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Hospitalised injury in NSW: A geographic comparison

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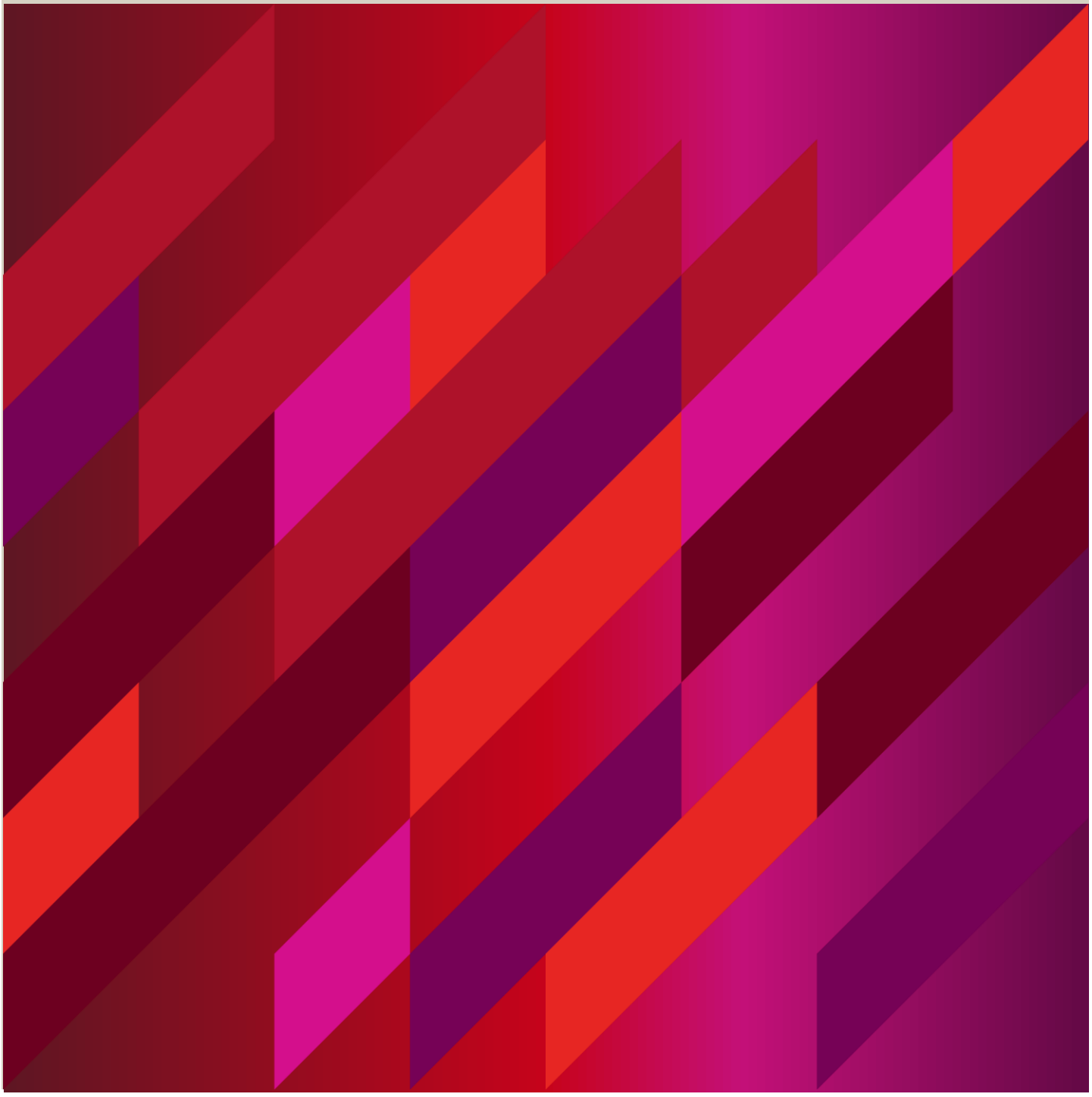

Hospitalised injury in NSW: A geographic comparison

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Abbreviations

95%CI	Ninety-five percent Confidence Interval
ABF	Activity Based Funding
ABS	Australian Bureau of Statistics
AR-DRG	Australian Refined-Diagnosis Related Group
ARIA+	Enhanced Accessibility/Remoteness Index of Australia
ASGS RA	Australian Statistical Geographical Standard Remoteness Area
AIHI	Australian Institute for Health Innovation
APDC	Admitted Patient Data Collection
ACAHS	Australian Centre for Agricultural Health and Safety
CCI	Charlson Comorbidity Index
CHeReL	Centre for Health Record Linkage
CO DURF	Cause of Death Unit Record File
DNR	District and Network Return
ED	Emergency Department
ICD-10-AM	International Classification of Diseases, 10th Revision, Australian Modification
ICU	Intensive Care Unit
ICISS	International Classification of Injury Severity Score
LHD	Local Health District
LOS	Length of Stay
MLK	Master Linkage Key
NSW	New South Wales
OR	Odds Ratio
PPN	Person Project Number
RBDM	Registry of Births Deaths and Marriages
SAR	Standardised Admission Ratio
SNAP	Sub-acute Non-acute Patient
SHN	Specialist Health Networks
SRR	Survival Risk Ratio
TBI	Traumatic Brain Injury

Executive Summary

In Australia, around 447,000 individuals are hospitalised annually following an injury. Traumatic injury can leave many individuals experiencing disabilities that can affect their quality of life and often require access to long-term health care. Individuals living in rural and remote locations have often been found to experience higher incidence rates of injury-related mortality and hospitalisation then urban residents. This study examines injury-related hospitalisations in NSW and compared the characteristics of hospitalised injury among rural and urban residents of NSW.

This was a retrospective analysis of injury-related hospitalisations by geographical location of residence in NSW during 1 January 2010 to 30 June 2014. Three administrative data collections were linked to examine injury-related hospitalisations of urban and rural residents of NSW. These were the NSW Admitted Patient Data Collection, the Registry of Births Deaths and Marriages and the Cause of Death Unit Record File mortality data files.

During 1 January 2010 to 30 June 2014, there were 496,325 (70.0%) injury hospitalisations of NSW residents from urban locations and 213,139 (30.0%) injury hospitalisations of residents from rural locations. There were similar overall injury hospitalisation rates between rural (2061.2 per 100,000 population) and urban (2062.9 per 100,000 population) residents of NSW during 2010 to 2013. The injury hospitalisation rates for rural residents were found to be significantly increasing by 2.96% each year during 2010 to 2013. There were 14,108 (6.6%) hospitalised injuries of rural residents who were indicated to be working at the time of their injury and there were 5,546 (2.6%) injury-related hospitalisations of rural residents where the location of the incident was indicated to be a farm. The total hospital cost of injury-related hospitalisations, rehabilitation and non-acute patient care for rural residents over the 4.5 years was $1.7 billion (mean cost $8,134).

Rural residents had an increased likelihood of being hospitalised for an injury relating to motorcyclist, motor vehicle and heavy vehicle crashes; other land transport incidents; being injured by animate mechanical forces; threats to breathing; electric current, radiation, extreme ambient air temperature and pressure; smoke, fire and flames; venomous animals and plants; forces of nature, intentional self-harm; and assault compared to urban residents.

This sort of examination of injury hospitalisations by geographic variation is useful to inform the development and targeting of injury prevention strategies by geographic location. The development, implementation and evaluation of injury prevention strategies targeting the most common injury mechanisms for rural residents will go some way towards reducing hospitalised injury in this population.

1. Introduction

Worldwide, injuries account for the deaths of more than five million people, representing 9% of all deaths, with many more millions hospitalised following an injury [1]. In Australia, around 447,000 individuals are hospitalised after sustaining an injury each year [2], costing round $3.4 billion [3]. In New South Wales (NSW) around 147,200 individuals were hospitalised in 2013-14 with a principal diagnosis of injury [4].

Rural residents have often been found to experience higher incidence rates of both injury-related mortality and hospitalised morbidity then urban residents [5-9], with the rate of hospitalised injury for rural residents previously around 1.4 times higher than that of urban residents Australia-wide in 2001-02 [10].

In terms of work-related injuries, the agricultural industry has one of the highest rates of occupational injury compared to all other industries [11], with many injuries of rural residents occurring on rural properties [12]. Rural residents who live and work on farms are often exposed to a range of injury-related hazards, due to the location of their residence being both a workplace, their home and a site for recreation [13].

In NSW, past examinations of hospitalised injury of rural and urban residents did not have access to linked hospitalisation and mortality data collections, so were not able to consider hospital readmissions and mortality post-discharge from hospital [8]. Nor have prior examinations of hospitalised injury taken into account individual comorbidities and their possible influence on patient outcomes for rural and urban residents. There has also been no examination of the cost of in-hospital treatment for injuries involving rural and urban residents in NSW.

The overall objective of this research was to examine injury-related hospitalisations in NSW and to compare the characteristics of hospitalised injury among rural and urban residents of NSW. The specific aims included the:

- identification of the number, incidence, characteristics and cost of injury-related hospitalisations for both rural and urban NSW residents;
- comparison of temporal trends of hospitalised injury for rural and urban residents in NSW;
- comparison of patient outcomes (i.e. hospital length of stay, hospital readmissions within 28 days; and 30-day mortality) between rural and urban residents; and
- identification of the number and characteristics of work-related and farm-related hospitalised injuries in NSW.

2. Method

This section describes the data collections used and the data linkage process conducted by the Centre for Health Record Linkage (CHeReL). Ethical approval for this project was obtained from the NSW Population and Health Services Research Ethics Committee (Approval number: 2015/08/599).

2.1 Data collections

A retrospective analysis of injury-related hospitalisations by geographical location of residence in NSW during 1 January 2010 to 30 June 2014 was conducted. Three linked data collections were used to examine injury-related hospitalisations of urban and rural residents of NSW: the NSW Admitted Patient Data Collection (APDC), the Registry of Births Deaths and Marriages (RBDM) and the Cause of Death Unit Record File (COD URF) mortality data files.

2.1.1 Admitted Patient Data Collection

The APDC is administered by the NSW Ministry of Health and includes information on all inpatient admissions from all public and private hospitals, private day procedures, and public psychiatric hospitals in NSW. The APDC contains information on patient demographics, source of referral, diagnoses, external cause(s), separation mode and clinical procedures. Each health record relates to individual episodes of care in hospital, which end with the discharge, transfer, or death of the patient, or when the service category for the admitted patient changes. Diagnoses and external cause codes are classified using the International Classification of Diseases, 10th Revision, Australian Modification (ICD-10-AM) [14].

The APDC is based on episodes of care in hospital. Therefore, a single injurious event may result in multiple admissions, if the patient was transferred to a different mode of care or hospital, or returns following a discharge. Individuals may also have several injurious events during the study timeframe. In order to include multiple admissions pertaining to a single injurious event, the person project numbers (PPN's) created from the data linkage process were used to identify the first admission per person (termed the index admission), and additional admissions related to the index admission (i.e. a continuous admission with no break from the hospital system, including transfers and statistical discharges) were treated as related to the index admission. Where a patient had a non-continuous hospital admission (i.e. there was a break from the hospital system), these admissions were treated as new admissions. The data extract of the APDC, supplied by the NSW Ministry of Health, included all records which contained an ICD-10-AM principal diagnosis

of an injury (i.e. ICD-10-AM: S00 to T98). Only injury-related hospital admission of residents of NSW were included in this analysis. Therefore, there were 27,181 (3.6%) injury-related hospitalisations of non-NSW residents in NSW (i.e. n=19,432) and individuals with missing residential location details (i.e. n=7,749) that were excluded.

2.1.2 Registry of Births, Deaths and Marriages and Cause of Death Unit Record File mortality data

Mortality data were obtained from the NSW RBDM from 1 January 2010 to 31 March 2015. All deaths in NSW are registered with the RBDM and information collected from death certificates (certified by a medical practitioner or pathologist) includes demographic data and fact of death. Mortality data were also obtained from the COD URF for deaths in NSW during 1 January 2010 to 31 December 2013 to identify the cause of death.

2.2 Data linkage

The CHeReL uses identifying information, such as name, address, date of birth and gender, to construct a Master Linkage Key (MLK) and create a PPN for each unique person identified in the linkage process. The record linkage was conducted using *ChoiceMaker* software [15]. The record linkage between the hospitalisation and mortality data was conducted using probabilistic methods. Upper and lower probability cut-offs started at 0.75 and 0.25 for a linkage and were adjusted for each individual linkage to ensure false links were kept to a minimum. Record groups with probabilities in between the cut-offs were subject to clerical review [16]. Successful links were defined as when the PPN matched in the data collections.

2.3 Hospital costs

The Australian Refined-Diagnosis Related Groups (AR-DRGs), episode of care length of stay (LOS) and episode of care type (e.g. acute, Sub-acute Non-Acute Patient (SNAP)) were used to estimate hospital costs. For this study, SNAP care was considered to involve psychogeriatric services, geriatric evaluation and management, maintenance services, and palliative care. These services aim to improve an individual's functional status and to maintain and/or enhance their quality of life. In-hospital rehabilitation, while considered SNAP care, was separately identified from other types of SNAP care for this study. Rehabilitation-related episodes of care were identified using the AR-DRG classifications of Z60A, Z60B and Z60C [17]. Estimates of public hospital costs were obtained from the *National Hospital Costing Data Collection, Round 14 (2009-10)* [18] and using the *NSW Costs of Care* Standards (2009-10) cost calculation guidelines

[17]. The average cost per AR-DRG included costs for medical and nursing clinical services, non-clinical salaries, pathology, imaging, allied health, pharmaceuticals, intensive and coronary care, operating rooms, emergency departments, supplies and ward overheads, specialist procedure suites, prostheses, staff on-costs (e.g. superannuation, termination, long-service leave, workers' compensation, recruitment costs), cleaning, linen and food services, and depreciation costs [18].

For acute, rehabilitation and SNAP admissions within a period of care related to the index injury hospital admission (See Section 2.10), the average daily cost per AR-DRG was multiplied by the episode of care LOS up to 120 days. Where an episode of care exceeded 120 days, a flat rate of $200 per day was applied thereafter, excluding long hospital stays for 19 select AR-DRGs used for treatment involving tracheostomies, neonates, and burns [17]. The *NSW Costs of Care Standards (2009-10)* [17] indicate that episode LOS should be capped at 365 days. However, so as not to underestimate injury-related hospital costs, the $200 flat rate was applied for LOS greater than 365 days. For patients who had existing chronic conditions that involved dialysis or chemotherapy treatment, the cost for these treatments were not included in the total hospital cost for injury, where these treatments were provided within an index injury hospitalisation period of care.

For patients treated for an injury-related period of care at a private hospital, the average daily public hospital AR-DRG costs were used as estimates of injury treatment cost. This was not ideal, but so as not to underestimate injury-related hospital costs by only including costs from public hospitals, public hospital costs were used as an approximation of private hospital costs. Fourteen percent of index injury-related admissions were treated at private hospitals. All costs are in 2009-10 Australian dollars.

2.4 Urban and rural identification

The Australian Statistical Geographical Standard Remoteness Area (ASGS RA) was used to identify rural and urban residents in NSW. The ASGS RA assigns residents to one of five categories (i.e. major cities, inner regional, outer regional, remote and very remote) using defined index scores of distance to service centres of various sizes [19]. The score is initially calculated on a 1 kilometre grid, and then the mean value for each Census Collection District is aggregated to form the remoteness areas. For ease of analysis and reporting, the five categories were collapsed into two categories: urban (i.e. major cities) and rural (i.e. inner regional, outer regional, remote, and very remote NSW) [9].

2.5 Work-related identification

Work-related injury hospitalisations were identified by creating a work-related identification flag (i.e. work-related or not work-related) using a combination of data variables that included: (i) the activity code that the injured person was indicated to be working at the time of the injury (i.e. ICD-10-AM: Y93.2 or U73.0 to U73.09); and/or (ii) payment status was specified as *'compensable – NSW workers' compensation'* (i.e. APDC payment status: 40); and/or (iii) supplementary factors related to causes of morbidity and mortality was specified as *'work-related condition'* (i.e. ICD-10-AM: Y96).

2.6 Farm identification

Farm-related injury hospitalisations were identified using the place of occurrence classification of farm (i.e. ICD-10-AM: Y92.7). Farm-related injury hospitalisations were only examined for rural residents (see Section 2.3).

2.7 Work-related injuries of rural residents

Work-related injury hospitalisations were identified using a combination of data variables that include the: (i) rural ASGS RA classifications (i.e. inner regional, outer regional, remote, and very remote NSW); and (ii) work-related flag indicating that the person was working at the time of the injurious incident (see Section 2.4).

2.8 Comorbidity identification

The Charlson Comorbidity Index (CCI) was used to identify comorbidities using diagnosis classifications from the hospitalisation records [20]. The CCI was treated as a categorical variable and categorised as severe comorbidity (CCI $\geq$ 3), mild comorbidity (CC1=1 or 2) and no reported comorbidity (CCI=0). A 12 month look back period to 1 January 2009 was used for the identification of comorbidities.

2.9 Injury severity

The International Classification of Injury Severity Score (ICISS) was used to estimate injury severity. The ICISS is derived for each person by summing the probability of survival for each injury diagnosis using survival risk ratios (SRR) calculated for each injury diagnosis [21]. In the current study, injury severity was calculated using each individual's injury diagnosis classifications, using SRRs previously developed by Stephenson et al [21]. Dayal et al [22] suggested three ICISS levels to define minor (≥0.99), moderate (0.941-0.99) and serious (≤0.941)

injury (i.e. equivalent to a survival probability of 94.1% or a 5.9% probability of death) [23]. These severity definitions were used for the current study.

2.10 Data management and analysis

Analysis was performed using SAS version 9.4 [24]. All hospital episodes of care related to the one injury were linked to form a period of care (i.e. all episodes of care related to the injury until discharge from the health system). Descriptive statistics were conducted and chi-square tests of independence were used to examine the characteristics of NSW residents who were hospitalised for an injury who resided in urban compared to rural locations.

Age-standardised incidence rates were calculated for the period 2010 to 2013 using PROC STDRATE for injured individuals residing in urban and rural locations. There were three missing ages and sex was missing for 11 individuals, with the missing data excluded from rate calculations. Denominator data for the number of people residing in NSW by urban and rural location were obtained from the Australian Bureau of Statistics (ABS) [25]. Direct age standardised rates and 95% confidence intervals (95%CI) were calculated per 100,000 population using the estimated Australian residential population at 30 June 2001 as the standard population. Negative binomial regression was used to examine the statistical significance of changes in trend over time in order to correct for over-dispersion in the injury-related hospitalisation data [26].

Thirty-day and 90-day mortality were calculated from the date of admission of the first injury-related hospital admission (i.e. the index admission). Twenty-eight day hospital readmission was considered as readmission within 28 days of hospital discharge for any cause.

The calculation of hospital LOS included transfers between hospitals and both hospital LOS and age-adjusted hospital LOS were truncated to three standard deviations in order to exclude extreme outliers [27]. Linear regression was used to age-adjust for hospital LOS and logistic regression for 28-day readmission and 30-day and 90-day mortality. T-tests were used to compare urban and rural hospitalisations and unadjusted and age-adjusted hospital LOS [26].

Standardised admission ratios (SAR) were calculated to compare characteristics of rural and urban hospitalised injuries by injury mechanism. Indirect age standardised rates were used to calculate the SARs using the rate for urban residents as the standard rate.

Multivariable logistic regression was used to examine the association between individual demographic and injury characteristics of injury-related hospitalisations and residential location.

The variables included in the model were: age group, gender, number of comorbidities (i.e. 0, 1-2, 3+), injury mechanism, principal injury type, place of occurrence and working status. A backwards stepwise regression was used to sequentially eliminate factors from the model that did not significantly contribute to risk of hospitalised injury at 0.25 [28]. Odds ratios (OR) and 95%CI were calculated.

Cox proportional hazard regression was used to examine the effect of risk factors on survival at three months following hospitalised injury. Variables were initially examined using univariate analyses and were then entered into a multivariate model. The variables included in the model were: age group, gender, number of comorbidities (i.e. 0, 1-2, 3+), injury severity (i.e. minor, moderate, serious), injury mechanism, principal injury type, place of occurrence and working status. A backwards stepwise regression was used to sequentially eliminate factors from the multivariate model that did not significantly contribute to mortality risk. Hazard ratios (HR) and 95%CI were calculated. The working status variable was removed from the model for rural residents.

Descriptive statistics were used to estimate the treatment cost data in terms of the sum, mean and median hospital costs by urban/rural location of residence. Total hospital cost (i.e. acute, rehabilitation and SNAP care) was examined for key characteristics, including age group, gender, injury mechanism, principal injury type and nature of injury.

3. Results

The results are reported in four sections. Section 3.1 describes the characteristics of injury-related hospitalisations of urban and rural residents of NSW and Section 3.2 describes work- and farm-related injury hospitalisations. Section 3.3 identifies demographic and injury characteristics associated with hospitalised injury and mortality by geographic location and Section 3.4 describes the injury-related hospital treatment costs.

3.1 Injury Characteristics

3.1.1 Comparison of injury characteristics of urban and rural residents

During 1 January 2010 to 30 June 2014, there were 709,464 injury-related hospitalisations of NSW residents. Of these, 496,325 (70.0%) hospitalisations were of NSW residents from urban locations and 213,139 (30.0%) were hospitalisations of NSW residents from rural locations. During 1 January 2010 to 31 December 2013, the age-standardised injury hospitalisation rate for rural residents was 2061.2 per 100,000 population (95%CI 2051.5-2070.8) and for urban residents the injury hospitalisation rate was 2062.9 per 100,000 population (95%CI 2056.7-2069.1). During 2010 to 2013, the injury hospitalisation rate for rural residents was estimated to significantly increase per year by 2.96% (95%CI 0.52-5.46, p<0.02) and the injury hospitalisation rate for urban residents was also estimated to increase per year by 1.76% (95%CI -0.66-4.25), but the increase was not significant (p=0.2) (Figure 3.1).

Males residing in rural areas (2465.5 per 100,000 population; 95%CI 2450.3-2480.7) had a higher injury hospitalisation rate than males residing in urban areas (2393.4 per 100,000 population; 95%CI 2383.8-2403.0), while females residing in rural areas (1656.8 per 100,000 population; 95%CI 1644.9-1668.7) had a lower injury hospitalisation rate than females residing in urban areas (1732.4 per 100,000 population; 95%CI 1724.6-1740.2). The injury hospitalisation rate for male (2.37%; 95%CI 1.57-3.19, p<0.0001) and female (3.40%; 95%CI 2.69-4.13, p<0.0001) rural residents significantly increased per year during 2010 to 2013. The injury hospitalisation rate for male (1.41%; 95%CI 0.79-2.03, p<0.0001) and female (2.24%; 95%CI 1.68-2.80, p<0.0001) urban residents also significantly increased per year during 2010 to 2013, but to a lesser extent. For both rural and urban residents, the rate of injury hospitalisations increased with age to 20-24 years, declined and then increased with increasing age from 50-54 years for rural residents and from 55-59 years for urban residents (Figures 3.2 and 3.3).

Compared to urban residents, a slightly higher proportion of males (56.5% versus 55.0%) and a lower proportion of females (43.5% versus 45.0%) residing in rural locations were hospitalised for

an injury during 1 January 2010 to 30 June 2014. A higher proportion of individuals aged 5 to 19 years and 45 to 74 years were injured and hospitalised who resided in rural locations compared to urban locations. Urban residents (20.3%) who were hospitalised for an injury had a higher proportion of one or more comorbidities than rural residents (18.3%) (Table 3.1).

Figure 3.1: Incidence rate for injury-related hospitalisations for urban and rural residents by year, linked hospitalisation and mortality data, NSW, 1 January 2010 to 31 December 2013

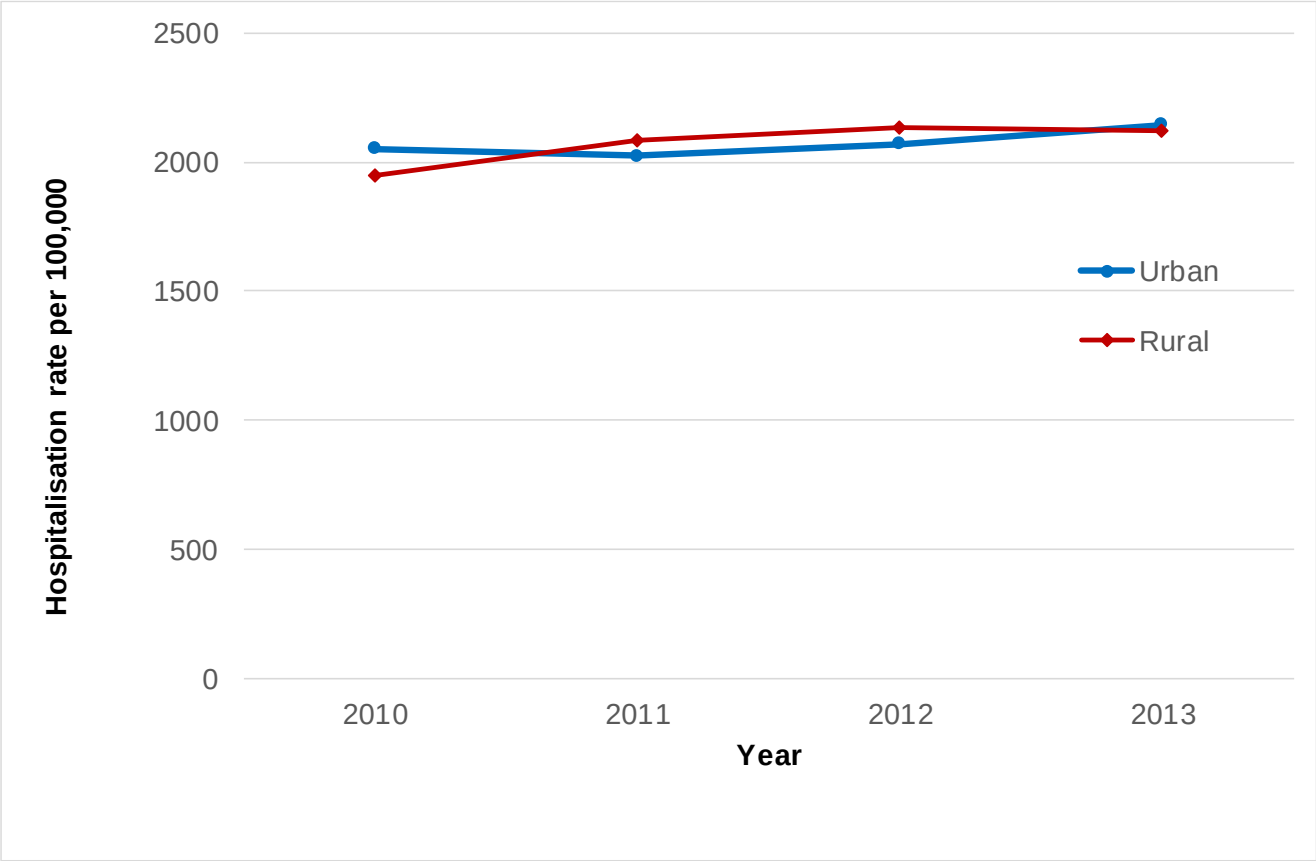


Figure 3.2: Incidence rate for injury-related hospitalisations for rural residents by age group and gender, linked hospitalisation and mortality data, NSW, 1 January 2010 to 31 December 2013

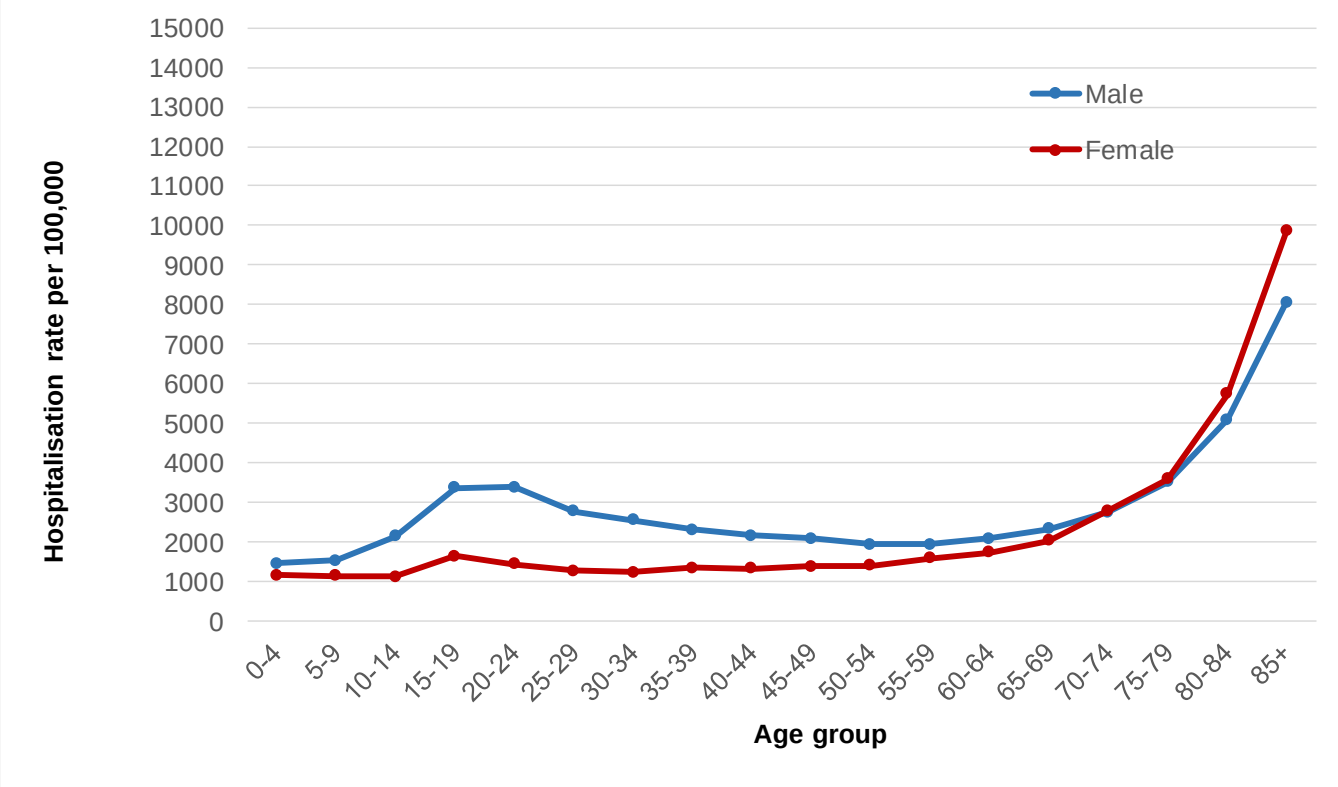


Figure 3.3: Incidence rate for injury-related hospitalisations for urban residents by age group and gender, linked hospitalisation and mortality data, NSW, 1 January 2010 to 31 December 2013

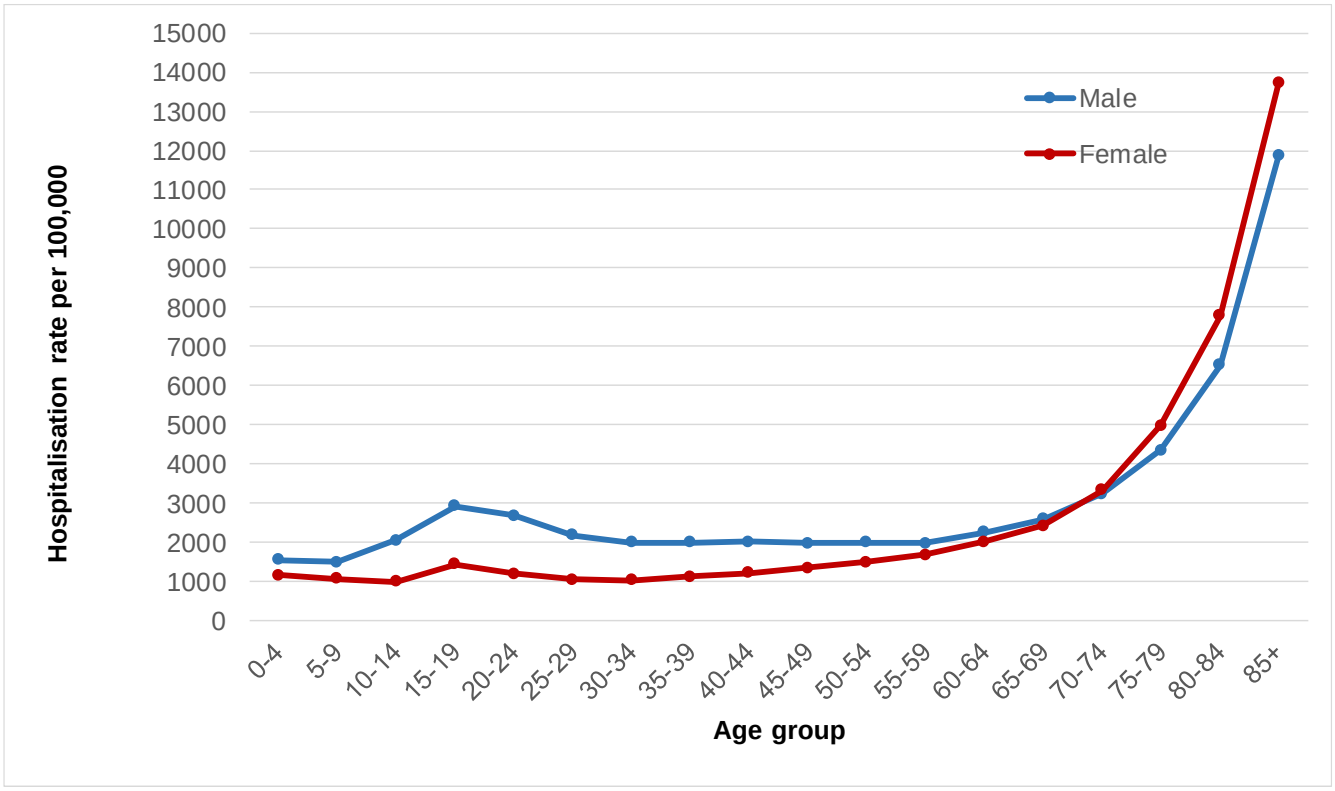


Table 3.1: Demographic characteristics of individuals with an injury-related hospitalisation by urban and rural location, linked hospitalisation and mortality data, NSW, 1 January 2010 to 30 June 2014

	Urban (n=496,325)		Rural (n=213,139)		X^2 (df)
	n	%	n	%	
Gender[1]					
Male	272,752	55.0	120,320	56.5	135.3 (1)*
Female	223,566	45.0	92,815	43.5	
Age group[2]					
0-4	20,871	4.2	8,032	3.8	3178.6 (11)*
5-9	17,951	3.6	8,439	4.0	
10-14	20,506	4.1	10,833	5.1	
15-19	31,298	6.3	16,557	7.8	
20-24	33,265	6.7	13,428	6.3	
25-34	57,031	11.5	19,454	9.1	
35-44	52,930	10.7	21,224	10.0	
45-54	51,733	10.4	23,079	10.8	
55-64	48,310	9.7	23,816	11.2	
65-74	46,773	9.4	23,758	11.1	
75-84	58,634	11.8	24,557	11.5	
85+	57,022	11.5	19,960	9.4	
Admission year					
2010	103,542	20.9	45,669	21.4	69.6 (3)*
2011	106,625	21.5	46,508	21.8	
2012	110,727	22.3	48,185	22.6	
2013	116,838	23.5	48,562	22.8	
2014[3,4]	58,593	11.8	24,215	11.4	
Number of comorbidities					
None	395,786	79.7	174,185	81.7	454.6 (2)*
One or two	82,904	16.7	32,940	15.5	
Three or more	17,635	3.6	6,014	2.8	
Urban and rural subcategories[4]					
Major cities	496,325	100.0	-	-	
Inner regional	-	-	156,809	73.6	
Outer regional	-	-	50,922	23.9	
Remote	-	-	4,178	2.0	
Very remote	-	-	1,230	0.6	

[1]Gender was missing for 7 urban and 4 rural residents. [2]Age was missing for 1 urban and 2 rural residents.
[3] Data were only available for 1 January 2014 to 30 June 2014. [4]Excluded from and chi-square test of independence.
*p<0.0001

Falls and transport incidents were the two most common injury mechanisms for both rural and urban residents. Inanimate mechanical forces (such as getting struck by or striking against objects; getting caught, crushed, jammed or pinched in or between objects; contact with glass, power tools or machinery; discharge of guns or rifles; or explosions), intentional self-harm and assault were also common injury mechanisms with a slightly higher proportion of these mechanisms occurring in rural locations (Table 3.2)

Table 3.2: Injury mechanism of injury-related hospitalisations by urban and rural location, linked hospitalisation and mortality data, NSW, 1 January 2010 to 30 June 2014

	Urban (n=496,325)		Rural (n=213,139)		X^2 (df)
	n	%	n	%	
Injury mechanism					
Transport incidents[1]	44,670	9.0	24,643	11.6	
Pedestrian	4,625	0.9	1,106	0.5	8651.3 (21)*
Pedal cyclist	8,969	1.8	3,076	1.4	
Motorcyclist	10,256	2.1	7,547	3.5	
Motor vehicle occupant	17,163	3.5	7,897	3.7	
Heavy vehicle occupant	413	0.1	396	0.2	
Bus occupant	749	0.2	137	0.1	
Other land transport	2,495	0.5	4,484	2.1	
Water, air and other and unspecified transport	1,345	0.3	625	0.3	
Falls	180,677	36.4	71,881	33.7	
Inanimate mechanical forces	58,909	11.9	26,240	12.3	
Animate mechanical forces	12,793	2.6	7,790	3.7	
Drowning and submersion	480	0.1	207	0.1	
Other threats to breathing	497	0.1	288	0.1	
Electric current, radiation, extreme ambient air temperature and pressure	478	0.1	284	0.1	
Smoke, fire and flames	1,519	0.3	1,195	0.6	
Heat and hot substances	3,104	0.6	1,327	0.6	
Venomous animals and plants	1,757	0.4	2,038	1.0	
Exposure to forces of nature	283	0.1	244	0.1	
Poisoning	7,882	1.6	3,152	1.5	
Intentional self-harm	23,509	4.7	10,669	5.0	
Assault	14,488	2.9	6,810	3.2	
Other and unspecified injury mechanism	143,934	29.0	55,746	26.2	

[1]Total road trauma excluded from and chi-square test of independence.
*p<0.0001

Rural residents had an increased likelihood of being hospitalised for an injury relating to motorcycles, motor vehicle and heavy vehicle crashes; other land transport incidents; being injured by animate mechanical forces (such as getting struck by another person, getting bitten by an animal); threats to breathing; electric current, radiation, extreme ambient air temperature and pressure; smoke, fire and flames; venomous animals and plants; forces of nature, intentional self-harm; and assault compared to urban residents. Rural residents had a lower likelihood of being hospitalised for an injury as a pedestrian, pedal cyclist or bus occupant compared to urban residents (Table 3.3).

Table 3.3: Standard admission ratios for injury-related hospitalisations by injury mechanism for urban and rural locations, linked hospitalisation and mortality data, NSW, 1 January 2010 to 31 December 2013

	Urban	Rural		
	n	n	SAR	95%CI
Injury mechanism				
Transport incidents	39,393	21,936	1.31	1.29-1.33
Pedestrian	4,134	990	0.56	0.53-0.60
Pedal cyclist	7,802	2,740	0.83	0.80-0.86
Motorcyclist	9,034	6,710	1.75	1.71-1.79
Motor vehicle occupant	15,210	7,069	1.09	1.07-1.12
Heavy vehicle occupant	367	355	2.28	2.04-2.51
Bus occupant	661	119	0.42	0.35-0.50
Other land transport	2,185	3,953	4.26	4.13-4.39
Water, air and other and unspecified transport	1,184	528	1.05	0.96-1.14
Falls	159,199	63,596	0.94	0.93-0.95
Inanimate mechanical forces	51,672	23,285	1.06	1.05-1.07
Animate mechanical forces	11,110	6,816	1.44	1.41-1.48
Drowning and submersion	428	184	1.01	0.87-1.16
Other threats to breathing	431	258	1.41	1.24-1.58
Electric current, radiation, extreme ambient air temperature and pressure	421	258	1.44	1.27-1.62
Smoke, fire and flames	1,331	1,055	1.87	1.75-1.98
Heat and hot substances	2,753	1,183	1.01	0.95-1.07
Venomous animals and plants	1,523	1,825	2.82	2.69-1.95
Exposure to forces of nature	265	208	1.85	1.60-2.10
Poisoning	6,898	2,769	0.95	0.91-0.98
Intentional self-harm	20,821	9,396	1.06	1.04-1.08
Assault	12,909	6,171	1.13	1.10-1.15
Other and unspecified injury mechanism	127,387	49,451	0.91	0.91-0.92
All injury mechanisms	437,725	188,919	1.02	1.01-1.02

Where the place of occurrence of the injury event was specified, the home and schools, other institutions and public administrative areas were the most common locations of the injurious incident for both rural and urban residents. Sporting activities were the most common activity specified that was being performed at the time of the injurious incident for both rural and urban residents (Table 3.4).

Head injuries, wrist and hand, knee and lower leg, and elbow and forearm were the most common principal injury type for both rural and urban residents. Rural residents (10.6%) had a lower proportion of wrist and hand injuries compared to urban residents (12.4%) (Figure 3.4). Fractures and open wounds were the most common nature of the principal injury for both rural and urban residents (Figure 3.5).

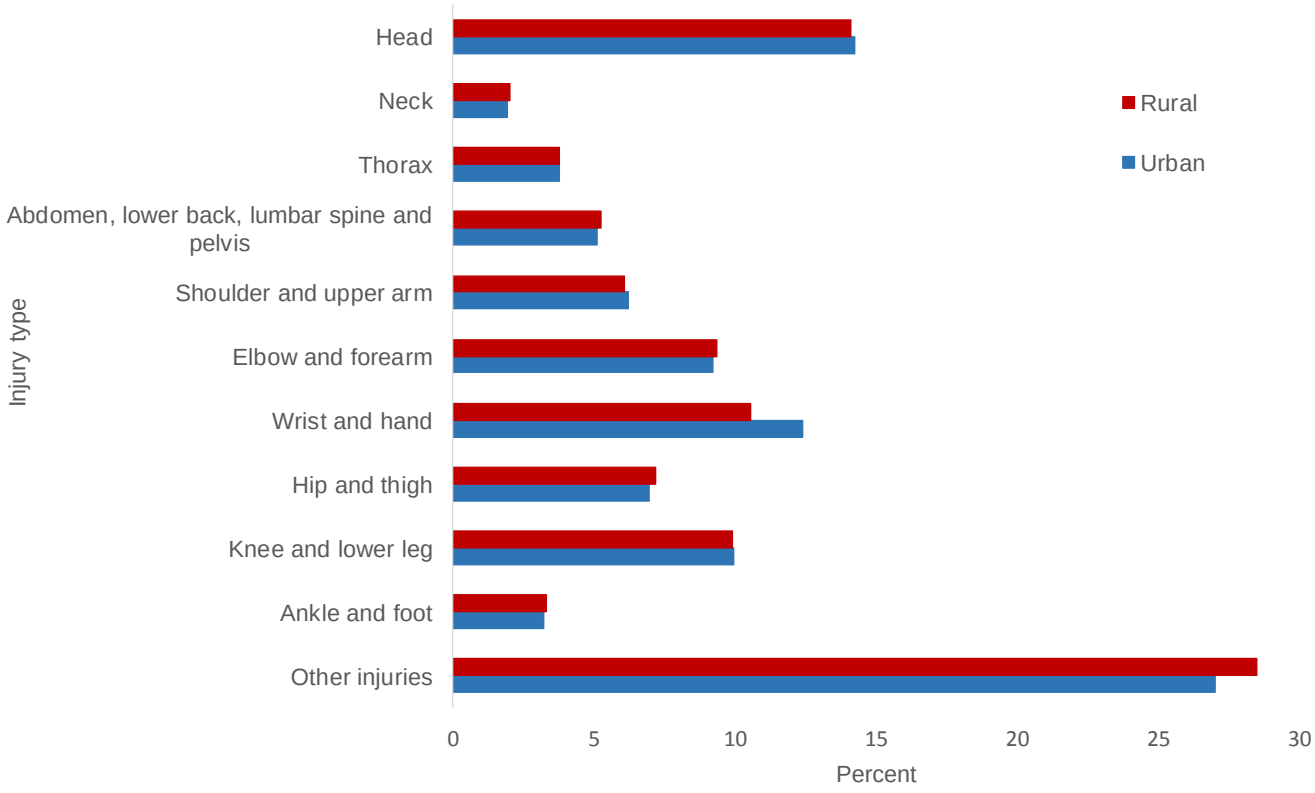
Rural residents had slightly higher moderate and serious injuries compared to urban residents (χ^2=192.7, df=2, p<0.0001). Rural residents had a higher unadjusted and age-adjusted 30-day mortality following an injury-related hospitalisation than urban residents and a lower age-adjusted 90-day mortality following an injury-related hospitalisation. Rural residents were significantly less likely to be readmitted to hospital within 28 days following an injury-related hospital admission. Rural residents had a significantly lower hospital LOS and age-adjusted hospital LOS than urban residents (Table 3.5).

Table 3.4: Place of occurrence and activity at time of incident for injury-related hospitalisations by urban and rural location, linked hospitalisation and mortality data, NSW, 1 January 2010 to 30 June 2014

	Urban (n=496,325)		Rural (n=213,139)		X^2 (df)
	n	%	n	%	
Place of occurrence					
Home	114,392	23.0	52,235	24.5	11182.7 (9)*
Residential institution	26,838	5.4	9,701	4.6	
School, other institution and public administrative area	91,631	18.5	39,204	18.4	
Sports and athletics area	22,319	4.5	9,793	4.6	
Street and highway	42,156	8.5	15,335	7.2	
Trade and service area	13,801	2.8	4,625	2.2	
Industrial and construction area	4,394	0.9	2,267	1.1	
Farm	724	0.1	5,546	2.6	
Other specified places	15,077	3.0	6,118	2.9	
Unspecified place	164,993	33.2	68,315	32.1	
Activity at time of incident[1]					
Sports activity	42,980	8.7	18,120	8.5	1354.5 (6)*
Team ball sports	18,746	3.8	7,133	3.3	
Team bat or stick sports	1,584	0.3	630	0.3	
Team water sports	18	0.0	2	0.0	
Boating sports	384	0.1	103	0.0	
Individual water sports	2,685	0.5	1,343	0.6	
Ice and snow sports	1,449	0.3	279	0.1	
Individual athletic activities	1,260	0.3	373	0.2	
Acrobatic sports	541	0.1	159	0.1	
Aesthetic activities	575	0.1	191	0.1	
Racquet sports	672	0.1	260	0.1	
Target and precision sports	497	0.1	223	0.1	
Combative sports	984	0.2	222	0.1	
Power sports	190	0.0	46	0.0	
Equestrian activities	798	0.2	1,701	0.8	
Adventure sports	482	0.1	107	0.1	
Wheeled motor sports	2,215	0.4	1,873	0.9	
Wheeled non-motor sports	6,693	1.3	2,467	1.2	
Multidiscipline sports	26	0.0	13	0.0	
Aero sports	141	0.0	50	0.0	
Other school-related recreational activities	140	0.0	116	0.1	
Other specified sport and exercise activity	2,900	0.6	829	0.4	
Leisure activity	12,349	2.5	6,023	2.8	
Working for income	22,971	4.6	11,059	5.2	
Other types of work	1,8404	3.7	8,682	4.1	
Resting, sleeping, eating or engaging in other vital activities	24,153	4.9	13,032	6.1	
Engaged in other specified activities	30,950	6.2	16,120	7.6	
During unspecified activity	344,518	69.4	140,103	65.7	

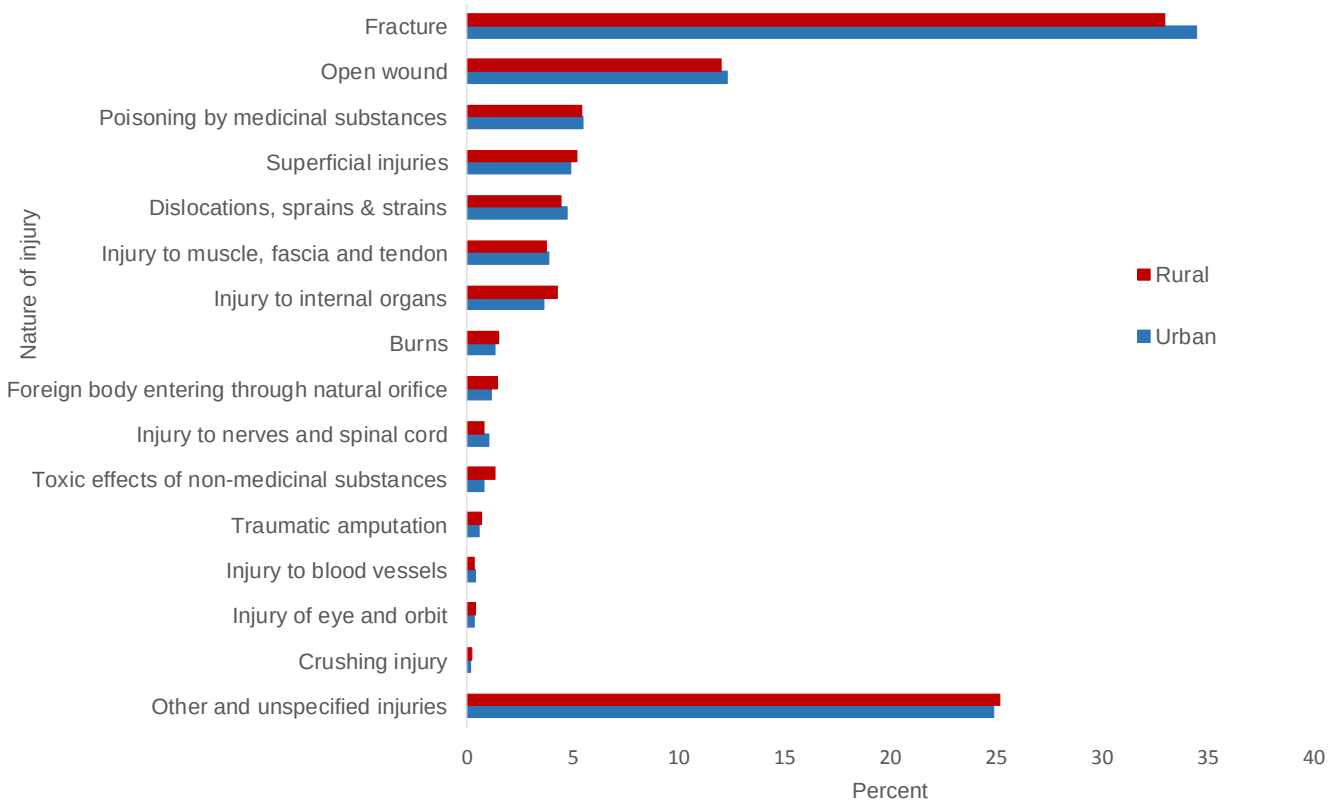
[1]Sport activity sub-categories excluded from and chi-square test of independence.
*p<0.0001.

Figure 3.4: Principal injury type for injury-related hospitalisations by urban and rural location by urban and rural location, linked hospitalisation and mortality data, NSW, 1 January 2010 to 30 June 2014[1]



[1]Other injuries include: injures involving multiple body regions, injuries to unspecified parts of trunk, limb or body region, effects of foreign bodies, burns, frostbite, poisoning, complications of trauma and other and unspecified injuries.

Figure 3.5: Nature of principal injury for injury-related hospitalisations by urban and rural location by urban and rural location, linked hospitalisation and mortality data, NSW, 1 January 2010 to 30 June 2014[1]



[1]Other and unspecified injuries include complications of trauma and other and unspecified effects of trauma.

Table 3.5: Injury severity and health outcomes of individuals with an injury-related hospitalisation by urban and rural location, linked hospitalisation and mortality data, NSW, 1 January 2010 to 30 June 2014

	Urban (n=496,325)		Rural (n=213,139)		
	n	**%**	**n**	**%**	**χ^2 or t-test (df)**
Injury severity					
Minor (ICISS ≤ 0.99)	209,517	42.2	86,326	40.5	192.7 (2)*
Moderate (ICISS between 0.942-0.99)	212,379	42.8	94,575	44.4	
Serious (ICISS <0.942)	74,429	15.0	32,238	15.1	
30-day mortality					
Unadjusted	7,280	1.5	3,298	1.6	6.6 (1)**
Age-adjusted (95%CI)	7,280	0.7 (0.67-0.74)	3,298	0.7 (0.65-0.78)	8.5 (406040)*
90-day mortality					
Unadjusted	14,223	2.9	6,014	2.8	1.0 (1)
Age-adjusted (95%CI)	14,223	1.2 (1.11-1.24)	6,014	1.2 (1.07-1.23)	7.9 (406433)*
28-day readmission					
Unadjusted	57,990	13.4	23,595	12.6	71.2 (1)*
Age-adjusted (95%CI)	57,990	13.0 (12.9-13.1)	23,595	12.3 (12.1-12.5)	8.1 (346653)*
Hospital length of stay	**Mean**	**(SD)**	**Mean**	**(SD)**	
Hospital length of stay (days)	6.2	12.4	5.6	11.4	20.9 (433755)*
Age-adjusted hospital length of stay (days)	6.1	4.6	5.9	4.4	15.3 (417796)*

*p<0.0001, ** p<0.01.

3.1.2 Injury characteristics of rural residents by age group

During 1 January 2010 to 30 June 2014, there were 43,861 (20.6%) hospitalised injuries of individuals aged 19 years or less, 101,001 (47.4%) hospitalised injuries of individuals aged 20-64 years and 68,275 (32.0%) hospitalised injuries of individuals aged 65 years or older who were rural residents of NSW. There were similar proportions of rural residents in each age group hospitalised for any injury during the time period examined. As age increased the number of comorbidities reported also increased.

The mechanism of injury varied by age group for rural residents. Fall-related injuries were most common for older individuals aged 65 years and older (57.8%) and for individuals aged 19 years or less (31.3%). Transport incidents were a common injury mechanism for individuals aged 19 years or less (17.7%), particularly while being injured as a motorcyclist or as a pedestrian, compared to the other age groups. Injuries from inanimate mechanical forces (such as getting struck by or striking against objects; getting caught, crushed, jammed or pinched in or between objects; contact with glass, power tools or machinery; discharge of guns or rifles; or explosions) were common for individuals aged 19 years or less (15.5%) and 20-64 years (15.7%) compared to individuals aged 65 years and older (5.3%). Intentional self-harm was highest for individuals aged 20-64 years (7.6%) and individuals aged 19 years or less (5.7%) compared to individuals aged 65 years or older (0.8%) (Table 3.6).

The home was the most common location of the injurious incident for each age group, where the incident location was specified. Just less than one-quarter of injuries where an individual aged 65 years and older was hospitalised occurred in the home compared to 18.2% for individuals aged 20 to 64 years and 20.1% for individuals aged 19 years or less. Individuals aged 65 years and older had the highest proportion of injuries occurring in school, other institutions and public administrative areas (this includes health service areas) (23.6%) and residential institutions (13.09%) than the other age groups. Eleven percent of injuries occurred at sports and athletics areas (11.0%) for individuals aged 19 years or less compared to 4.6% for individuals aged 20 to 64 years and 0.4% for individuals aged 65 years and older.

Where the activity at the time of the injurious incident was specified, sports activities were the most common activity being performed by individuals aged 19 years or less (19.9%), working for income was the most common activity performed by individuals aged 20 to 64 years (9.4%), and resting, sleeping, eating or engaging in other vital activities (13.3%) was the most common activity being performed by individuals aged 65 years and older (Table 3.7).

Table 3.6: Demographic characteristics and injury mechanism for injury-related hospitalisations of rural residents by age group, linked hospitalisation and mortality data, NSW, 1 January 2010 to 30 June 2014

	0-19 years[1] (n=43,861)		20-64 years[1] (n=101,001)		65+ years[1] (n=68,275)	
	n	%	n	%	n	%
Gender[2]						
Male	28,194	64.3	62,745	62.1	29,380	43.0
Female	15,666	35.7	38,254	37.9	38,895	57.0
Admission year						
2010	9,792	22.3	21,655	21.4	14,221	20.8
2011	9,598	21.9	22,121	21.9	14,788	21.7
2012	9,906	22.6	22,826	22.6	15,453	22.6
2013	9,743	22.2	22,973	22.7	15,846	23.2
2014[3]	4,822	11.0	11,426	11.3	7,967	11.7
Number of comorbidities						
None	43,238	98.6	89,892	89.0	41,053	60.1
One or two	616	1.4	9,681	9.6	22,643	33.2
Three or more	7	0.0	1,428	1.4	4,579	6.7
Injury mechanism						
Transport incidents	7,746	17.7	14,253	14.1	2,644	3.9
Pedestrian	337	0.8	504	0.5	265	0.4
Pedal cyclist	1,528	3.5	1,341	1.3	207	0.3
Motorcyclist	2,682	6.1	4,657	4.6	208	0.3
Motor vehicle occupant	1,744	4.0	4,681	4.6	1,472	2.2
Heavy vehicle occupant	14	0.0	347	0.3	35	0.1
Bus occupant	25	0.1	48	0.0	64	0.1
Other land transport	1,416	3.2	2,675	2.6	393	0.6
Water, air and other and unspecified transport	134	0.3	391	0.4	100	0.1
Falls	13,712	31.3	18,706	18.5	39,463	57.8
Inanimate mechanical forces	6,800	15.5	15,814	15.7	3,625	5.3
Animate mechanical forces	2,517	5.7	4,352	4.3	921	1.3
Drowning and submersion	137	0.3	56	0.1	14	0.0
Other threats to breathing	97	0.2	91	0.1	100	0.1
Electric current, radiation, extreme ambient air temperature and pressure	55	0.1	206	0.2	23	0.0
Smoke, fire and flames	348	0.8	729	0.7	118	0.2
Heat and hot substances	662	1.5	519	0.5	146	0.2
Venomous animals and plants	410	0.9	1,361	1.3	267	0.4
Exposure to forces of nature	26	0.1	100	0.1	118	0.2
Poisoning	884	2.0	1,521	1.5	747	1.1
Intentional self-harm	2,481	5.7	7,644	7.6	543	0.8
Assault	1,189	2.7	5,443	5.4	178	0.3
Other and unspecified injury mechanism	6,663	15.2	29,815	29.5	19,268	28.2

[1] Age was missing for 2 rural residents. [2]Gender was missing for 3 rural residents. [3] Data were only available for 1 January 2014 to 30 June 2014.

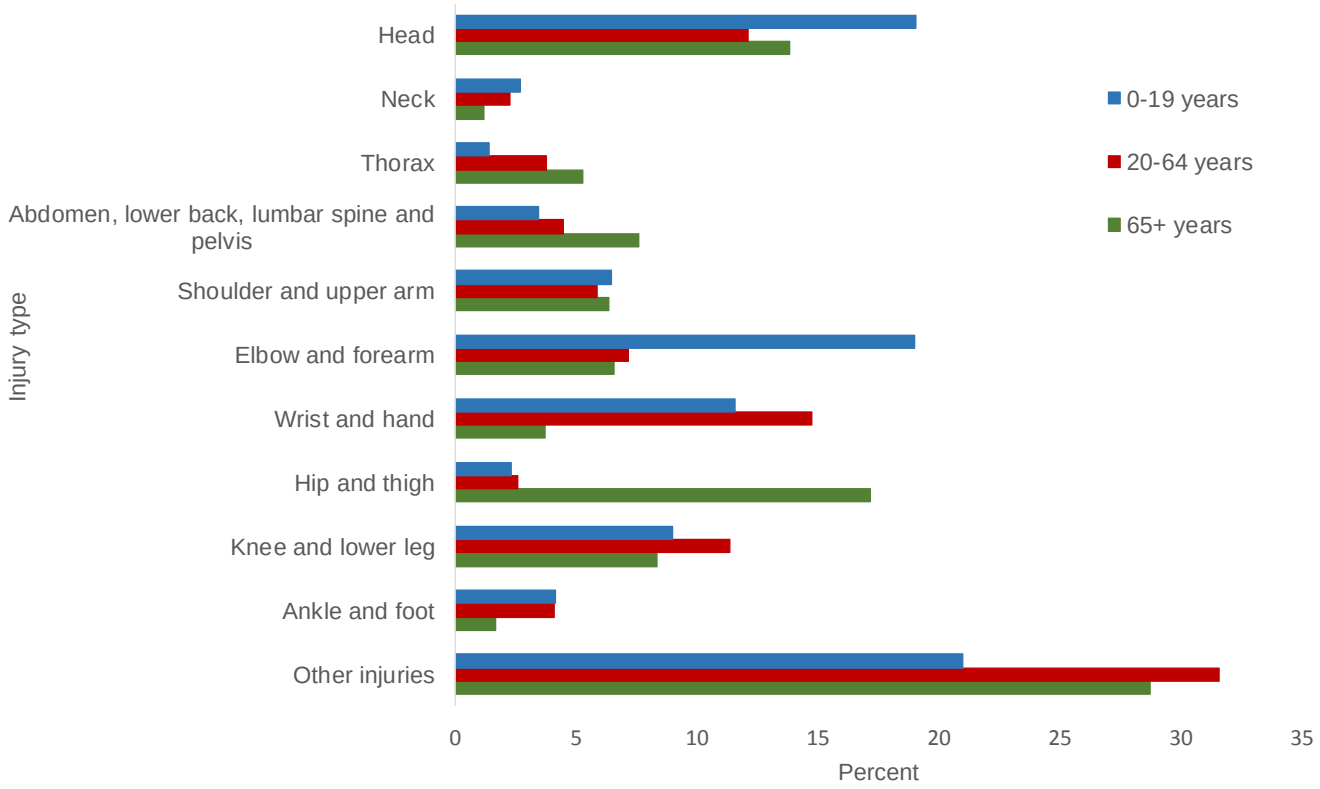
Table 3.7: Place of occurrence and activity at time of injury for injury-related hospitalisations of rural residents by age group, linked hospitalisation and mortality data, NSW, 1 January 2010 to 30 June 2014

	0-19 years[1] (n=43,861)		20-64 years[1] (n=101,001)		65+ years[1] (n=68,275)	
	n	%	n	%	n	%
Place of occurrence						
Home	8,796	20.1	18,356	18.2	25,081	36.7
Residential institution	88	0.2	704	0.7	8,909	13.0
School, other institution and public administrative area	5,084	11.6	17,977	17.8	16143	23.6
Sports and athletics area	4,825	11.0	4,694	4.6	274	0.4
Street and highway	2,927	6.7	9,167	9.1	3,241	4.7
Trade and service area	517	1.2	2,705	2.7	1,403	2.1
Industrial and construction area	212	0.5	1,986	2.0	69	0.1
Farm	1,140	2.6	3,428	3.4	978	1.4
Other specified places	1,857	4.2	3,348	3.3	913	1.3
Unspecified place	18,415	42.0	38,636	38.3	11,264	16.5
Activity at time of incident						
Sports activity	8,747	19.9	8,690	8.6	683	1.0
Leisure activity	3,948	9.0	1,522	1.5	553	0.8
Working for income	824	1.9	9,449	9.4	786	1.2
Other types of work	639	1.5	4,234	4.2	3,809	5.6
Resting, sleeping, eating or engaging in other vital activities	963	2.2	2,987	3.0	9,082	13.3
Engaged in other specified activities	4,326	9.9	9,381	9.3	2,412	3.5
During unspecified activity	24,414	55.7	64,738	64.1	50,950	74.6

[1] Age was missing for 2 rural residents.

Elbow and forearm injuries (19.0%) and head injuries (19.0%) were the most common principal injury types for rural residents aged 19 years or less who were injured and hospitalised. Wrist and hand injuries (14.7%) and head injuries (21.1%) were the most common type of principal injury for individuals aged 20 to 64 years and hip and thigh injuries (17.2%) and head injuries (13.8%) were the most common type of principal injury for individuals aged 65 years and older (Figure 3.6).

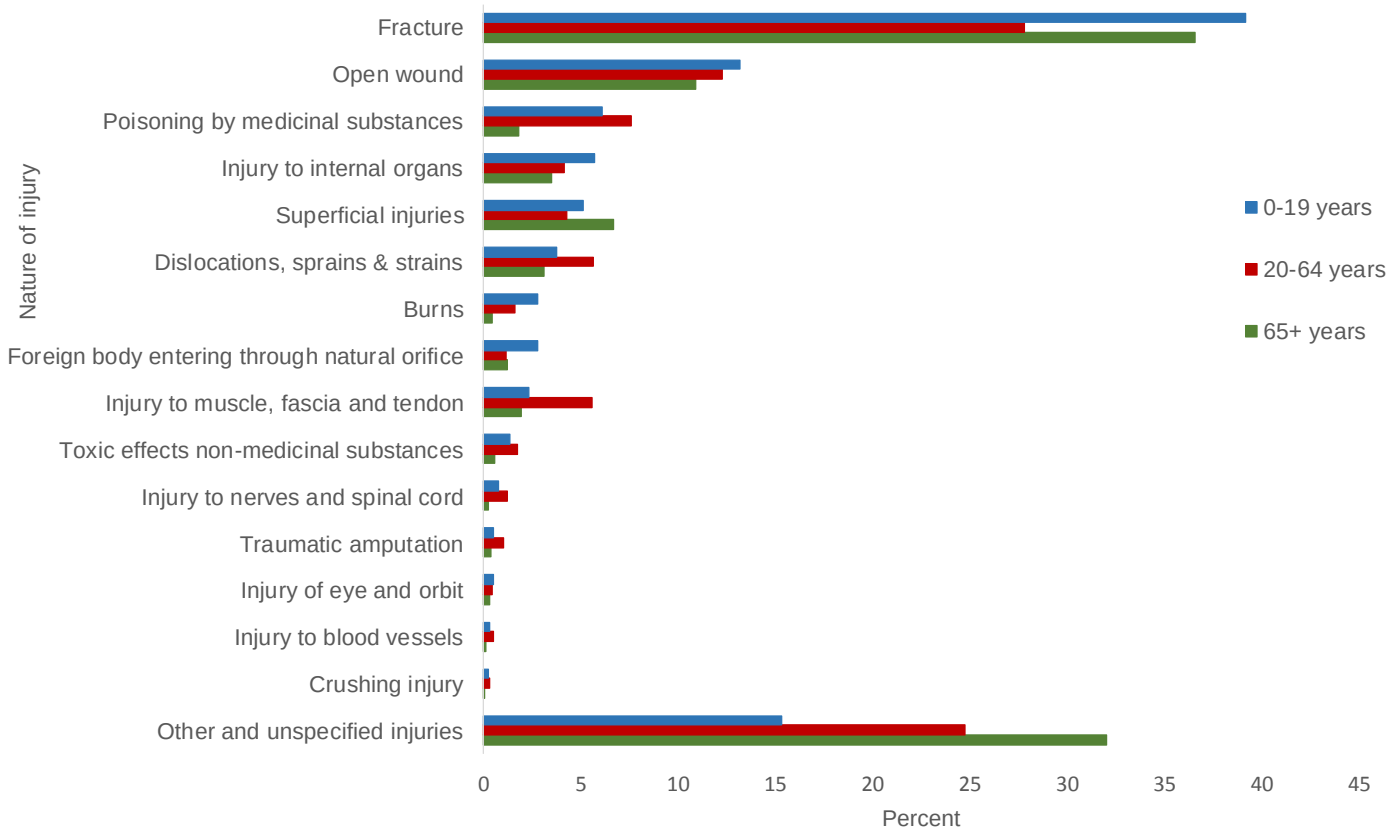
Figure 3.6: Principal injury type for injury-related hospitalisations of rural residents by age group, linked hospitalisation and mortality data, NSW, 1 January 2010 to 30 June 2014[1]



[1]Other injuries include: injures involving multiple body regions, injuries to unspecified parts of trunk, limb or body region, effects of foreign bodies, burns, frostbite, poisoning, complications of trauma and other and unspecified injuries.

Fractures and open wounds were the most common nature of the principal injury for those aged 19 years or less (39.2% and 13.2%, respectively), 20 to 64 years (27.8% and 12.3%, respectively) and 65 years and older (36.6% and 10.9%, respectively). Poisoning by medicinal substances was least common for individuals aged 65 years and older (1.8%) compared to those aged 19 years or less (6.1%) or 20 to 64 years (7.6%). Superficial injuries were most common for individuals aged 65 years and older (6.7%) compared to those aged 19 years or less (5.1%) or 20 to 64 years (4.3%). Injuries to muscle, fascia and tendons were most common for individuals aged 20 to 64 years (5.6%) compared to those aged 19 years or less (2.4%) or 65 years or older (1.9%). Other and unspecified injuries accounted for between 15.3% and 32.1% of the nature of the principal injury by age group (Figure 3.7).

Figure 3.7: Nature of principal injury for injury-related hospitalisations of rural residents by age group, linked hospitalisation and mortality data, NSW, 1 January 2010 to 30 June 2014[1]



[1]Other and unspecified injuries include complications of trauma and other and unspecified effects of trauma.

Older rural residents had significantly different injury severity profile to younger rural residents, with older residents experiencing more severe injuries (χ^2=19534.4, df=4, p<0.0001). There were significant differences between 30-day (χ^2=4301.3, df=2, p<0.0001) and 90-day mortality (χ^2=8442.3, df=2, p<0.0001) after an injury-related hospital admission by age group for rural residents, with individuals aged 65 years and older having the highest proportion of mortality compared to the younger age groups. Twenty-eight day hospital readmission post discharge from an injury-related hospitalisation was significantly different by age group (χ^2=1628.0, df=2, p<0.0001), with those aged 20 to 64 years (12.6%) and those aged 65 years and older (16.8%) having a higher proportion of readmissions within 28 days than individuals aged 19 years or less (7.9%). Mean hospital LOS was highest for those aged 65 years and older (10.9 days) compared to those aged 20 to 64 years (3.7 days) and those aged 19 years or less (2.0 days) (Table 3.8).

Table 3.8: Injury severity and health outcomes of rural residents who had an injury-related hospitalisation by age group, linked hospitalisation and mortality data, NSW, 1 January 2010 to 30 June 2014

	0-19 years[1] (n=43,861)		**20-64 years**[1] (n=101,001)		**65+ years**[1] (n=68,275)	
	n	**%**	**n**	**%**	**n**	**%**
Injury severity						
Minor (ICISS ≤ 0.99)	24,689	56.3	46,393	45.9	15,242	22.3
Moderate (ICISS between 0.942-0.99)	15,928	36.3	43,890	43.5	34,757	50.9
Serious (ICISS <0.942)	3,244	7.4	10,718	10.6	18,276	26.8
Health outcomes						
30-day mortality	80	0.2	420	0.4	2,798	4.1
90-day mortality	86	0.2	730	0.7	5,198	7.6
28-day readmission	3,463	7.9	12,282	12.6	7,850	16.8
	Mean	**(SD)**	**Mean**	**(SD)**	**Mean**	**(SD)**
Hospital length of stay (days)	2.0	4.7	3.7	8.2	10.9	16.7

[1] Age was missing for 2 rural residents.

3.2 Work- and farm-related injury hospitalisations of rural residents

3.2.1 Work-related injury characteristics of rural residents

There were 14,108 (6.6%) hospitalised injuries of rural residents of any age who were indicated to be working at the time of their injury. The majority of work-related injuries occurred to males (83.5%), with just over half the work-related injuries involving individuals aged 25 to 54 years (58.7%). Nearly all of the individuals injured did not have any reported comorbidities (95.5%) (Table 3.9). Contact with inanimate mechanical forces (39.8%), falls (15.3%) and transport incidents (11.9%) were the most common mechanisms of work-related injury (Table 3.10).

Table 3.9: Demographic characteristics of rural residents with a work-related injury hospitalisation, linked hospitalisation and mortality data, NSW, 1 January 2010 to 30 June 2014

Demographic characteristics	n	%
Gender[1]		
Male	11,775	83.5
Female	2,332	16.5
Age group		
0-14	20	0.1
15-19	948	6.7
20-24	1,532	10.9
25-34	2,381	16.9
35-44	2,679	19.0
45-54	3,216	22.8
55-64	2,356	16.7
65-74	717	5.1
75-84	208	1.5
85+	51	0.4
Admission year		
2010	3,072	21.8
2011	3,179	22.5
2012	3,266	23.2
2013	3,116	22.1
2014[2]	1,475	10.5
Number of comorbidities		
None	13,468	95.5
One or two	605	4.3
Three or more	35	0.3

[1]Gender was missing for 1 rural resident.
[2] Data were only available for 1 January 2014 to 30 June 2014.

Table 3.10: Injury mechanism of work-related injury hospitalisations of individuals living in a rural location, linked hospitalisation and mortality data, NSW, 1 January 2010 to 30 June 2014

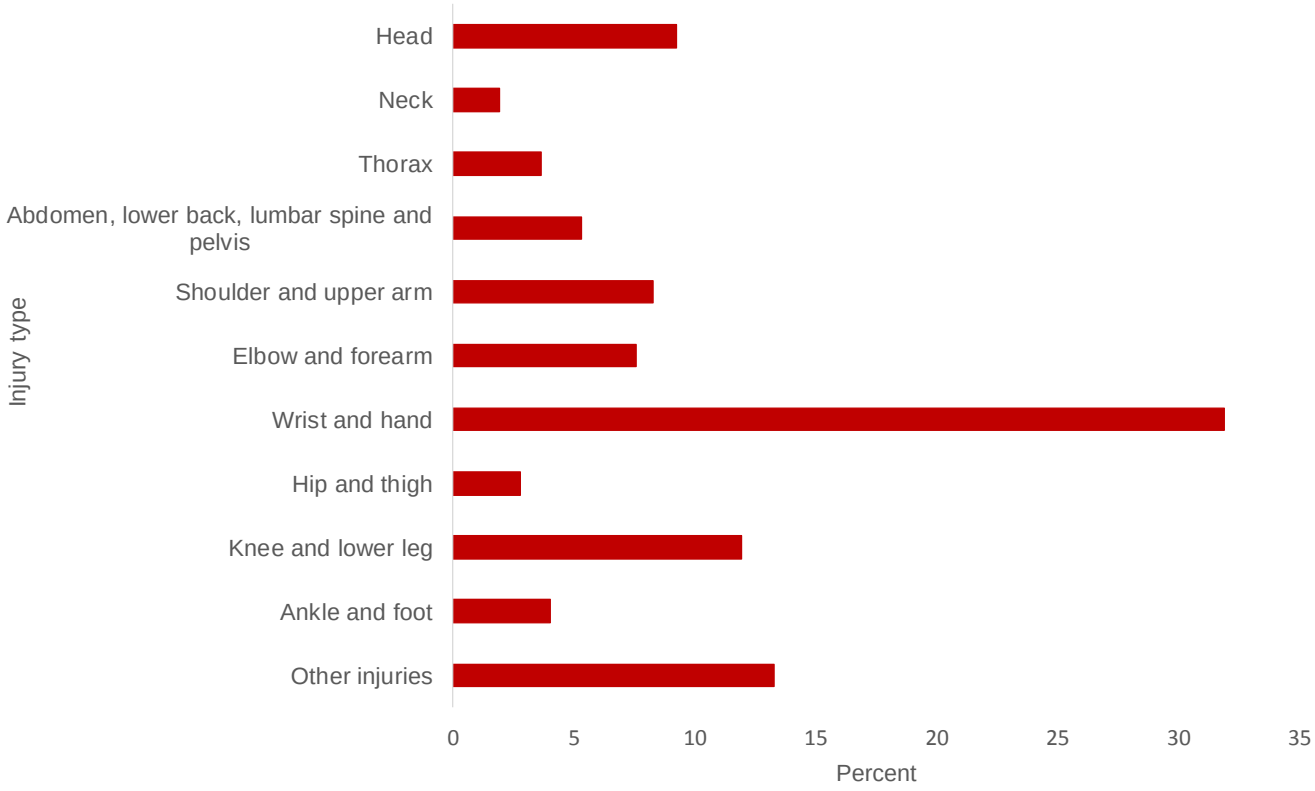
Injury mechanism	n	%
Transport incidents	1,657	11.9
Pedestrian	57	0.4
Pedal cyclist	36	0.3
Motorcyclist	278	2.0
Motor vehicle occupant	303	2.2
Heavy vehicle occupant	262	1.9
Bus occupant	14	0.1
Other land transport	707	5.0
Water, air and other and unspecified transport	51	0.4
Falls	2,159	15.3
Fall on same level	824	5.8
Fall on from steps and stairs	145	1.0
Fall on and from ladder or scaffolding	279	2.0
Fall from, out of or through building or structure	158	1.1
Other fall from one level to another	368	2.6
Other specified fall	93	0.7
Unspecified fall	292	2.1
Inanimate mechanical forces	5,619	39.8
Struck by thrown, projected or falling object	700	5.0
Striking against or struck by other objects	352	2.5
Caught, crushed, jammed or pinched in or between objects	741	5.3
Contact with lifting and transmission devices, not elsewhere classified	188	1.3
Contact with sharp glass	92	0.7
Contact with knife, sword or dagger	451	3.2
Contact with non-powered hand tool	239	1.7
Contact with powered lawnmower	28	0.2
Contact with other powered hand tools and household machinery	627	4.4
Contact with agricultural machinery	296	2.1
Contact with other and unspecified machinery	1,103	7.8
Explosion and rupture of gas cylinder or pressurised tyre, pipe or hose or other materials	40	0.3
Foreign body or objected entering into or through eye or natural orifice or skin	350	2.5
Exposure to other and unspecified inanimate mechanical forces	409	2.9
Animate mechanical forces	716	5.1
Bitten or struck by dog	34	0.2
Bitten or struck by horse	150	1.1
Bitten or struck by cattle	300	2.1
Bitten or struck by sheep	66	0.5
Electric current, radiation, extreme ambient air temperature and pressure	127	0.9
Smoke, fire and flames	112	0.8
Heat and hot substances	128	1.2
Venomous animals and plants	164	1.2
Exposure to forces of nature	28	0.2
Poisoning	182	1.3
Intentional self-harm	35	0.3
Assault	120	0.9
Other and unspecified injury mechanism	3,010	21.3

Where the place of occurrence was specified, industrial and construction areas (15.4%), farms (15.3%) and trade and service areas (9.0%) were the most common location of where the work-related injury occurred (Table 3.11). The wrist and hand (31.9%) and knee and lower leg (12.0%) were the two most common principal diagnoses of injury for work-related injuries of rural residents (Figure 3.8). Fractures (28.1%), open wounds (17.5%) and injury to muscle, fascia and tendons (11.5%) were the most common nature of the principal diagnosis of injury for work-related injuries of rural residents (Figure 3.9).

Table 3.11: Place of occurrence at time of incident for work-related injury hospitalisations of rural residents, linked hospitalisation and mortality data, NSW, 1 January 2010 to 30 June 2014

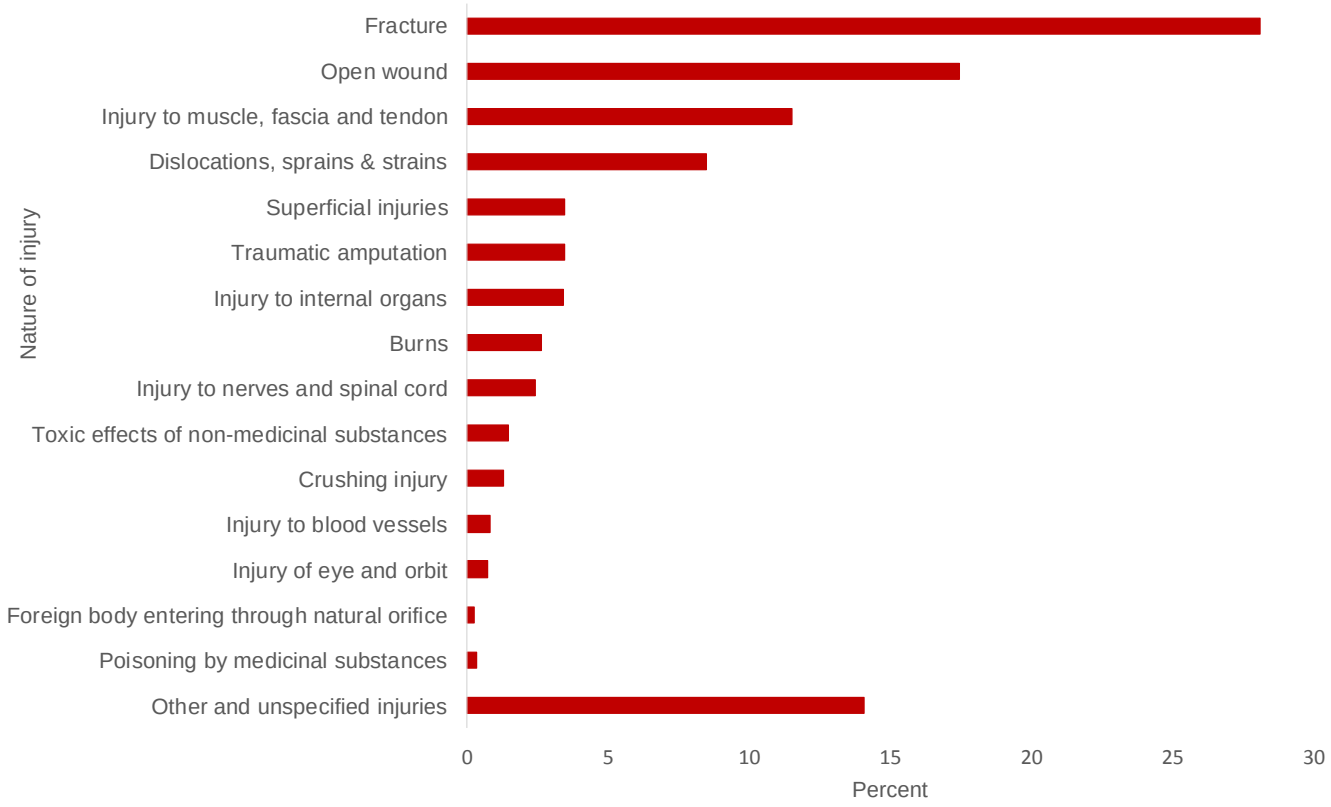
Place of occurrence	n	%
Home	311	2.2
Residential institution	142	1.0
School, other institution and public administrative area	1,213	8.6
Sports and athletics area	207	1.5
Street and highway	742	5.3
Trade and service area	1,265	9.0
Industrial and construction area	2,165	15.4
Farm	2,157	15.3
Other specified places	409	2.9
Unspecified place	5,497	39.0

Figure 3.8: Principal injury type for work-related injury hospitalisations of rural residents, linked hospitalisation and mortality data, NSW, 1 January 2010 to 30 June 2014[1]



[1]Other injuries include: injures involving multiple body regions, injuries to unspecified parts of trunk, limb or body region, effects of foreign bodies, burns, frostbite, poisoning, complications of trauma and other and unspecified injuries.

Figure 3.9: Nature of principal injury for work-related injury hospitalisations of rural residents, linked hospitalisation and mortality data, NSW, 1 January 2010 to 30 June 2014[1]



[1]Other and unspecified injuries include complications of trauma and other and unspecified effects of trauma.

There were 8,320 (59.0%) minor injuries, 4,463 (31.6%) moderate injuries and 1,325 (9.4%) serious injuries sustained by rural residents who were working at the time of their injury. There were 32 (0.2%) deaths within 30 days and 37 (0.3%) deaths within 90 days of the injured worker being hospitalised. There were 1,204 (8.6%) readmissions within 28-days of hospital discharge for work-related injuries. The hospital LOS was 3.0 days (SD 7.3) for work-related injuries of rural residents.

3.2.2 Injury characteristics of rural residents where a farm was the place of occurrence

There were 5,546 (2.6%) injury-related hospitalisations of rural residents where the location of the injurious incident was indicated to be a farm. Over three-quarters (78.7%) of farm-related injuries occurred to males, with 55-64 year olds (16.1%) and 45-54 year olds (15.2%) experiencing the highest proportion of farm-related injuries where the individual was hospitalised. Almost all of the individuals injured did not have any reported comorbidities (94.3%) (Table 3.12). Transport incidents (43.5%), particularly other land transport and motorcycle crashes, contact with inanimate mechanical forces (23.0%) and contact with animate mechanical forces (15.3%) were the most common mechanisms of injury that occurred on a farm (Table 3.13). Other land transport commonly consisted of incidents involving horse riders (45.1%), occupants of special all-terrain or other vehicles designed for off-road use (35.4%), including 268 (24.5%) quad bikes, and occupants of special vehicles used in agriculture (18.2%). Working was the most common activity performed at the time of the injurious incident on the farm (Table 3.14).

Table 3.12: Demographic characteristics of rural residents with a farm-related injury hospitalisation, linked hospitalisation and mortality data, NSW, 1 January 2010 to 30 June 2014

Demographic characteristics	n	%
Gender		
Male	4,364	78.7
Female	1,182	21.3
Age group		
0-14	637	11.5
15-19	503	9.1
20-24	384	6.9
25-34	630	11.4
35-44	679	12.2
45-54	843	15.2
55-64	892	16.1
65-74	583	10.5
75-84	307	5.5
85+	88	1.6
Admission year		
2010	1,104	19.9
2011	1,193	21.5
2012	1,258	22.7
2013	1,350	24.3
2014[1]	641	11.6
Number of comorbidities		
None	5,230	94.3
One or two	293	5.3
Three or more	23	0.4

[1] Data were only available for 1 January 2014 to 30 June 2014.

Table 3.13: Injury mechanism of farm-related injury hospitalisations of individuals living in a rural location, linked hospitalisation and mortality data, NSW, 1 January 2010 to 30 June 2014

Injury mechanism	n	%
Transport incidents	2,411	43.5
Pedestrian	35	0.6
Pedal cyclist	15	0.3
Motorcyclist	1,084	19.6
Motor vehicle occupant	170	3.1
Heavy vehicle occupant	13	0.2
Other land transport	1,094	19.7
Water, air and other and unspecified transport	13	0.2
Falls	535	9.7
Fall on same level	258	4.7
Fall on and from ladder	21	0.4
Fall from, out of or through building or structure	48	0.9
Other fall from one level to another	119	2.1
Other specified fall	41	0.7
Unspecified fall	48	0.9
Inanimate mechanical forces	1,277	23.0
Struck by thrown, projected or falling object	173	3.1
Striking against or struck by other objects	112	2.0
Caught, crushed, jammed or pinched in or between objects	190	3.4
Contact with lifting and transmission devices, not elsewhere classified	36	0.6
Contact with knife, sword or dagger	68	1.2
Contact with non-powered hand tool	48	0.9
Contact with powered lawnmower	18	0.3
Contact with other powered hand tools and household machinery	57	1.0
Contact with agricultural machinery	306	5.5
Contact with other and unspecified machinery	110	2.0
Foreign body or objected entering into or through eye or natural orifice or skin	54	1.0
Exposure to other and unspecified inanimate mechanical forces	105	1.9
Animate mechanical forces	851	15.3
Electric current, radiation, extreme ambient air temperature and pressure	4	0.1
Smoke, fire and flames	11	0.2
Heat and hot substances	64	1.2
Venomous animals and plants	10	0.2
Exposure to forces of nature	101	1.8
Poisoning	12	0.2
Intentional self-harm	56	1.0
Assault	8	0.1
Other and unspecified injury mechanism	10	0.2

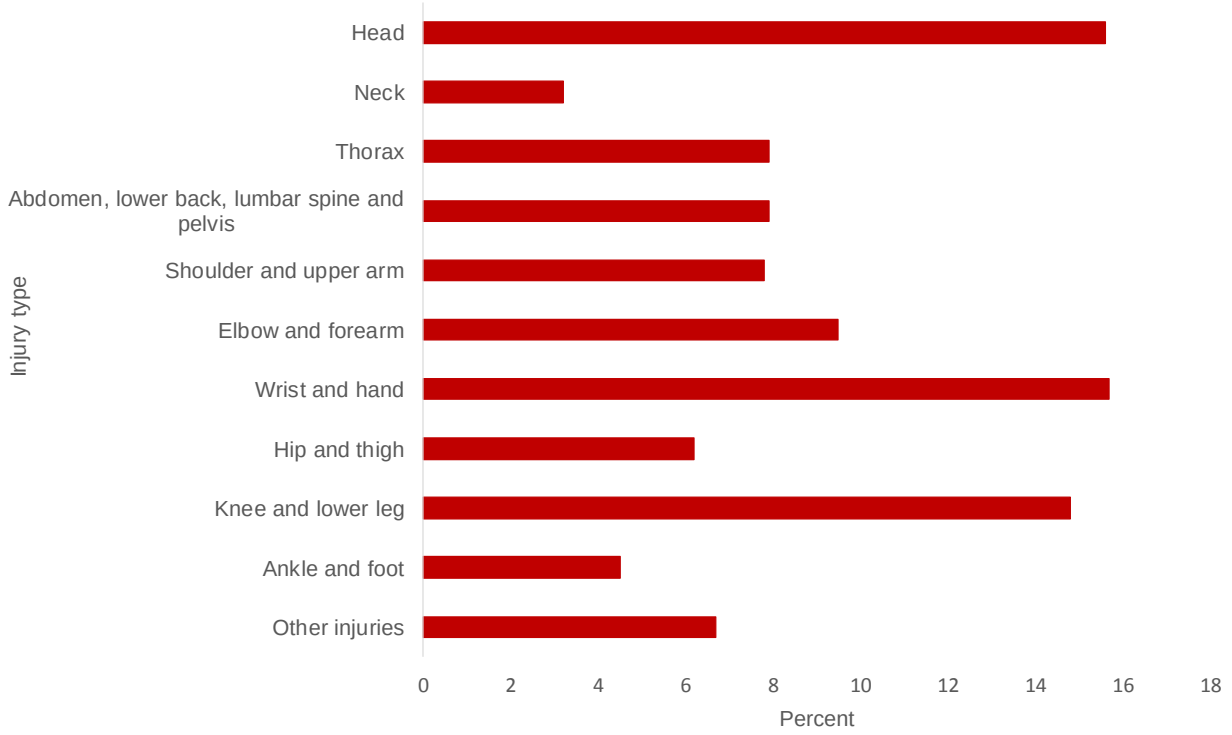
Table 3.14: Activity at time of incident for farm-related injury hospitalisations of rural residents, linked hospitalisation and mortality data, NSW, 1 January 2010 to 30 June 2014

Activity at time of incident	n	%
Sports activity	451	8.1
Leisure activity	247	4.5
Working for income[1]	2,060	37.1
Other types of work	424	7.7
Resting, sleeping, eating or engaging in other vital activities	23	0.4
Engaged in other specified activities	190	3.4
During unspecified activity	2,151	38.8

[1] Working for income was only identified using the activity at time of incident variable.

The wrist and hand (15.7%), head (15.6%) and knee and lower leg (14.8%) injuries were the most common principal diagnoses of injury for work-related injuries of rural residents (Figure 3.10).

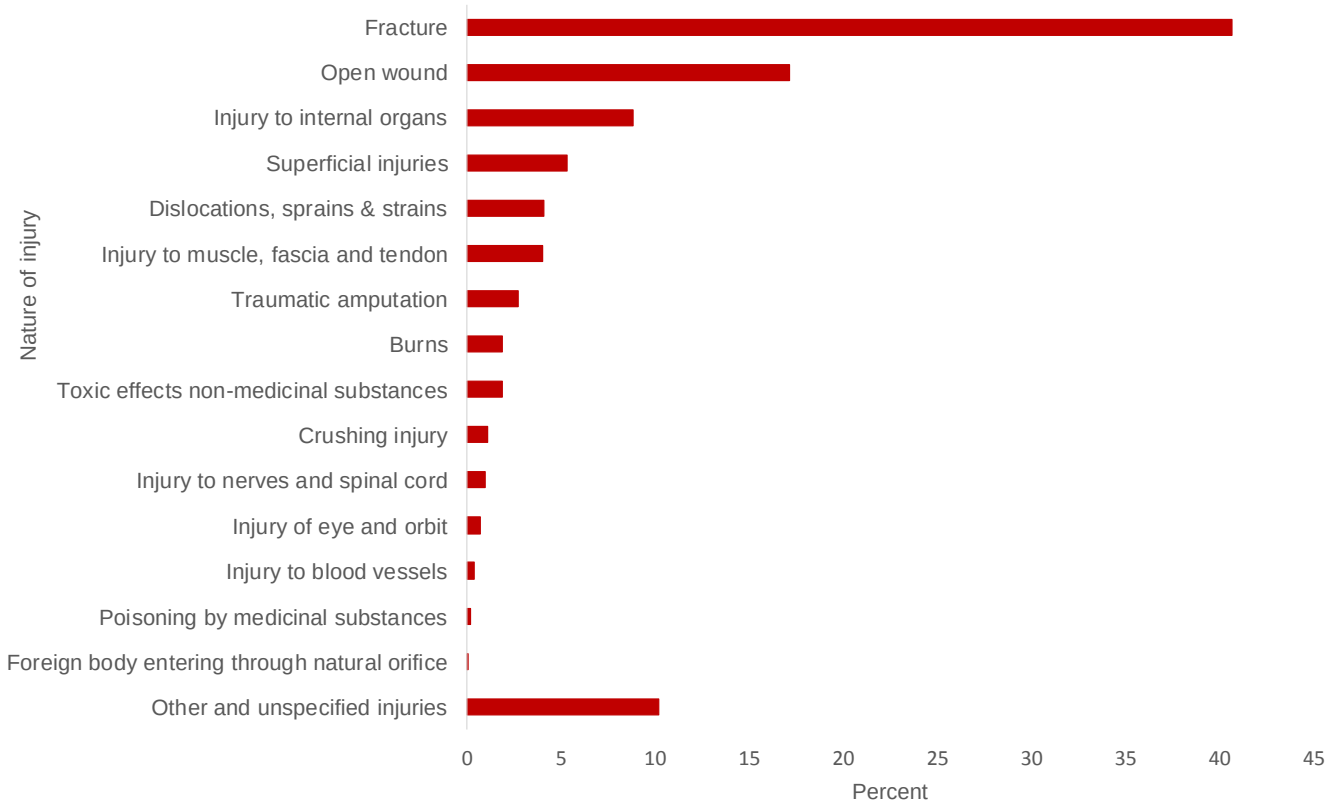
Figure 3.10: Principal injury type for farm-related injury hospitalisations of rural residents, linked hospitalisation and mortality data, NSW, 1 January 2010 to 30 June 2014[1]



[1]Other injuries include: injures involving multiple body regions, injuries to unspecified parts of trunk, limb or body region, effects of foreign bodies, burns, frostbite, poisoning, complications of trauma and other and unspecified injuries.

Fractures (40.7%), open wounds (17.25%) and injury to internal organs (8.8%) were the most common nature of the principal diagnosis of injury for rural residents injured on a farm (Figure 3.11).

Figure 3.11: Nature of principal injury for farm-related injury hospitalisations of rural residents, linked hospitalisation and mortality data, NSW, 1 January 2010 to 30 June 2014[1]



[1]Other and unspecified injuries include complications of trauma and other and unspecified effects of trauma.

There were 2,067 (37.3%) minor injuries, 2,323 (41.9%) moderate injuries and 1,156 (20.8%) serious injuries sustained by rural residents who were injured on a farm. There were 20 (0.4%) deaths within 30 days and 26 (0.5%) deaths within 90 days following injuries of rural residents on farms. There were 519 (9.6%) readmissions within 28-days of hospital discharge for farm-related injuries. The hospital LOS was 4.1 days (SD 8.9) for farm-related injuries of rural residents.

3.3 Demographic and injury characteristics associated with hospitalised injury and mortality by geographic location

Compared to urban residents, the multivariable logistic regression identified that hospitalised injuries of rural residents were less likely to involve females compared to males (OR 0.96; 95%CI: 0.94-0.97), those aged 15 to 24 years (OR 0.94; 95%CI 0.92-0.96), 25 to 44 years (OR 0.86; 95%CI: 0.84-0.87) and individuals aged 85 years and older (OR 0.88; 95%CI: 0.86-0.90) compared to those aged 14 years or less, and were less likely to involve individuals with comorbidities than no comorbidities.

Compared to urban residents, hospitalised injuries of rural residents were more likely to involve venomous animals and plants (OR 1.41; 95%CI: 1.32-1.52) than transport incidents. Almost all other injury mechanisms had a lower odds of resulting in a hospitalised injury of rural residents compared to urban residents. Compared to the home, the farm was 12 times more likely (OR 12.69; 95%CI: 11.72-13.75) to be the place of occurrence of the injury for rural residents compared to urban residents. Compared to the home, all other places of occurrence were associated with a lower odds of hospitalised injury of rural residents compared to urban residents.

Hospitalised injuries to the hip and thigh (OR 1.13; 95%CI: 1.10-1.16), injuries involving the abdomen, lower back, lumbar spine and pelvis (OR 1.05; 95%CI: 1.02-1.08) and injuries involving the knee and lower leg (OR 1.03; 95%CI: 1.01-1.05) all had a higher likelihood of being sustained by rural rather than urban residents compared to head injuries. In contrast, injuries to the wrist and hand (OR 0.81; 95%CI: 0.79-0.83) and injuries to the thorax (OR: 0.96; 95%CI: 0.93-0.99) had a lower likelihood of being sustained by rural compared to urban residents compared to head injuries (Table 3.15).

Table 3.15: Association of demographic and injury characteristics of injury-related hospitalisations for urban and rural residents, linked hospitalisation and mortality data, NSW, 1 January 2010 to 30 June 2014

Characteristics	OR[1]	95% CI
Gender		
Male	1	
Female	0.96*	0.94-0.97
Age group		
0-14	1	
15-24	0.94*	0.92-0.96
25-44	0.86*	0.84-0.87
45-64	1.08*	1.06-1.10
65-84	1.12*	1.10-1.14
85+	0.88*	0.86-0.90
Number of comorbidities		
None	1	
One or two	0.90*	0.88-0.91
Three or more	0.76*	0.73-0.78
Injury mechanism		
Transport incidents	1	
Water, air and other and unspecified transport	0.73*	0.66-0.81
Falls	0.56*	0.55-0.58
Inanimate mechanical forces	0.66*	0.64-0.68
Animate mechanical forces	0.82*	0.79-0.85
Drowning and submersion or other threats to breathing	0.62*	0.55-0.69
Electric current, radiation, extreme air temperature and pressure	0.71*	0.61-0.83
Smoke, fire and flames or heat and hot substances	0.63*	0.60-0.67
Venomous animals and plants	1.41*	1.32-1.52
Exposure to forces of nature	1.05	0.88-1.26
Poisoning	0.47*	0.45-0.50
Intentional self-harm	0.57*	0.55-0.59
Assault	0.74*	0.72-0.77
Other and unspecified injury mechanism	0.48*	0.47-0.50
Place of occurrence		
Home	1	
Residential institution	0.90*	0.87-0.92
School, other institution and public administrative area	0.97***	0.95-1.00
Sports and athletics area	0.97***	0.94-0.99
Street and highway	0.54*	0.52-0.55
Trade and service area	0.72*	0.70-0.75
Industrial and construction area	1.18*	1.11-1.25
Farm	12.69*	11.72-13.75
Other specified places	0.79*	0.76-0.82
Unspecified place	0.90*	0.89-0.92
Principal injury type		
Head	1	
Neck	1.03	0.99-1.08
Thorax	0.96**	0.93-0.99
Abdomen, lower back, lumbar spine and pelvis	1.05**	1.02-1.08
Shoulder and upper arm	1.00	0.97-1.02
Elbow and forearm	1.02	0.99-1.04
Wrist and hand	0.81*	0.79-0.83
Hip and thigh	1.13*	1.10-1.16
Knee and lower leg	1.03**	1.01-1.05

Characteristics	OR[1]	95% CI
Ankle and foot	1.00	0.97-1.03
Other injuries	1.19*	1.15-1.22
Work-related injury		
No	1	
Yes	0.98	0.96-1.00

[1] Urban injury is the reference group. *p<0.0001; **p<0.01; ***p<0.05.

The multivariate cox regression model identified that the demographic and injury-related predictors of mortality were almost identical at three months post the injury admission for both rural and urban residents of NSW. For both rural and urban residents, females, compared to males, had a significantly lower risk of mortality at 3 months post the injury hospital admission, as did individuals aged 25 to 44 years compared to those aged 14 years or less, and individuals who fell, contacted either inanimate or animate mechanical forces compared to those that were injured in transport incidents.

Individuals who were injured in schools, other institutions and public administrative areas, in sports and athletic areas or in trade and service areas had a significantly lower risk of mortality at 3 months post the injury hospital admission compared to individuals that were injured at home. All injury types, except for neck injuries, were associated with a significantly lower risk of mortality at 3 months post injury hospitalisation compared to head injuries. Both rural and urban residents had a higher risk of mortality at 3 months post injury hospitalisation if they had comorbidities, if they sustained either moderate or severe injuries compared to minor injuries, if they were hospitalised following a near-drowning or other threats to breathing or intentional self-harm compared to transport incidents, and if they sustained their injury in a residential institution compared to the home (Table 3.16).

Table 3.16: Predictors of injury-related mortality at 3 months following hospitalisation for urban and rural residents, linked hospitalisation data from 1 January 2010 to 30 June 2014 and mortality data from 1 January 2000 to 31 March 2015, NSW

	Rural		Urban	
Characteristics	**Hazard ratio**	**95% CI**	**Hazard ratio**	**95% CI**
Gender				
Male	1		1	
Female	0.82*	0.78-0.86	0.82*	0.78-0.86
Age group				
0-14	1		1	
15-24	1.15	0.79-1.68	1.16	0.80-1.69
25-44	0.68***	0.46-0.99	0.68***	0.47-1.00
45-64	0.78	0.55-1.10	0.78	0.55-1.10
65-84	0.79	0.56-1.12	0.80	0.56-1.12
85+	0.95	0.68-1.35	0.96	0.68-1.35
Number of comorbidities				
None	1		1	
One or two	1.58*	1.49-1.68	1.58*	1.49-1.68
Three or more	2.27*	2.10-2.45	2.27*	2.09-2.45
Injury severity				
Minor (ICISS ≤ 0.99)	1		1	
Moderate (ICISS between 0.942-0.99)	1.36*	1.23-1.51	1.36*	1.23-1.51
Serious (ICISS <0.942)	2.79*	2.50-3.10	2.78*	2.50-3.10
Injury mechanism				
Transport incidents	1		1	
Water, air and other and unspecified transport	0.66	0.24-1.78	0.66	0.24-1.78
Falls	0.63*	0.52-0.76	0.63*	0.52-0.76
Inanimate mechanical forces	0.54*	0.42-0.71	0.55*	0.42-0.71
Animate mechanical forces	0.35**	0.20-0.62	0.35**	0.20-0.63
Drowning and submersion or other threats to breathing	1.61***	1.07-2.42	1.61***	1.07-2.42
Electric current, radiation, extreme air temperature and pressure	0.76	0.19-3.10	0.77	0.19-3.11
Smoke, fire and flames or heat and hot substances	0.77	0.51-1.16	0.77	0.51-1.16
Venomous animals and plants	0.85	0.37-1.95	0.85	0.37-1.96
Exposure to forces of nature	0.77	0.41-1.45	0.77	0.41-1.45
Poisoning	0.74	0.54-1.01	0.74	0.54-1.01
Intentional self-harm	1.40***	1.08-1.81	1.39**	1.07-1.81
Assault	0.66***	0.47-0.93	0.66***	0.47-0.92
Other and unspecified injury mechanism	0.72**	0.57-0.90	0.71**	0.57-0.89
Place of occurrence				
Home	1		1	
Residential institution	1.35*	1.26-1.44	1.35*	1.26-1.44
School, other institution and public administrative area	0.71*	0.60-0.83	0.71*	0.61-0.83
Sports and athletics area	0.48***	0.25-0.90	0.48***	0.25-0.90
Street and highway	1.02	0.86-1.21	1.02	0.86-1.21
Trade and service area	0.56*	0.42-0.74	0.56*	0.42-0.74

	Rural		Urban	
Characteristics	**Hazard ratio**	**95% CI**	**Hazard ratio**	**95% CI**
Industrial and construction area	1.63	0.72-3.68	1.76	0.75-4.15
Farm	0.69	0.47-1.03	0.71	0.47-1.06
Other specified places	0.83	0.62-1.10	0.83	0.62-1.10
Unspecified place	0.71*	0.64-0.79	0.71*	0.64-0.79
Principal injury type				
Head	1		1	
Neck	1.07	0.88-1.29	1.07	0.88-1.29
Thorax	0.72*	0.63-0.82	0.72*	0.63-0.82
Abdomen, lower back, lumbar spine and pelvis	0.72*	0.65-0.80	0.72*	0.65-0.80
Shoulder and upper arm	0.81**	0.71-0.92	0.81**	0.71-0.92
Elbow and forearm	0.60*	0.51-0.70	0.60*	0.51-0.70
Wrist and hand	0.53*	0.41-0.69	0.53*	0.41-0.69
Hip and thigh	0.73*	0.67-0.79	0.73*	0.67-0.79
Knee and lower leg	0.66*	0.57-0.76	0.66*	0.57-0.76
Ankle and foot	0.52**	0.36-0.76	0.52**	0.36-0.76
Other injuries	0.84***	0.72-0.97	0.84***	0.72-0.97
Work-related injury				
No	-	-	1	
Yes	-	-	0.91	0.64-1.29

*p<0.0001; **p<0.01; ***p<0.05.

3.4 Hospital-based treatment cost

During 1 January 2010 to 30 June 2014, the total hospital costs of injury-related hospital admissions and any subsequent rehabilitation or SNAP-related hospital treatment within the same period of care (See Section 2.10) for urban and rural residents were $4.4 billion and $1.7 billion, respectively. The mean cost per injured individual who resided in an urban location was $9,003 (median $2,933) and the mean cost per injured individual who resided in a rural location was $8,134 (median $2,644). Annually, acute injury treatment ($1.1 billion), rehabilitation ($130 million) and SNAP care ($57 million) cost $1.3 billion ($990 million for urban and $384 million for rural residents).

The total and average hospital costs for acute care for injury-related hospitalisations were $3.8 billion and $7,707 (median $2,897) for urban residents and $1.5 billion and $7,191 (median $2,607) for rural residents. For rehabilitation episodes of care that were in the same period of care as the index injury admission, the total and average hospital costs for urban residents were $452 million and $13,529 (median $10,704) and for rural residents the total and average costs of rehabilitation were $136 million and $13,651 (median $10,168). For SNAP episodes of care that were within the same period of care as the index injury admission, the total and average costs for urban residents were $190 million and $16,687 (median $9,713) and for rural residents the total and average costs of SNAP care were $65 million and $16,564 (median $8,904).

For both urban and rural residents, females and individuals aged 65 years and older had higher mean and median total hospital costs than males and younger individuals, respectively. Injuries to the hip and thigh ($893 million and $345 million), knee and lower leg ($512 million and $194 million), and head injuries ($482 million and $166 million) represented the highest total principal injury costs for both urban and rural residents, respectively. Injuries to the hip and thigh also had the highest mean ($25,968 and $22,488) and median costs ($19,254 and $14,832) for both urban and rural residents, respectively (Table 3.17).

Fall-related injuries and transport incidents were the costliest mechanisms of injury for both urban and rural residents. Motor vehicle occupants ($146 million and $89 million) and motorcyclists ($101 million and $60 million) represented the costliest type of transport incidents for both urban and rural residents, respectively (Table 3.18).

Fractures and open wounds were the most common principal nature of injury for both urban and rural residents, with fractures representing the highest total hospital costs. Injury to internal organs represented the second highest total hospital costs for urban residents and the

third highest total hospital costs for rural residents, despite having the seventh and sixth highest number of injury-related hospitalisations for these types of injuries for urban and rural residents, respectively. Total hospital costs varied by injury severity, with the most serious injuries accounting for the highest cost for both urban and rural residents, even though they represented the smallest proportion of injuries (15% for both urban and rural residents) (Table 3.19).

For rural residents, total hospital costs for work-related hospitalised injuries were $83 million, consisting of around $79 million for acute care, $3 million for rehabilitation and $397,300 for SNAP care. For injuries that occurred on a farm involving rural residents, total hospital costs were $39 million, comprising $37 million for acute care costs, $2 million for rehabilitation and $329, 610 for SNAP care.

Table 3.17: Total hospital costs by demographic and principal injury characteristics of individuals with an injury-related hospitalisation by urban and rural location, linked hospitalisation and mortality data, NSW, 1 January 2010 to 30 June 2014

	Urban (n=494,829)[1]				Rural (n=212,794)[1]			
	n[1]	Mean ($)	Median ($)	Total ($)	n[1]	Mean ($)	Median ($)	Total ($)
Gender[2]								
Male	272,684	7,755	2,721	2,114,613,722	120,303	7,203	2,523	866,520,776
Female	222,145	10,537	3,110	2,340,832,864	92,491	9,346	2,987	864,421,858
Age group[3]								
0-4	20,778	2,826	1,262	58,720,107	8,005	3,066	1,262	24,541,169
5-9	17,949	2,653	1,262	47,616,477	8,439	2,893	1,210	24,410,581
10-14	20,506	3,339	1,441	68,478,276	10,833	3,102	1,262	33,608,049
15-19	31,286	4,571	2,483	142,995,117	16,555	4,456	2,211	73,776,336
20-24	33,235	4,877	2,523	162,091,805	13,422	4,817	2,449	64,655,221
25-34	56,858	5,229	2,523	297,330,602	19,439	5,089	2,483	98,920,079
35-44	52,610	5,932	2,607	312,093,643	21,173	5,664	2,523	119,914,366
45-54	51,396	7,147	2,765	367,337,956	23,025	6,583	2,607	151,579,640
55-64	47,971	9,391	3,173	450,474,723	23,725	8,371	3,121	198,590,704
65-74	46,607	12,687	4,279	591,325,872	23,675	11,365	3,964	269,062,117
75-84	58,621	16,330	7,048	957,302,042	24,545	14,438	5,866	354,385,027
85+	57,018	17,533	9,530	999,702,179	19,960	15,907	7,651	317,501,650
Principal injury type								
Head	70,651	6,831	1,267	482,637,604	30,009	5,541	1,267	166,294,692
Neck	9,470	10,450	1,147	98,959,433	4,283	8,403	1,147	35,991,242
Thorax	18,784	10,317	3,750	193,791,117	8,018	9,201	3,671	73,773,964
Abdomen, lower back, lumbar spine and pelvis	25,463	13,693	5,456	348,674,891	11,206	11,952	4,423	133,939,536
Shoulder and upper arm	30,827	7,843	2,875	241,771,325	12,937	6,924	2,875	89,580,375
Elbow and forearm	45,765	5,631	3,110	257,718,906	19,893	4,533	2,140	90,171,707
Wrist and hand	61,413	3,504	2,999	215,196,991	22,484	3,689	2,999	82,947,806
Hip and thigh	34,402	25,968	19,254	893,353,193	15,351	22,488	14,832	345,217,098
Knee and lower leg	49,350	10,377	4,967	512,094,439	21,072	9,228	4,453	194,450,803
Ankle and foot	16,013	5,931	2,483	94,971,545	7,093	5,226	2,442	37,069,003
Other injuries	132,698	8,412	2,483	1,116,301,481	60,452	7,966	2,475	481,532,087

[1]Where valid AR-DRG was present. [2]Gender was missing for 7 urban and 4 rural residents. [3]Age was missing for 1 urban and 2 rural residents.

Table 3.18: Total hospital costs by injury mechanism for individuals with an injury-related hospitalisation by urban and rural location, linked hospitalisation and mortality data, NSW, 1 January 2010 to 30 June 2014

	Urban (n=494,829)[1]				Rural (n=212,794)[1]			
	n[1]	**Mean ($)**	**Median ($)**	**Total ($)**	**n**[1]	**Mean ($)**	**Median ($)**	**Total ($)**
Injury mechanism								
Transport incidents	44,667	72,582	18,377	421,597,114	24,642	68,137	18,364	216,149,711
Pedestrian	4,625	19,206	3,253	88,829,093	1,106	14,118	2,924	15,614,834
Pedal cyclist	8,968	5,794	2,573	51,957,726	3,076	4,969	2,211	15,284,716
Motorcyclist	10,256	9,893	2,999	101,462,337	7,547	7,992	2,875	60,317,715
Motor vehicle occupant	17,162	8,527	1,175	146,343,615	7,896	11,378	2,103	89,837,829
Heavy vehicle occupant	413	8,882	2,349	3,668,257	396	10,272	2,528	4,067,662
Bus occupant	749	12,173	3,154	9,117,843	137	12,882	3,317	1,764,787
Other land transport	2,494	8,107	2,875	20,218,243	4,484	6,526	2,406	29,262,169
Water, air and other and unspecified transport	1,345	7,708	2,721	10,367,355	624	7,889	2,607	4,922,504
Falls	180,638	12,672	4,236	2,288,983,488	71,866	10,884	3,597	782,220,559
Inanimate mechanical forces	58,897	3,928	2,523	231,351,887	26,237	4,078	2,523	106,995,229
Animate mechanical forces	12,792	4,167	2,500	53,306,234	7,790	4,053	2,211	31,575,969
Drowning and submersion	479	6,983	1,294	3,344,701	207	5,097	1,294	1,055,039
Other threats to breathing	494	4,207	1,426	2,078,233	287	5,257	1,441	1,508,658
Electric current, radiation, extreme ambient air temperature and pressure	478	4,117	1,294	1,968,005	284	3,378	1,294	959,356
Smoke, fire and flames	1,519	9,365	1,905	14,225,216	1,195	8,811	1,905	10,528,558
Heat and hot substances	3,099	6,906	1,905	21,400,258	1,327	6,983	1,905	9,266,973
Venomous animals and plants	1,756	2,365	1,262	4,153,374	2,038	2,073	1,262	4,224,175
Exposure to forces of nature	282	6,939	1,294	1,956,933	244	5,778	1,294	1,409,899
Poisoning	7,880	4,663	1,262	36742217	3,150	3,965	1,262	12,489,017
Intentional self-harm	23,508	8,239	2,523	193,680,170	10,669	6,587	2,408	70,277,131
Assault	14,488	4,963	1,441	71,903,383	6,810	4,225	1,267	28,770,858
Other and unspecified injury mechanism	142,514	7,707	2,999	1,098,412,355	55,428	8,094	2,999	448,614,675

[1]Where valid AR-DRG was present.

Table 3.19: Total hospital costs by nature of principal injury and injury severity for individuals with an injury-related hospitalisation by urban and rural location, linked hospitalisation and mortality data, NSW, 1 January 2010 to 30 June 2014

	Urban (n=494,829)[1]				Rural (n=212,794)[1]			
	n[1]	Mean ($)	Median ($)	Total ($)	n[1]	Mean ($)	Median ($)	Total ($)
Nature of principal injury								
Fracture	171,023	12,809	4,061	2,190,597,577	70,231	11,490	3,926	806,947,004
Open wound	61,101	4,333	2,201	264,741,806	25,619	4,200	2,140	107,605,451
Poisoning by medicinal substances	27,263	6,502	1,382	177,269,730	11,555	5,636	1,382	65,120,650
Superficial injuries	24,258	4,531	1,175	109,908,760	11,110	4,102	1,175	45,573,588
Dislocations, sprains and strains	23,533	4,907	2,875	115,476,094	9,448	5,103	2,721	48,216,265
Injury to muscle, fascia and tendons	19,278	4,953	2,999	95,482,072	7,982	4,841	2,999	38,639,191
Injury to internal organs	18,117	17,218	4,373	311,934,897	9,129	10,948	2,097	99,941,800
Burns	5,683	8,788	1,905	49,942,651	3,103	9,192	1,905	28,523,085
Foreign body entering through natural orifice	6,455	2,721	1,267	17,566,701	3,225	2,327	1,267	7,504,771
Injury to nerves and spinal cord	4,973	11,505	3,110	57,215,568	1,746	13,371	3,110	23,345,987
Toxic effects of non-medicinal substances	3,847	4,475	1,262	17,216,212	2,750	3,270	1,262	8,992,480
Traumatic amputation	2,715	5,873	2,523	15,946,262	1,494	5,777	2,523	8,630,370
Injury to blood vessels	2,006	8,697	2,647	17,446,053	748	8,786	3,245	6,571,707
Injury of eye and orbit	1,720	5,749	2,523	9,888,887	879	4,306	2,186	3,785,003
Crushing injury	732	4,604	2,523	3,370,120	466	4757	2,454	2,216,791
Other and unspecified injuries	122,132	8,200	2,328	1,001,467,535	53,313	8,053	2,365	429,354,170
Injury severity								
Minor	208,158	4,376	2,523	910,847,218	86,027	3,980	2,483	342,412,712
Moderate	212,269	7,804	2,442	1,656,619,512	94,544	7,144	2,408	675,400,127
Serious	74,409	25,373	14,419	1,888,004,195	32,227	22,129	11,119	713,155,473

[1]Where valid AR-DRG was present.

4. Discussion

Worldwide, it is estimated that injury mortality will rise and that by 2020 injuries will be either the first or second leading cause of years of life lost [29]. Traumatic injury can leave many individuals experiencing severe disabilities that can affect their health-related quality of life and often require access to long-term care. In NSW, during 1 January 2010 to 30 June 2014, there were 496,325 (70.0%) injury hospitalisations of NSW residents from urban locations and 213,139 (30.0%) injury hospitalisations of residents from rural locations. This study identified that, during 2010 to 2013, the 30.0% of injury hospitalisations of NSW rural residents roughly equated to the proportion of residents living in rural NSW during that timeframe (29.8%).

There were similar overall injury hospitalisation rates between rural (2061.2 per 100,000 population) and urban (2062.9 per 100,000 population) residents of NSW during 2010 to 2013. While previous studies have found higher injury hospitalisation rates for rural compared to urban residents [8, 10], these studies used differing geographical definitions of urban and rural locations using the enhanced Accessibility/Remoteness Index of Australia (ARIA+) classification system, where 'major cities' and 'inner regional' were considered to represent urban residents, rather than using only 'major cities' to represent urban residents as in the current study.

The injury hospitalisation rates for rural residents were found to be significantly increasing by 2.96% each year during 2010 to 2013 and males living in rural areas had higher injury-related hospitalisation rates than their urban counterparts. Similarly, rural males have been found to have higher injury hospitalisation rates in other studies [8, 30, 31]. This is likely to be due to males living in rural areas more likely to be employed in high-risk industries, such as agriculture, forestry and logging, and mining [32], with these industries shown to have higher rates of compensated work-related injuries compared to the all-industry work-related compensated injury average in NSW [11].

Hospitalised injury incidence rates increased with age to 20-24 years then declined, then increased from around 50+ years for both rural and urban residents. Similarly, high rates of hospitalised injury for children and young people and for those aged 55 years and older have been identified in other studies of rural and urban injuries [8, 33]. Children and young people living in rural areas had higher injury-related hospitalisations than their urban counterparts. For children and young people, their home and recreation area is also often a rural workplace and their high rate of hospitalised injury is often attributed to the dual nature of the location of the injurious incident as both a worksite and an area for recreation [8, 13, 34, 35]. Young people can be injured

while completing work tasks, as a bystander to the work activities of others or while participating in recreational activities [36]. Ensuring that any work tasks are appropriate to the capabilities of the young person, both physically and developmentally, are essential to ensure that tasks are able to be safety performed [36]. For young children (aged less than five years), the creation of safe play areas on rural properties is advocated as a mechanism to try to separate children from occupational hazards and to reduce the rate of childhood injury on farms [37].

The annual total hospital cost of injury involving rural residents was $384 million and for the whole 4.5 year period it was $990 million. The total hospital cost for urban residents per year was naturally higher (i.e. $990 million), with more residents of NSW living in urban areas. On a per capita population basis, this roughly works out at $1,804 for every person living in rural NSW and $1,996 per person living in urban NSW. Similar to a previous study conducted in the United States that examined the cost of injury-related hospitalisations [33], this study identified that mean hospital costs were higher for urban residents compared to rural residents. Like previous studies of injury-related hospitalisation costs [33, 38], this study also found that motor vehicle crashes and falls represented the highest costs.

Falls and transport incidents were the two most common injury mechanisms identified for both rural and urban residents in the current study, as has been found when examining urban and rural hospitalised injuries elsewhere [33]. From the SARs, rural residents were shown to have an increased likelihood of being hospitalised for certain types of injury mechanisms compared to urban residents, in particular for transport incidents in general, but especially motorcyclist, motor vehicle and heavy vehicle crashes, and for other land transport, for injuries involving animate mechanical forces (such as those involving tools and machinery), threats to breathing, electric current, smoke, fire and flames, venomous plants and animals, forces of nature, intentional self-harm, and assault. Similar differences in SARS for injury mechanisms experienced by rural and urban residents have been identified in other studies [8, 30]. In Ireland, rural residents had higher SAR compared to urban residents for fire and burn injuries and for machinery injuries [30], but unlike the current study, also for injuries involving pedal cyclists. Whereas, pedestrian injuries in Ireland were found to have a higher SAR for urban residents compared to rural residents as found in the current study [30]. This is likely to be due to reduced exposure to motor vehicle traffic in rural locations compared to urban residents, with a significantly less likelihood of being hit by a vehicle in a rural location.

The higher likelihood of transport incidents involving hospitalised injury of rural residents is likely to be related to a number of factors, including longer travel distances, often poorer street lighting,

higher vehicle speed zones, an increased likelihood of head-on collisions and vehicle rollovers, poor use of seat belt restraints, unregulated environments (i.e. private rural property) and a lack of road safety features compared to more urban locations [5, 8, 30, 32, 33]. In addition, there is likely to be an increased time to discovery and provision of medical treatment for rural compared to urban residents [8, 32, 33]. That there was a higher likelihood of hospitalised injuries of rural residents stemming from other land transport incidents, venomous animals and plants, smoke, fire and flames and animate mechanical forces is likely to be due to increased exposure to these types of mechanisms of injury compared to urban residents [8].

For rural residents aged 19 years or less, there were a higher proportion of hospitalised injuries following motorcyclist and pedal cyclist incidents compared to older rural residents, likely reflecting time exposed to these activities. Being injured as a motor- or pedal cyclist is a common injury mechanism for young people [39-42] as road trauma is one of the most common injuries experienced by young people worldwide [43]. To reduce the number of pedal cyclist injuries among young people, injury prevention strategies could include increasing their road safety knowledge and traffic skills, introducing environmental changes, such as traffic calming methods like speed bumps to slow vehicle speed, and creating mechanisms to separate pedal cyclists from vehicles, such as cycle pathways, particularly in more inner regional areas. While helmet use during cycling was not able to be examined in the current study, several studies have found a protective effect of helmet wearing if a crash occurs while cycling for both head and facial injuries [40, 44, 45]. A prior study in NSW identified that helmet use among young people was relatively low (i.e. between 28.0% for individuals who sustained serious injuries and 39.4% for those that sustained minor injuries), indicating that the promotion of helmets to prevent head injury needs to be encouraged [41].

Like the current study, motorcycle injuries were also identified as a common cause of injury hospitalisation in NSW, Victoria and Queensland for young people [46-48], with off-road motorcycle use on private properties by young riders unregulated. Motorcycle riding on rural properties exposes the rider to environmental hazards, such as uneven surfaces and rocky terrain [47], that can be difficult to navigate for even experienced riders. Injury prevention measures to reduce motorcycle injuries among young people can include riding a well-maintained motorcycle, novice rider mentoring programmes, skills and risk awareness training for riders, and use of protective clothing and helmets [47, 48].

For the rural residents aged 65 years and older, falls accounted for 57.8% all the injury-related hospitalisations. Falls are the most common cause of injury-related hospital admission among

older individuals [49, 50], with common fall risk factors for older individuals including chronic health conditions, multiple medication use, poor balance and vision [49, 51, 52]. While the causes of falls are usually multifactorial in nature, in terms of reducing overall falls risk, fall prevention initiatives for older individuals living in the community include involvement in activities that promote healthy ageing, such as increasing strength and balance, reviews of medication, and home safety modifications [53].

The most common place of occurrence of the injurious incident for both rural and urban residents was the home. For rural residents, the place of occurrence varied with age, with individuals aged 65 years and older notably having 13 times higher proportion of injuries occurring in residential institutions compared to younger individuals. This is likely to reflect where older individuals spend most of their time.

Sport and leisure activities were the most common activities being performed at the time of the injury for both rural and urban residents. Up to 3.8 million individuals aged 15 years and older were reported to participate in sport or general physical recreation each year in NSW [54]. Sporting activities, such as team ball sports, are a popular form of physical activity, but in some instances, sports participation can result in injury [55]. A previous study that examined self-reported sport injury identified that almost one in three individuals aged 16 years or older reported participating in organised sport in the previous 12 months and that they had been injured during their sports participation [55]. In rural areas, sporting injuries have been linked to poorer playing conditions, such as standards of playing fields and courts, pressure on injured individuals to keep playing due to a lack of available players, and a lack of formal sports safety policies [56].

The profile of the types of principal injuries sustained was similar between rural and urban residents, with head injuries, wrist and hand, knee and lower leg, and elbow and forearm injuries identified as the most common types of injuries sustained. There was a slightly higher proportion of wrist and hand injuries among rural residents, which is likely to be reflective of the injury mechanisms experienced by rural residents commonly involving machinery or tools [30]. Head injuries are one of the leading causes of hospitalisation and of mortality, particularly for land transport-related incidents which were common in the current study [57-59].

For rural residents aged 65 years and older, injuries to the hip and thigh represented 17.2% of the principal injuries compared to 2.3% and 2.6% of the principal type of injury for individuals aged 19 years or less and 20 to 64 years. Hip fractures are one of the most common hospitalised injuries sustained by individuals aged 65 years and older [50, 60]. High rates of hip fracture have also been identified among females living in rural areas in the United States [33].

Rural residents of NSW had a slightly higher 30-day mortality than urban residents and were less likely to be readmitted within 28 days following an injury-related hospitalisation. Rural residents who were hospitalised as a result of an injury also had a significantly lower age-adjusted hospital LOS than urban residents. It is possible that an unexpected deterioration in health following return from hospital to an isolated place of residence could play a part in higher initial mortality rates for rural compared to urban residents [61, 62]. A previous study reported that rural residents remain longer in hospital compared to urban residents due to limitations with services and transport to support their rehabilitation in remote locations [61], however, this does not appear to be the case in the current study, nor in a previous examination of severe traumatic brain injury (TBI) among rural and urban residents in NSW, where it was found that an integrated network of inpatient, outpatient and outreach services were able to provide effective injury rehabilitation for all individuals who had a TBI, regardless of geographic location [63].

For rural residents, individuals aged 65 years and older had a higher mortality within both 30 and 90 days, were more likely to be readmitted to hospital within 28 days and had a longer hospital LOS than younger rural residents. This is not surprising as injury for older people are more likely to result in adverse consequences due to effects of ageing on the physical body, making it less resistant to injury [64, 65].

There were 14,108 hospitalised injuries of rural residents who were indicated to be working at the time of the injurious incident, representing 6.6% of all rural residents hospitalised for an injury. In terms of work-related injuries, the agricultural industry has one of the highest rates of injury of all Australian industries [11, 66]. The majority of individuals injured were males (83.5%) and were aged 25 to 54 years (58.7%). As discussed previously, rural males are more likely to be employed in high-risk industries, such as agriculture and mining, that have higher rates of compensated work-related injuries compare to the other industries in NSW [11].

Of the hospitalised injuries of rural residents, there were 5,546 injury-related hospitalisations where the location of incident was indicated to be a farm. Farms are a workplace that contain occupational hazards, including agricultural machinery and animals, which can present injury risks for all family members and visitors, as work tasks and worksite areas on a farm are also a site for family recreation [32, 67]. Males had a three times higher proportion of being injured on a farm than females, which is the same 3:1 male to female injury ratio found in a study of hospitalised farm-related non-machinery injuries in Canada during 1990 to 1996 [67], with males found to experience a higher ratio of hospitalised injury to females, if the injurious incident was machinery-related [67, 68].

For both work- and farm-related hospitalised injuries, contact with inanimate mechanical forces, such as machinery, falls and transport incidents, particularly involving other land transport, such as horses and quad bikes and also motorcycles on farms, were the most common mechanisms of injury. Similar injury mechanisms have also been identified in other studies of work- and farm-related injuries [13, 68-72]. Machinery-related incidents appear to play a substantial role in injury-related hospitalisations of rural residents [73]. The type and nature of machinery will vary by type of agricultural activity and the type of machinery involved in the current study was not often specified. To reduce hazards associated with machinery, machinery needs to be well-guarded, maintained, operated away from any bystanders, any machinery safety devices kept in working order, and operators trained in safe machinery use [73].

Fall-related injuries, involving slips and trips on the same level, are a common mechanism of injury, particularly for older individuals on rural and farming properties [74]. Falls from ladders and scaffolds and from one-level to another were also identified in the current study as common fall sub-mechanisms. Other studies have identified that falls from a height are a common cause of work-related injury [75], and that there has been a growing number of falls in and around the home environment, predominantly from ladders or from buildings while undertaking home repairs [76, 77]. Injury prevention strategies to reduce ladder falls could include the use of ladders with non-slip feet and mechanisms to secure the top rungs of a ladder to a building to reduce ladder instability.

Horse-related hospitalised injuries of rural residents on farms represented 45.1% of all other land transport incidents. Incidents involving horses are a common injury mechanism on farms involving both adults and young people during both work and leisure pursuits [78, 79]. While horse riding is seen as an enjoyable recreational activity, there is the potential for rider injuries to occur due to the often unpredictable nature of horses [79]. The use of protective equipment, such as helmets, appropriately fitted equipment, including stirrups and tack, and adherence to good animal handling practices [78, 79] are some of the injury prevention practices aimed at reducing horse-related injuries.

Quad bikes are four wheeled vehicles that have a single seat that is straddled by the operator, they use low pressure tyres, and are steered using handle bars similar to a motorcycle. They have varying engine sizes and are capable of speeds up to 120km/h [80]. Quad bikes are a popular off-road vehicle that are used largely in rural settings for a variety of activities, such as general personal transport, for checking on or mustering stock, conducting chemical spraying, and increasingly quad bikes are also used for recreational purposes [81, 82]. While quad bikes are

often seen as a useful off-road vehicle, they have been involved as the mechanism of injury of their occupants [82-86]. Incidents involving quad bikes have commonly involved the operator losing control of the quad bike and either falling from the vehicle or the vehicle rolling or flipping over, with injuries commonly occurring to the head, neck and thorax [87]. A number of common risk factors for injury have been found to be associated with quad bike incidents and these include young operator age, male operators, inexperienced operators, traversing steep and uneven terrain, lack of helmet use by operators, and greater quad bike engine size [83, 86, 88]. Identifying mechanisms to address these quad bike injury risk factors would go some way towards reducing the number of quad bike-related injuries sustained in NSW.

There are several limitations of the current study. Information on the location of the injury event was not available in the hospitalisation data collection and the residence of the injured individuals was used as a proxy for the location of the injury. This was not ideal as the location of the injurious incident may not have occurred in the same geographic location (i.e. urban or rural location) where the individual resided. No information was available in the hospitalisation data collection regarding aspects of rural and farm properties, such as property size, the type of agricultural farm, specific type of machinery involved in the incident, or person-time exposed to each type of activity, which would allow the calculation of person-time injury risk.

The classification of urban and rural location in Australia is now often conducted using the ASGS rather than the ARIA+ classification system. Using the ASGS there have been differences in how rural areas are defined by researchers, i.e. either including or excluding 'inner regional NSW' [89-92]. These sort of definitional differences will have an effect on the number and hospitalised incidence rates of injury in NSW for urban and rural residents. For this study, inner regional NSW was considered to be rural NSW after a review of a sample of postcodes included in inner regional NSW. The calculation of injury-related costs only included hospital treatment costs, so will underestimate personal (e.g. lost earnings, any legal expenses) and societal costs (e.g. compensation, property damage) and other treatment costs, such as treatment provided by general practitioners and/or allied health professionals.

Data validity was not able to be assessed and it is possible there could be some misclassification in hospitalisation records. In particular, around one-third of the place of occurrence and two-thirds of the activities conducted at the time of the incident were not specified in the hospitalisation data. The identification of these unspecified places and activities would have likely altered the results of the place of occurrence and activity at time of injury data. It is possible that the identification of work-related injurious incidents is under-enumerated [93].

For the identification of health conditions in the Charlson Comorbidity Index, only health conditions that were relevant to the current hospital episode of care are reported in each hospitalisation record. However, by using a one year look back period, better estimates of the prevalence of health conditions were able to be obtained in the current study [94]. When using record linkage there is likely to be some degree of error in the data linkage process. However, for the current study, the CHeReL estimates the false positive rate for this linkage to be 0.5% (i.e. the proportion of false matches).

5. Conclusion

This epidemiological study was conducted to describe and compare the incidence and characteristics of hospitalised injury between urban and rural residents in NSW. This sort of examination of injury hospitalisations and their cost by geographic variation will be useful to inform the development and targeting of injury prevention strategies by geographic location. However, there can be challenges when delivering injury prevention activities across rural NSW, due to the spare geographic areas, the small rural population and the nature of the occupational hazards. The development, implementation and evaluation of injury prevention strategies targeting the most common injury mechanisms for rural residents will go some way towards reducing hospitalised injury in this population.

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