strategy to cause older men to rethink their actions. This impact was evident in participant and spouse stories, with the spouse encouraging and in some cases insisting on
changes in the ladder climbing practice and behaviour of her husband. This current study indicated that there was support from participants for a ladder safety campaign that was vivid and realistic in conveying the consequences of unsafe ladder use. Other participants suggested the use of print media such as club magazines, as an effective way to reach the target audience.

Health practitioners can contribute in both educating and screening older people for medical conditions that may predispose the older person to injury (Abou-Raya & ElMeguid, 2009). The current health assessment for people aged 75 years and older (an Australian Government Department of Health initiative), may provide one platform for medical practitioners to discuss with older men and their family their DIY activities, the associated risks and possible options for reducing the risk. This health assessment aims to identify risk factors that may require further management as well as a broader assessment of such factors as social and psychological functioning (Australian Government, 2014). Medical practitioners would also be able to assess specific risk factors, such as high risk medications (for example anti-coagulants), limited mobility, and chronic diseases such as cardiac disease that place the older man at higher risk when climbing a ladder. The results and outcomes of the assessment could be included in the ‘assess home safety’ section of the assessment. A trigger or reminder to consider specific activities such as ladder climbing could be included to assist practitioners at this point.

Practice nurses are also ideally placed to both assess the older man’s ability to use a ladder and educate older men about the risks of using ladders and the principles of safe ladder use. Given the role of practice nurses in chronic disease management and primary care in many general practice settings they could have a pivotal role in influencing behavioural change in men. The development of a pamphlet on safe ladder use to appeal to the older male
population should also be considered. Pamphlets can provide useful reinforcement of information and enable patients to take information home with them (Talbot & Verrinder, 2005). This pamphlet could be provided by practice nurses, and to older men who present to health facilities.

Given that the qualitative findings of this study indicate that a number of older men interviewed are likely to still climb a ladder after their fall, the need to provide education pre-discharge from hospital is important. The role of the trauma nurse in providing this education in the hospital setting could be considered. The educational intervention could be a pamphlet to older men who have fallen from a ladder and their spouses, focusing on the principles of safe ladder use. The trauma nurse, in consultation with the medical officer, could also review the older man’s medications prior to discharge from hospital and discuss with the older man and his spouse, the possible adverse effects of these medications should the older man engage in further climbing of ladders. The role of the trauma nurse in community injury prevention campaigns on ladder falls targeting places where older men meet, for example local Men’s Sheds, should also be considered as an opportunity to engage with older men in an environment familiar to them with their peers. The physical and psychological impacts that continued to affect participants in this current study, suggest that trauma nurses and discharge planners focus on ensuring that these older men are followed up by their General Practitioner. Informing older men of the importance of medical follow up for physical or mental health issues could be part of the role of the trauma nurse in pre-discharge education, especially as the quantitative results indicated that the vast majority of patients (just over 80%) returned directly to their home setting post discharge.

Coroner’s reports (National Coroners’ Information System, 2010) on falls from ladders include recommendations that people participating in home maintenance follow the
Australian and New Zealand Standards for ladder use, as these Standards generally represent best practice in safe ladder use. The relevant standard would be AS/NZS 1892:2000 *Portable ladders, Part 5: Selection, safe use and care*. This standard provides guidelines for safe ladder use including the handling of ladders, pitch angle, footing, climbing and working on ladders and movement on ladders, all of which are most applicable in the non-occupational setting. This standard includes specific safety considerations when using metal, plastic and timber ladders. It would appear therefore that linking this AS/NZ Standard to the non-occupational use of ladders may be worthwhile. However, these standards are not readily available to the general public, needing to be purchased from the SAI Global Infostore (via Standards Australia website), and the technical language used may limit understanding.

Summary documents in lay language made freely available to the public may be useful, given the lack of safe practices at home and the absence of any legislation governing safe ladder use in this population.

The need to promote the use of personal safety equipment has been identified in this study, given that incorrect footwear was used by some participants. The use of safety harnesses has been suggested by Oxley et al. (2014); and the use of a helmet by climbers to reduce the risk of traumatic head injury in the event of a fall by Ackland et al. (2016). In the absence of evidence, further research is needed to identify whether helmet use by the older man would be acceptable to older men and effective in reducing head injury severity. The older man needs to have an understanding of the importance of using personal safety equipment, to encourage compliance. Others have suggested that the use of personal protective equipment should be offered at time of purchase at a reduced cost (Bedi & Goldbloom, 2008).

Point of sale education was discussed by some participants in this current study, with participants seeing this as the role of the salesperson. Bedi & Goldbloom (2008) suggest that
interactive sessions would be of most value. However, there is no discussion of point of sale education in the literature, and it is unknown as to whether it would be effective. Muir and Kanwar (1993) identified that information booklets available from ladder manufacturers and DIY stores were not being routinely distributed to consumers. This strategy of point of sale advice would ideally require the training of salespersons, the production of resources to for those with limited English language skills and engagement with consumers. The use of community radio (radio presented in different languages) may assist in addressing the challenge of communicating the injury prevention message to older non-English speaking men.

6.3.2 Ladder

In the context of the Haddon’s matrix, the ladder is the agent of injury. Therefore, attention to the ladder and its placement before climbing is of utmost importance. One area of concern raised in this study is the width of ladder rungs (see Mark’s account, in Chapter 5). Narrow rungs provide a smaller base of support for the climber (Pliner et al., 2014; Tichon et al., 2011). A recommendation from this current study is for research on rung width and surface, and the modification of the appropriate AS/NZ Standards if necessary. Further, as one participant (Mark) noted, dirt often fills the grooves on the ladder step hence reducing the potential grip offered to the climber; climbers need to be aware of this potential hazard and ensure the necessary ladder maintenance is undertaken. However better design of the grooves to avoid the accumulation of dirt would be preferable. Cassell and Clapperton (2006) have suggested focusing on the design of ladder accessories to reduce ladder slipping, sliding and tipping. This idea was raised by several participants at interview in relation to injury prevention. The benefits of using these accessories is recognised (Björnstig & Johnsson, 1992). However, as the participants in this study highlighted, there needs to be consideration
in regards to the cost of these accessories and whether the accessories should be mandated to be sold with the ladder, at the time of purchase.

Safety warnings exist on medicine packaging to alert people of the risks of taking certain medicines that can cause drowsiness or altered mentation whilst driving and/or using machinery. It can be argued that using a ladder is not unlike using machinery, especially given the height that the person is working from and the degree of alertness needed to work safely, and maintain balance. It may therefore be beneficial for medicine alerts to include ladder climbing, and for alert labels to be applied to ladders advising consumers of potential risks, including use of certain medications.

The degree of engagement and understanding of safety instructions and labels on ladders has been variable (Campbell & Pagano, 2014). Confusion with the instructions on some labels has led to error in following the instructions provided and there was an apparent reliance more on personal preference and experience than on instructional labels on the ladder (Campbell & Pagano, 2014). This was similarly identified in the current study; some participants relied on their previous work experience in using ladders which influenced their level of confidence and degree of complacency towards safe ladder use in the non-occupational setting. Thus, older men should be encouraged to read instructive alert labels and have an understanding as to why they are important.

6.3.2.1 Review of Australian and New Zealand Standards

The Australian and New Zealand standards must continue to be enforced for all ladders sold in Australia. These standards (such as AS/NZS 1892.1: 1996, 1893.3:1996 and AS 1892.2 1992) refer to minimum constructional and safety requirements for the design and manufacture of ladders. Mandating the standard AS/NZS 1892.5:2000 Portable ladders, Part 5: Selection, safe use and care for the use of ladders in the non-occupational setting
would be difficult to enforce and monitor compliance thus likely ineffective (Bedi & Goldbloom, 2008), given the large number of ladders being used in this setting on any one day across Australia (Bedi & Goldbloom, 2008). This context is in contrast to the work health and safety legislation that exists within the occupational context (Diggs, Lenfesty et al. 2005). What could be considered is the mandatory recertification of second-hand ladders prior to private sale to ensure that unsuitable ladders are removed from the home setting. Public education or labelling on ladders to encourage men to dispose of ladders which have been damaged during a fall may also be helpful.

6.3.3 Physical environment

The physical environment in non-occupational ladder injury in this study was primarily the homes of the participants, or buildings in close proximity to the home (e.g. shed). Therefore, variable slopes and surfaces in these settings put climbers at risk. Thus again, climbers need to be educated about assessment of the surface on which the ladder is being placed on (COF) (Chang et al., 2004), setting the ladder at the correct angle of inclination (S. Young & Wogalter, 2000), and the need to ensure someone holds the ladder to reduce opportunities for slippage (Partridge et al., 1998). Bedi & Goldbloom (2008) suggest the use of padded landing areas however no evidence of the effectiveness of this strategy is available.

The installation of mesh over gutters to prevent debris from falling into them reduces the need for older men to take on the task of cleaning gutters. Deciding to use a tradesman for jobs that after assessment, are deemed to hold too great a risk to the older man, should be encouraged. In addition to the physical environment, the importance of understanding the many psychosocial factors impacting on the decision to climb or not to climb the ladder need to be considered. These factors will now be discussed.
6.3.4 Social environment

The psychosocial environment refers to the social or contextual factors in which older men live, as well as the opinions, beliefs and generational norms of these older men and those around them. Therefore, preventive strategies need to focus on providing a viable alternative to having to climb a ladder, on helping older men appreciate their limitations, and ensuring that it is acceptable for older men to not climb ladders.

Cassell and Clapperton (2006) suggest providing an alternative for older people with regards to a reliable and low cost home maintenance service for tasks performed at a height. One participant in this study (see Max’s account Chapter 5) highlighted the plight of the older person living alone with no support mechanism to assist with home maintenance. Living alone limits available options. Whilst he was the only participant living alone, it is likely that he is representative of many older people living in the community. A report on the demographics of living alone by de Vaus and Qu (2015) for the Australian Institute of Family Studies, shows there has been a sharp increase in the proportion of people living alone aged 80 years and over. In 1986, this age group comprised just 9% of all those living alone compared with 2011 at 15% (an increase of 62%), indicating that the issue of home maintenance for older people is one of growing concern. Further, it was noted in this study, that even where older people live as a couple, home maintenance still needs to be undertaken, and a fall event in the male partner often leads to a role reversal with older women struggling to maintain the home.

In situations of financial constraint (low income or pension), these changing demographics suggest that some form of additional government assistance or subsidy may be required for home maintenance activities. At this current time, Fire and Rescue NSW has an established program for smoke alarm and battery replacement, called SABRE (Fire and Rescue New...
South Wales, 2015). This program is free to people over the age of 65 years. Fire and Rescue NSW will install battery operated smoke alarms and replace existing smoke alarm batteries. Home fire safety advice can also be provided. It may be possible for such a program to be extended, or to be undertaken by local government or other authority to assist the older person with jobs at a height (those requiring the use of a ladder) such as cleaning of gutters, changing light globes, cutting off tree branches and so on. These strategies would negate the need for the older person to engage with a ladder and to risk injury.

In targeting social and generational norms, a peer education approach in clubs and organisations where older men socialise may be effective. Peer educators are often seen as role models. Peer educators themselves also feel satisfied that they have made a difference to their community, and the process has been shown to be cost effective (Peel & Warburton, 2009). Older men also need to be reassured that it is acceptable to not climb ladders when they are no longer able to do so safely. Providing education to older women on safe ladder use could also be considered, as they may be pivotal in influencing their spouse’s attitudes, beliefs and behaviours.

In summary, informed by the current study, the application of the Haddon’s matrix to non-occupational falls in older men has identified a range of potential preventive interventions. A collaborative approach involving many key stakeholders including older men and their spouses, policy makers at all levels of government, community service providers, ladder manufacturers, health professionals, retail outlets and professional associations, is required to consider, prioritise and implement effective interventions. An innovative approach with a good communication and management framework and technical package supported by partnerships and political commitment are the components needed for the implementation of an effective public health program (Frieden, 2014). However, there is little or no research
reported in the scientific literature on the effectiveness of preventive strategies in the
domestic setting (Oxley et al., 2014). Where no published evidence is available, further
research to determine effectiveness is essential before adoption. However, this is outside the
scope of this thesis.

6.4 Study limitations and strengths

The findings of this thesis should be interpreted in the light of the study’s limitations. These
limitations as they relate to the quantitative and qualitative aspects of the research have been
discussed in detail in Chapters 4 and 5. The main limitations will be briefly outlined again
here. Firstly, the study excluded patients who presented to the Emergency Department with
minor injuries and were not admitted to hospital, which means that the sample represented
only those with injury severe enough to require admission to hospital. Those men who fell
and were not injured or fell and consulted a General Practitioner have also not been included.
Similarly, those men who fell and presented to another hospital within the local health
district, or to a private hospital were not captured. Thus, the sample studied is not
generalizable to all older ladder fallers. Further, in addition to under-enumeration, this study
has been unable to determine an estimate of ladder fall rate. Thus, it does not provide
comparative data for other Australian research.

Secondly, only a subsample of patients was willing to participate in an in-depth interview,
thus potentially limiting the diversity of participant stories and opinions. However, the
richness of data provided by participants and the recurrence of some themes suggests that
sufficient data was received to provide insights to address the research questions posed.

Thirdly, four participants interviewed had fallen between twelve to thirty-six months prior to
interview hence the possibility of recall bias should be considered (Schmier & Halpern, 2004)
particularly for the LLFDI. However, the convergence between the participant narratives, the LLFDI results and in some cases the participant’s medical record appears to have provided evidence that recall bias, if present, has been minimal. It should be noted that the researcher did not find the LLFDI-CAT suitable for use in telephone interviews, due to its length and number of questions, particularly for participants from non-English speaking backgrounds. This led to the exclusion of data from one case.

Despite these limitations, there are a number of strengths of this research. Firstly, the use of the LLFDI-CAT to compare pre and post fall functional status appears to be a new and innovative way to use the LLFDI-CAT, not published in this way elsewhere. While there are limitations associated with the use of the LLFDI-CAT as discussed above and in Chapter 5, the LLFDI-CAT complemented and reinforced the findings of the participant interviews. Further, the pre-fall LLFDI measures provided some indication of patient perception of their functional status prior to injury, enabling a sense of the level of persistent functional loss to be determined. Secondly, specific ladder design improvements were identified by Adam and Mark in the current study which may contribute to future reviews of ladder safety features.

This current study was planned and commenced prior to the publication of the study by Oxley et al. (2014) on ladder falls in Victoria. Interestingly, this current study supports a number of the findings from the Oxley et al. (2014) study: need for public awareness, multisectorial collaboration, promoting alternatives to ladder use, use of protective equipment and improving compliance with recognised standards of safe ladder use of Australia and New Zealand. However, some important opportunities identified by Oxley et al. (2014) (building design innovation, improving surfaces around ladders and improvements to overall ladder design) have not been identified in this current study.
6.5 Recommendations for future research and research translation

This study has demonstrated the impact of injuries in older men arising from ladder falls in the non-occupational setting. While the healthcare system continues to bear the burden of injury from ladder falls, the role of identifying and implementing solutions is largely outside of the control and scope of the healthcare system (Finch & Hayen, 2006). However, it has been suggested that the healthcare system needs to assume leadership for injury prevention, bringing injury prevention to the attention of other government and non-government sectors, and forming partnerships which can start to develop, trial, implement and evaluate solutions to injury problems, such as non-occupational ladder falls in older men (Finch & Hayen, 2006).

The growing body of literature on ladder falls in the non-occupational setting which has been presented in Chapter 2 of this thesis, along with the findings of this current study suggest that evidence exists to demonstrate that ladder falls at home are an increasing problem that requires attention. The literature, as well as the research presented in this thesis has suggested a range of potential interventions which may be effective in preventing ladder falls. Therefore, the time is right for consultation and collaboration among key stakeholders, such as older people (including those who have been injured), ladder manufacturers, governments (local, state, federal), health professionals (trauma clinicians, health promotion officers, professional organisations), media and the hardware (ladder) retail sector. Together, they should refine, implement and evaluate a range of injury prevention strategies, thus moving to steps 3 and 4 of the public health model (as outlined in Chapter 2). Injury prevention researchers (academics) need to partner with key stakeholders to design good quality studies to evaluate the effectiveness of preventive interventions applied in this setting.
6.6 Conclusion

The factors contributing to falls from ladders in men fifty years and over in the non-occupational setting are multifactorial. This study identified a lack of assessment of risk as being at the core of this major injury prevention challenge, with many factors feeding into this, primarily an attitude of complacency, a focus on the task at hand, impulsiveness, a lack of knowledge, a strong sense of self-belief and powerful social influences, many originating from previous generations. There are life changing and often devastating impacts of these falls on not just on the men, but on their families, and at a broader level, the health care system. This thesis has provided insight into the wide-ranging impact of ladder falls and on recommendations from this and previous studies. In addition, robust measures of the burden of injury are vital in harnessing political support and informing the development of prevention programs (Ivers, Bhandari, & Norton, 2014).

This study has identified pre-disposing factors contributing to, and the impact of, falls from ladders in men 50 years of age and over who presented to a tertiary trauma hospital including a sub-sample who participated in an in-depth semi-structured interview after their fall. Given the gap in the literature, these findings have provided further insight into this public health issue to inform future injury prevention strategies. The public health approach to injury prevention was a useful model to situate this study within the prevention trajectory. The socio-ecological model was valuable in organising and understanding the individual factors that increase the likelihood of injury and also the other factors: interpersonal, community and organisational that may influence the extent to which older men will adopt the recommended injury prevention strategies. By identifying these determinants, researchers can then work with key stakeholders to develop injury prevention strategies that specifically address the factors important to the causation of the target injury (McClure et al., 2010). This current
study has contributed new knowledge to the significant issue of older men failing from ladders in the non-occupational setting which may usefully inform the development and evaluation of injury prevention strategies.
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Appendix 1

Interview questions (Patient)

Interview questions (Spouse)
Interview guide (for interviewing the patient)

• Can you tell me what happened?
  Probes:
  What were you doing at the time/reason for getting up the ladder?
  What safety measures did you have in place at the time of the fall? What
  footwear were you wearing at the time of the fall?
  Did you think what you were doing to be taking a risk?
  What has been the impact of the fall on you and your family?
• Did you consider the risks before getting up the ladder?
  Probe: What thought processes did you go through?
• Have you used a ladder since the fall? If so, have you done anything
  differently i.e., have you learnt anything from the fall?
• How often do you use a ladder and for what purpose?
• What safety aspects do you think you need to consider before using a ladder?
  Probe: Getting up a ladder, while up a ladder and coming down a ladder?
• Do you have any health problems?
  Probe: eyesight, other?
• Why do you think men of your age are falling off ladders?
• Retrospectively, what now do you think may be the risks of using a ladder at
  your age?
• What do you think could be done to decrease falls from ladders in your age
  group?
• Do you consider yourself to be someone who takes risks? If so, what types of
  risks?
• What advice would you give men of your age who want to use a ladder?
• Anything else you wish to add?
Interview questions for spouse

- I understand your partner recently had a fall and was admitted to hospital? (how is he/she doing now?)
- Can you tell me what you know about the fall – how it happened?
- What do you think led to the fall happening?
- What has been the impact of this fall (and subsequent injuries) on you, your spouse and the family overall? (ask each component separately)

Probes: In regards to ADLs, (of the patient), impact on your time and "life" (social, personal) as a carer; impact on the family dynamics (roles, tasks).

- How do you feel about what has occurred?
- Are you surprised that the fall occurred?

Probes: Previous risk taking behaviour pre fall, previous ladder use, has he been undertaking this unsafe behaviour for some time?

- Why do you think he thought it was OK to get up the ladder?
- Do you feel that his behaviour in regards to ladder use will change after this fall?

Probes: Do you think he will continue to get up a ladder? If so, why?

- What do you think can be done or needs to be done to decrease the amount of falls from ladders in this population?

Probes: What do you see as the role (if any) of the partner in preventing falls?

- Since discharge from Hospital, has he been readmitted to Hospital for problems related to the fall? If yes, Can you tell me more about the problems he is experiencing?
Appendix 2

Table - Comparison between total sample and interviewed sample
### Comparison between total sample and interviewed sample

<table>
<thead>
<tr>
<th>Variable</th>
<th>Interviewed sample N=13</th>
<th>Full sample N=86</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mean age</strong></td>
<td>64.92 years</td>
<td>64.7</td>
</tr>
<tr>
<td><strong>Age range</strong></td>
<td>N (%)</td>
<td>N (%)</td>
</tr>
<tr>
<td>50-60 years</td>
<td>3 (23.0%)</td>
<td>28 (32.5 %)</td>
</tr>
<tr>
<td>61-70 years</td>
<td>7 (53.9%)</td>
<td>32 (37.2%)</td>
</tr>
<tr>
<td>71-80 years</td>
<td>1 (7.7%)</td>
<td>25 (29.1%)</td>
</tr>
<tr>
<td>&gt; 80 years</td>
<td>2 (15.4%)</td>
<td>1 (1.2%)</td>
</tr>
<tr>
<td><strong>Height fallen</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤1.5m</td>
<td>3 (23.1%)</td>
<td>18 (20.9%)</td>
</tr>
<tr>
<td>1.6-2m</td>
<td>5 (38.5%)</td>
<td>17 (19.8%)</td>
</tr>
<tr>
<td>2.1-3m</td>
<td>4 (31.0%)</td>
<td>28 (32.6%)</td>
</tr>
<tr>
<td>&gt;3m</td>
<td>1 (7.7%)</td>
<td>23 (26.7%)</td>
</tr>
<tr>
<td><strong>ISS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minor</td>
<td>11 (84.6%)</td>
<td>63 (73.1%)</td>
</tr>
<tr>
<td>Major</td>
<td>2 (15.4%)</td>
<td>23 (26.9%)</td>
</tr>
<tr>
<td><strong>Surgical intervention</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>9 (69.3%)</td>
<td>38 (45.7%)</td>
</tr>
<tr>
<td>No</td>
<td>4 (30.7%)</td>
<td>48 (54.3%)</td>
</tr>
<tr>
<td><strong>LOS (days)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-6</td>
<td>6 (46.4%)</td>
<td>57 (66.3%)</td>
</tr>
<tr>
<td>7-10</td>
<td>6 (46.2%)</td>
<td>13 (15.1%)</td>
</tr>
<tr>
<td>11-&gt;28</td>
<td>1 (7.4%)</td>
<td>16 (18.6%)</td>
</tr>
<tr>
<td><strong>Discharge</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Home</td>
<td>9 (69.2%)</td>
<td>71 (82.5%)</td>
</tr>
<tr>
<td>Other</td>
<td>4 (30.7%)</td>
<td>6 (7.0%)</td>
</tr>
</tbody>
</table>