

## **REPORT: LADDER INJURIES IN NSW**

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## KEY FINDINGS

Between 2010-2014 in NSW, falls from ladders across all ages resulted in:

- 8,496 hospital admissions (average 1,699 p.a.) and 51 deaths reported (average 10 p.a.)
- 496 major trauma cases (average 99 p.a.) and 35 deaths (average 7 p.a.); 7.1% mortality
- 154 admissions per 100,000 persons and 11 falls classified as major trauma per 100,000 persons in the 65-69 age group
- peak age for injury in the 60-64 age group
- majority of injuries to the head and thorax
- majority of falls between 1-5m and classified as moderate or serious
- majority of patients discharged home without requiring assistance (rehabilitation or care)

## **1. INTRODUCTION**

Falls from ladders are a significant cause of injury and have been increasing across the Australian population. A recent report by Monash University (Oxley 2014) found domestic ladder falls accounted for a high proportion of all ladder falls, resulting in major trauma and death. An annual average of 1,331 emergency and 1,251 hospital admissions were reported, along with 86 major trauma hospital admissions and 9 deaths. Previous reports have described the increasing prevalence of ladder falls in the Victorian (Cassell and Clapperton 2006; Bedi and Goldbloom 2008) and Australian population (Bradley 2007), indicative of a growing public health concern. While occupational injuries involving ladder falls have been addressed through adoption of Australian Standards and a Code of Practice (Safe Work Australia 2015) and implementation of legislative measures (Occupational Health and Safety (Prevention of Falls) Regulation 2003), non-occupational ladder use is more difficult to enforce due to the variety of behavioural factors that contribute to this type of injury and the barriers to prevention (Ashby 2007; Oxley 2014).

This report describes falls from ladders in the NSW population. There was an annual average of 1,699 hospital admissions following a ladder fall, and 99 cases reported at major trauma services. There were 35 deaths due to major trauma over this five year period (average 7 p.a.). Similar to previous studies, the peak age for injury was in people aged between 60-64 for both admission to hospital and major trauma. The majority of injuries were seen in the head and thorax. Most falls resulting in major trauma were between 1-5m and were classified as moderate or serious.

## 2. METHODS

Two sources of data were used in this descriptive analysis of injuries due to falls from ladders.

1. NSW Admitted Patients Data Collection (hospital admissions)
2. NSW Trauma Registry (major trauma)

Data containing the ICD-10-AM code for '*Fall on and from ladder*' (W11) were extracted from both datasets between 2010 and 2014. Data for age, gender, diagnosis codes, urgency on admission, mode of separation and length of stay were obtained from the Admitted Patients Data Collection. Data for age, gender, fall height, injury activity, abbreviated injury scale (AIS) and severity, injury severity score (ISS), post-ED, discharge destination, length of stay and outcome were obtained from the NSW Trauma Registry. Only 'major trauma' (ISS >12, or death in hospital excluding those resultant from neck of femur fractures from standing height, Appendix 1) cases were considered. The AIS is a classification system which assigns a severity score to individual body regions; the top three injuries in different body regions are used to calculate the ISS (Appendix 2). Single main body regions of injury were derived from the body region with the highest AIS score, with 'multiple regions' referring to a patient with two or more regions of equal AIS severity. Descriptive analyses were performed in SAS, separately for each dataset.

### 3. RESULTS

#### 3.1 Hospital Admissions- all ages

Between 2010 and 2014, there were 8,496 hospital admissions across NSW due to falls from ladders, resulting in an average of 1,699 admissions per year. There was an increase from 1,542 in 2010 to 1,809 in 2014. The majority of these falls were in males (n=6,841, 80.5%) (Figure 1.1), and 62.7% of injuries occurred in patients aged 55 years and over. Peak admissions due to falls from ladders were seen in the 60-64 age group (n=1,091, 12.8%) (Figure 1.2), with a median age of 60 (average age 58). The crude rate of admissions due to falls from ladders in the population is 44 per 100,000, with 154 admissions per 100,000 persons in the 65-69 age group (Figure 1.3).

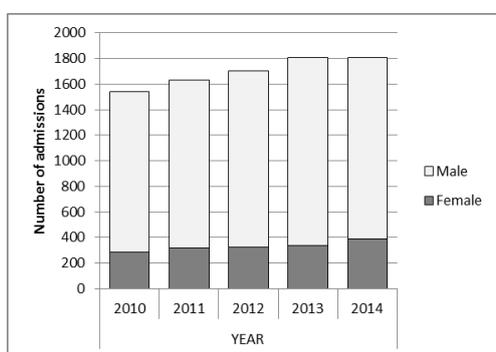


Figure 1.1: Total number of hospital admissions due to falls from ladders by year, NSW 2010-2014 (n=8,496)

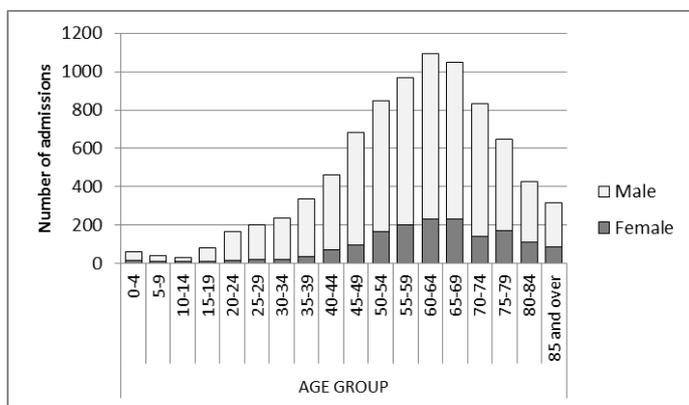


Figure 1.2: Total number of hospital admissions due to falls from ladders by age group, NSW 2010-2014 (n=8,496)

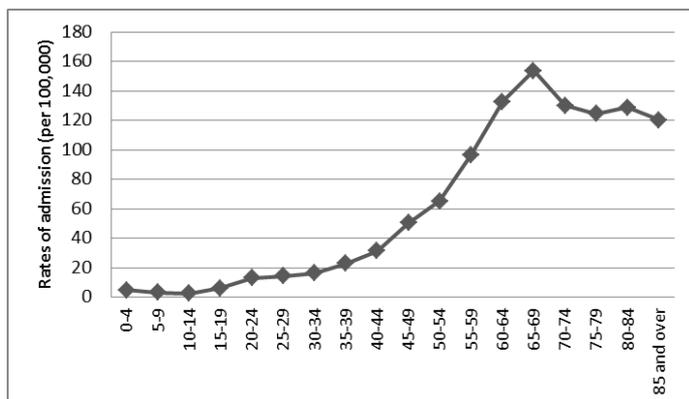


Figure 1.3: Age-standardised rates of hospital admissions due to falls from ladders, NSW 2010-2014 (n=8,496)

Across all 8,496 patients, there were a total of 46,353 injuries classified by body region (ICD-10-AM). The most common injury was to the head (20.6%); there also were high proportions of injuries to the thorax (13.5%) and abdomen, lower back, lumbar spine and pelvis (13.3%) (Figure 1.4). There were 57,065 recorded procedures performed in this patient cohort. The ten most common procedures are shown with the most common procedure being the administration of packed cells (6.7%), followed by open reduction of fracture of distal radius with internal fixation (5.3%) (Figure 1.5).

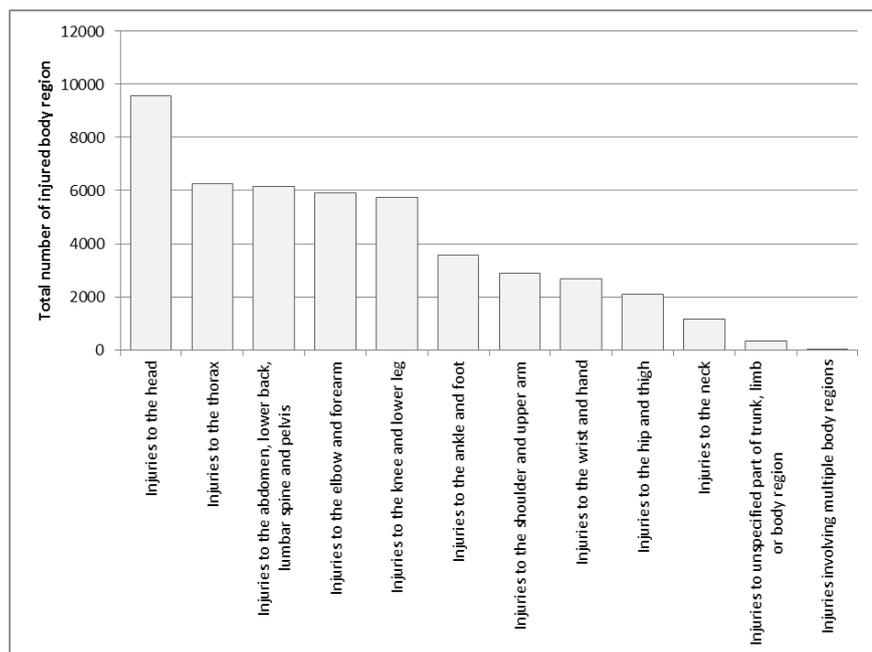


Figure 1.4: Total number of injuries to different body regions, NSW 2010-2014 (n=46,353)

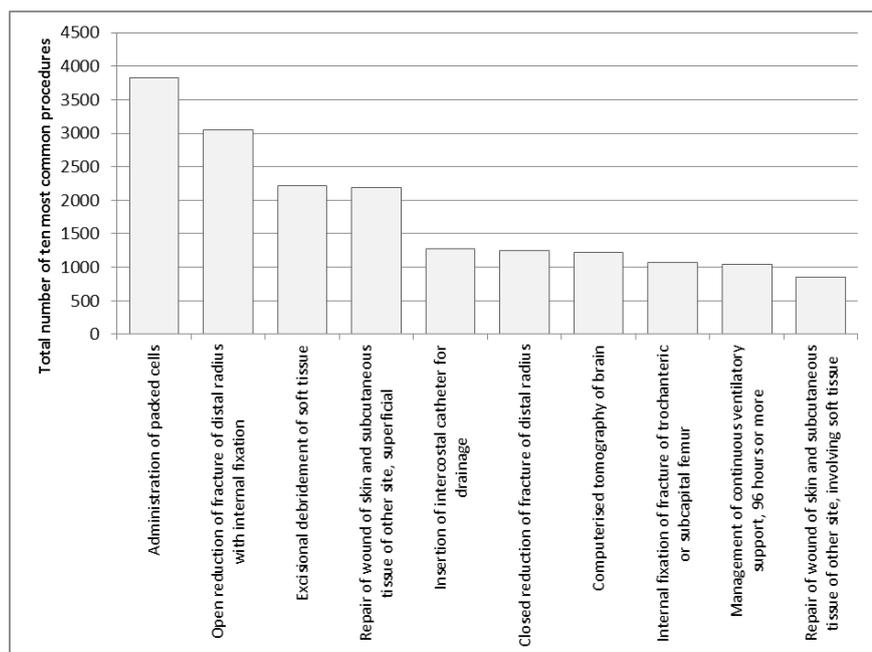


Figure 1.5: Total number of the ten most common procedures performed, NSW 2010-2014 (n=57,065)

Most admissions were classified as 'Emergency' on admission, requiring treatment within 24 hours at the time of diagnosis (n=7,372, 86.8%) (Figure 1.6). The median length of stay was 2 days (average 5 days) with a range of 0-28 days stay in intensive care. Most patients were discharged by the hospital to their normal place of residence (n=6,974, 82.1%) (Figure 1.7), with a small proportion of transfers to other hospitals. There were 51 recorded deaths in total.

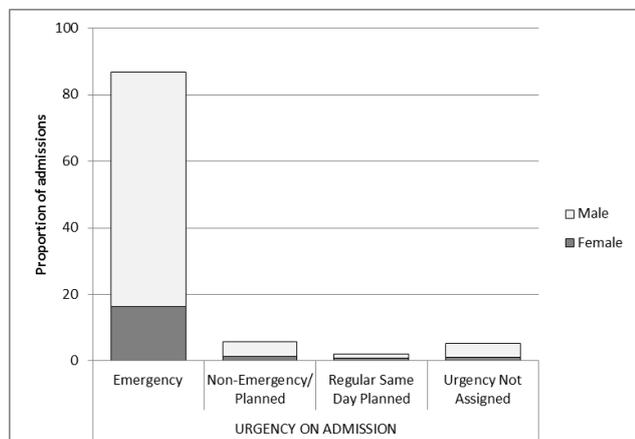


Figure 1.6: Proportion of hospital admissions due to falls from ladders by urgency on admission, NSW 2010-2014 (n=8,496)

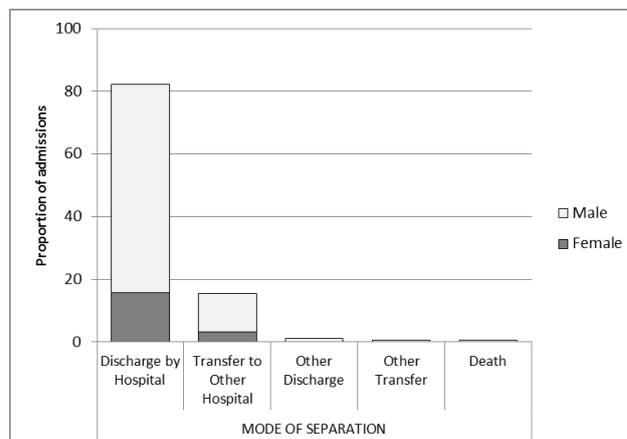


Figure 1.7: Proportion of hospital admissions due to falls from ladders by mode of separation, NSW 2010-2014 (n=8,496)

### 3.2 Hospital Admissions- 55 years and over

A large proportion of hospital admissions due to falls from ladders occurred in patients aged 55 and over (n=5,331, 62.7%); many were aged 60-69 (40.3% male, 39.4% females) (Table 1.1). There were 48 deaths (1.2%), all in males. There were similar patterns of urgency on admission and mode of separation when compared to the all-ages cohort.

**Table 1.1: Characteristics of ladder injuries in patients aged 55 and over**

	<b>MALE</b>	<b>FEMALE</b>
<b>AGE GROUP (years)</b>		
55-59	768 (19%)	202 (17%)
60-64	857 (21%)	234 (20%)
65-69	818 (20%)	230 (20%)
70-74	687 (17%)	144 (12%)
75-79	474 (11%)	173 (15%)
80-84	313 (7.5%)	112 (10%)
85 and over	235 (5.7%)	84 (7.1%)
<b>URGENCY ON ADMISSION</b>		
Emergency	3636 (88%)	968 (82%)
Urgency Not Assigned	266 (6.4%)	74 (6.3%)
Non-Emergency/Planned	171 (4.1%)	76 (6.5%)
Regular Same Day Planned Admissions	78 (1.9%)	60 (5.1%)
<b>MODE OF SEPARATION<sup>1</sup></b>		
Discharge by Hospital	3273 (79%)	931 (79%)
Transfer to Other Hospital	747 (18%)	230 (20%)
Death	48 (1.2%)	0
Other Discharge	48 (1.2%)	9 (0.8%)
Other Transfer	36 (0.9%)	9 (0.8%)

<sup>1</sup>Death includes with and without autopsy; Other discharge includes discharge on leave, at own risk; Other transfer includes transfer to other accommodation, to palliative care unit/hospice, public psychiatric hospital, residential aged care.

### 3.3 Major Trauma- all ages

From 2010 to 2014, there were 496 falls from ladders that were considered to be major trauma (see Appendix 1), with an annual average of 99 cases and an increase from 74 in 2010 to 109 in 2014. Most falls from ladders occurred in males (n=459, 92.5%) (Figure 1.8) in the 60-64 age group (n=76, 15.3%) (Figure 1.9), with a median age of 63 (average age 62). The crude rate of major trauma ladder-related falls in the population is 3 per 100,000 persons, with a peak of 11 falls per 100,000 in the 65-69 age group (Figure 1.10).

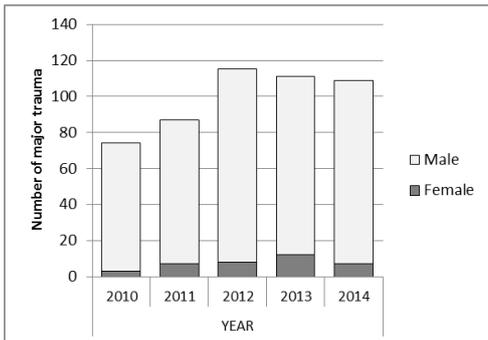


Figure 1.8: Total number of major trauma cases due to falls from ladders by year, NSW 2010-2014 (n=496)

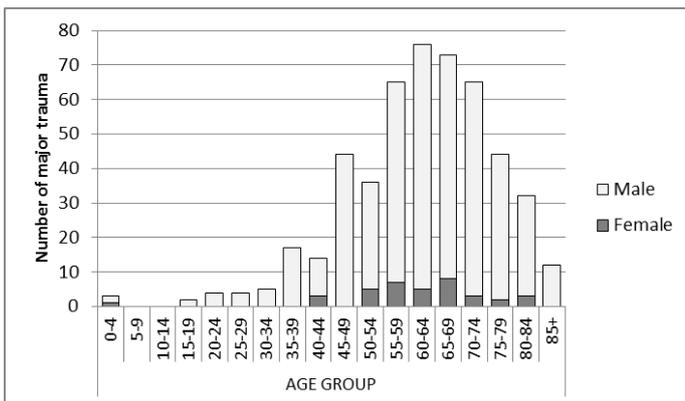


Figure 1.9: Total number of major trauma cases due to falls from ladders by age group, NSW 2010-2014 (n=496)

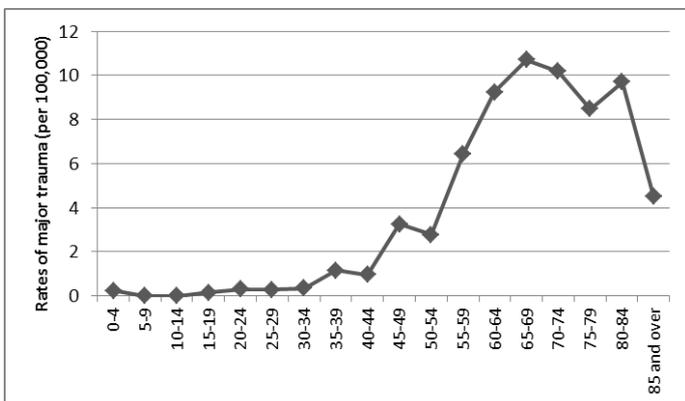


Figure 1.10: Age-standardised rates of major trauma cases due to falls from ladders, NSW 2010-2014 (n=496)

Most patients were carrying out non-occupational activities when injured following a ladder fall (n=222, 57.1% of deaths in this category) (Figure 1.11). Most falls were between 1-5m (n=418, 86.7%); this also resulted in the majority of deaths (88.2% of deaths) (Figure 1.12). Most injuries were classified as serious (n=217, 43.8%) with a significant proportion of deaths occurring in the severe category (71.4% of deaths) (Figure 1.13). The median ISS was 17 (average ISS 20). There were 58 surgical procedures performed, the most common being open reduction of fracture (n=37), followed by craniotomy (n=16).

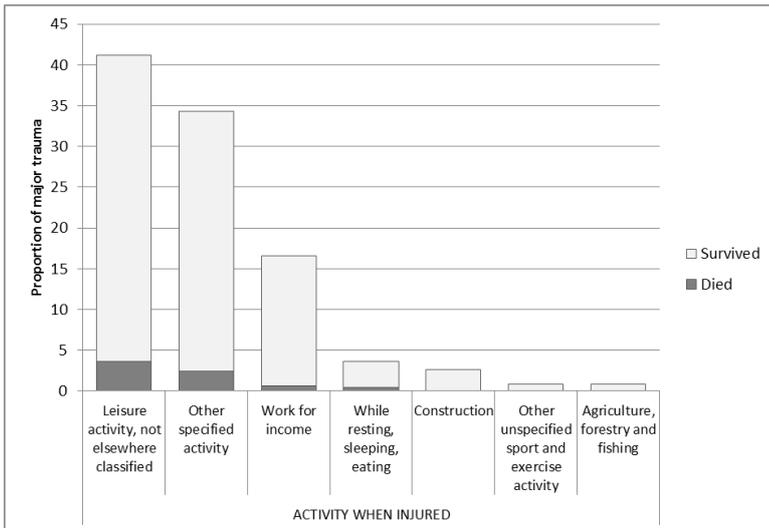


Figure 1.11: Proportion of major trauma cases due to falls from ladders by injury activity, NSW 2010-2014 (n=495)

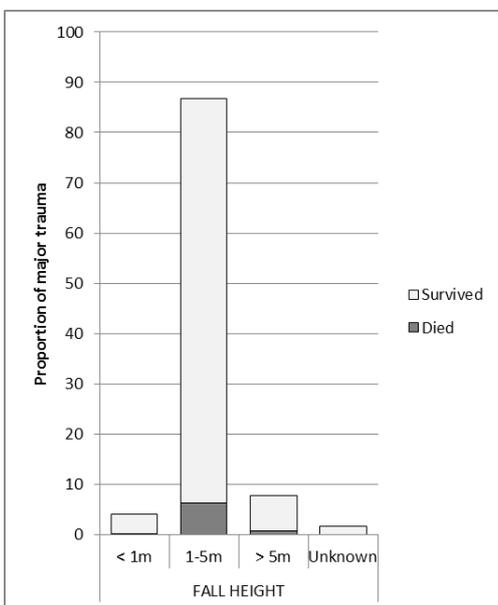


Figure 1.12: Proportion of major trauma cases due to falls from ladders by fall height, NSW 2010-2014 (n=482)

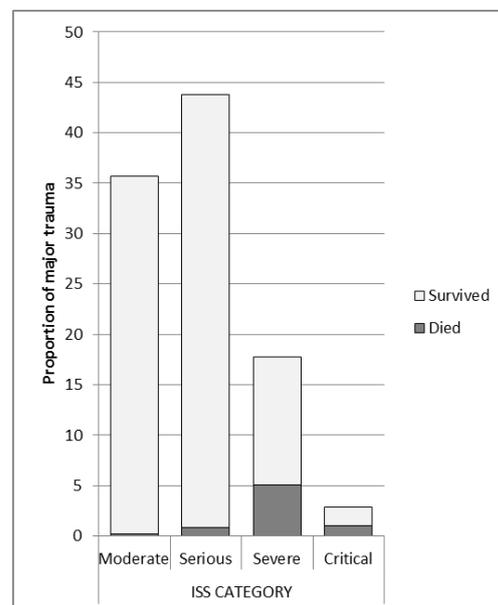


Figure 1.13: Proportion of major trauma cases due to falls from ladders by ISS category, NSW 2010-2014 (n=496)

When considering the main body region of injury in a patient (i.e. the body region with the highest AIS score), most of these injuries were found at the thorax (n=176, 35.5%), followed by the head (n=144, 29.0%) and spine (n=66, 13.3%) (Figure 1.14), although patients often present with injuries across multiple body regions. Deaths predominated where the single most severely injured body region was the head (77.1% of deaths). When considering all body regions injured, there were 710 injuries in total to different body regions, most commonly affecting the thorax, head and spine (Figure 1.15).

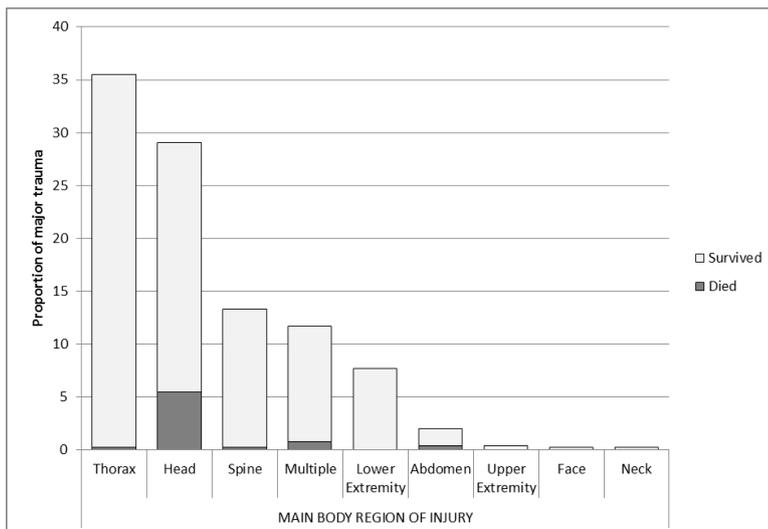


Figure 1.14: Proportion of major trauma cases due to falls from ladders by main body region of injury, NSW 2010-2014 (n=496)

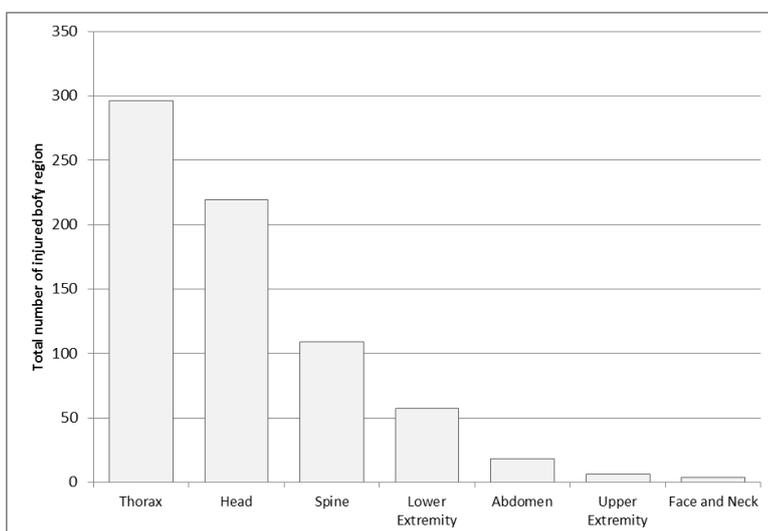


Figure 1.15: Total number of injuries to different body regions, NSW 2010-2014 (n=710)

Most patients were sent from the emergency department (post-ED) to the ward (n=221, 48.7%), intensive care unit (n=87, 19.2%) or high dependency unit (n=85, 18.7%); most deaths occurred in the intensive care unit (51.7% of deaths) or operating suite (31.0%) (Figure 1.16).

Across all ages, the median number of ventilation days was 3 (average 4.8 days with a range of 1-28 days), the median intensive care unit length of stay was 0 days (average 1.3 days, range 0-28), and total length of stay was 6.5 days (average 10.5 days, range 1-91).

Most patients were discharged home, without requiring assistance (n=253, 51.1%), with a significant proportion discharged to a rehabilitation facility (including brain or spinal units) (n=79, 16.0%) (Figure 1.17). There were 35 reported deaths among major trauma cases.

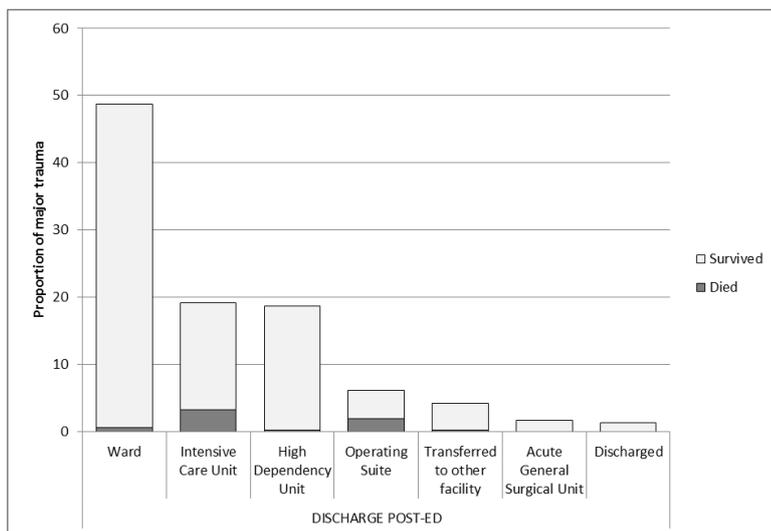


Figure 1.16: Proportion of major trauma cases due to falls from ladders by post-ED discharge, NSW 2010-2014 (n=454)

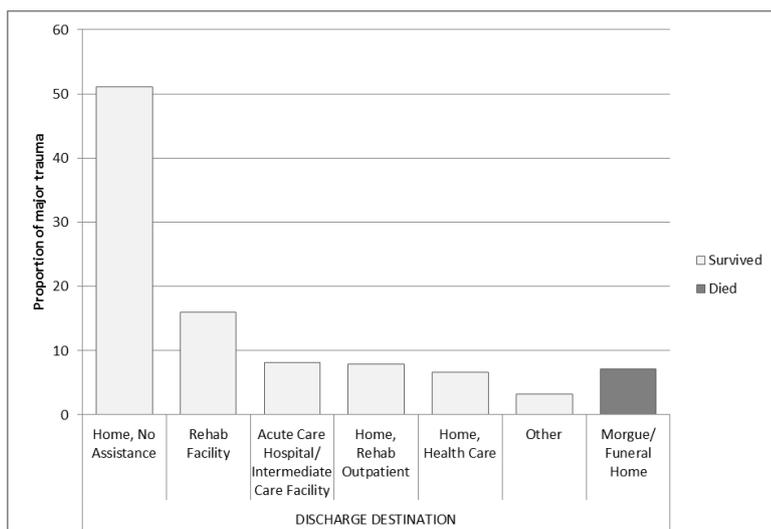


Figure 1.17: Proportion of major trauma cases due to falls from ladders by discharge destination, NSW 2010-2014 (n=495)

### 3.4 Major Trauma- 55 years and over

The majority of ladder falls resulting in major trauma occurred in those aged 55 and over (Table 1.2), with 40-46% in the 60-69 age group. Serious and moderate injuries were common; more severe injuries were found in males. The thorax, followed by the head and spine, were the main areas of injury. Patients were most commonly discharged home (without requiring assistance) or to a rehabilitation facility. There were 32 deaths, all in males (9.4%).

**Table 1.2: Characteristics of ladder injuries in patients aged 55 and over**

<b>AGE GROUP (years)</b>	<b>MALE</b>	<b>FEMALE</b>
55-59	58 (17%)	7 (25%)
60-64	71 (21%)	5 (18%)
65-69	65 (19%)	8 (29%)
70-74	62 (18%)	<5
75-79	42 (12%)	<5
80-84	29 (8.6%)	<5
85+	12 (3.5%)	0
<b>ISS GROUP</b>		
Moderate (12-15)	122 (36%)	14 (50%)
Serious (16-24)	140 (41%)	11 (39%)
Severe (25-40)	63 (19%)	<5
Critical (41-75)	14 (4.1%)	0
<b>BODY REGION</b>		
Thorax	119 (35%)	9 (32%)
Head	100 (30%)	6 (21%)
Multiple regions	44 (13%)	0
Spine	38 (11%)	7 (25%)
Lower extremity	28 (8.3%)	<5
Abdomen	6 (1.8%)	<5
Upper extremity	<5	0
Neck	<5	0
Face	<5	0
<b>DISCHARGE</b>		
Home, No Assistance	163 (48%)	12 (43%)
Rehab Facility	58 (17%)	7 (25%)
Morgue/ Funeral Home	32 (9.4%)	0
Acute Care Hospital/ Intermediate Care Facility	30 (8.8%)	<5
Home, Rehab Outpatient	26 (7.7%)	<5
Home, Health Care	17 (5.0%)	<5
Other/Unknown	13 (3.8%)	<5
<b>OUTCOME</b>		
Survived	307 (91%)	28 (100%)
Died	32 (9.4%)	0

#### **4. SUMMARY**

This study describes the epidemiology of injuries sustained following a fall from a ladder in NSW between 2010 and 2014. Similar patterns were observed between admission and major trauma cases, with a predominance of males between the ages of 60-69 injured from non-occupational activities. Compared to averaged annual data from Victoria, there were slightly more hospital admissions (1,699 in NSW compared with 1,251 in Victoria) and major trauma cases (99 compared with 86) in NSW, and similar average annual numbers of death. The head (21%, 29%) and thorax (14%, 36%) were the main areas of injury requiring admission and also resulting in major trauma, respectively.

There are significant clinical implications from these results. Hospital admission from this mechanism of injury was estimated to have cost the health system \$51.8 million over this five year period, based on the NSW State Price per National Weighted Activity Unit. Use of hospital resources was high- some 57,000 procedures performed- including administration of packed cells and open reduction of fractures, which can expose an already vulnerable group to secondary complications of surgical and anaesthetic interventions. Numbers of ladder-related falls are underestimated in this report by excluding emergency and other admissions. Given the financial cost and high use of rehabilitation services, prevention of ladder-related falls through safety campaigns and provision of services to the older adult for tasks requiring ladders, is critical in addressing this emerging public health issue. While ladder falls remain challenging due to the variety of behavioural factors involved, and the impracticalities of enforcing safer ladder use in domestic settings, there are a number of recommendations that can be introduced to successfully reduce ladder falls.

Given the similarities between the NSW and Victorian populations, recommendations arising from the Victorian report (Oxley 2014) are generalisable to these NSW findings. The key opportunities identified for reducing ladder falls are:

1. Improving the design and mechanism of ladders for safe consumer use through reviewing the strength and stability of ladder design.
2. Supporting ladder standard and regulation improvements and enhancement for improved compliance and ladder manufacture.
3. Supporting safe ladder use through building design innovation and features such as gutter guards and anchor points.

4. Improving surfaces around ladders, such as the use of anti-slip floor coverings and surface treatments to reduce injury risk from falls.
5. Promoting of the use of protective equipment when using ladders in the domestic context.
6. Supporting public awareness of the risks and dangers of ladder use in the domestic setting through public education and resources on ladder fall prevention.
7. Promoting alternatives to ladder use such as services and resources available to domestic ladder users within the community.
8. Addressing the prevention of domestic ladder falls and fall injuries through multi-sectorial collaboration and further research as required.

The Office of Fair Trading Queensland is leading the way with a new, nationally-funded campaign on ladder safety. This is a collaborative effort between the commonwealth, state and territory consumer protection regulators. This ladder safety campaign aims to reduce the number of injuries over time by promoting behavioural changes and providing education on safe ladder use. It also aims to raise awareness of the dangers associated with using a ladder, especially by men over 65 years. The campaign is now in the research phase, and is due for completion by the end of November 2015. The research findings will assist with developing a marketing strategy and targeted communication material which will be implemented in 2016.

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## **APPENDIX 1- Major Trauma**

Major trauma in NSW is defined as all patients of any age, who were admitted to a NSW Trauma Service within 14 days of sustaining an injury, and who:

- had an Injury Severity Score (ISS) > 12 (moderate to critically injured), or
- died in hospital (irrespective of ISS) following injury

Patients who died from an isolated fractured neck of femur injury sustained from a fall from a standing height (<1 metre) are excluded.

The patient records submitted for inclusion in this report do not represent all injuries in NSW, the full set of data recorded in hospital trauma registries, or the full work or caseload of trauma teams in hospitals.

## **APPENDIX 2- Calculation of the Injury Severity Score**

The injury severity score (ISS) is based on divisions of the body into six ISS body regions (head/neck, face, chest, abdominal/pelvic contents, extremities/pelvic girdle, external) and calculated using Abbreviated Injury Scores (AIS).

$$ISS = A^2 + B^2 + C^2$$

where A, B, and C are the highest AIS severity scores in the three most severely injured ISS body regions