**Final Report**

# A 10-year review of the characteristics and health outcomes of injury-related hospitalisations of children in Australia

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# Abbreviations

| | |
|---|---|
| 95%CI | 95% confidence interval |
| ABS | Australian Bureau of Statistics |
| ACT | Australian Capital Territory |
| AIHI | Australian Institute for Health Innovation |
| AIHW | Australian Institute of Health and Welfare |
| AR-DRG | Australian Refined Diagnosis Related Group |
| ASGS | Australian Statistical Geographical Standard Remoteness Area |
| CHeReL | Centre for Health Record Linkage |
| COD-URF | Cause of Death Unit Record File |
| GP | General Practitioner |
| HR | Hazard Ratio |
| HREC | Human Research Ethics Committee |
| ICD-10-AM | International Classification of Diseases, 10th Revision, Australian Modification |
| ICISS | International Classification of Injury Severity Score |
| LOS | Length of Stay |
| NCIS | National Coronial Information System |
| NEC | Not Elsewhere Classified |
| NDI | National Death Index |
| NHMD | National Hospital Morbidity Database |
| NHMRC | National Health and Medical Research Council |
| NSW | New South Wales |
| NT | Northern Territory |
| QLD | Queensland |
| RBDM | Registry of Births Deaths and Marriages |
| SA | South Australia |
| SD | Standard Deviation |
| SNAP | Sub-acute Non-Acute Patient |
| SRR | Survival Risk Ratio |
| TAS | Tasmania |
| VIC | Victoria |
| WA | Western Australia |
| WHO | World Health Organization |

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# Executive Summary

Injury is the leading cause of death of children aged 1 to 16 years in Australia. Injury happens in the blink of an eye and can be lifechanging. An injured child often experiences ongoing limitations related to their physical abilities, chronic pain and psychological issues. Despite this enormous incidence and impact, there has been no comprehensive national examination of childhood injury characteristics and health outcomes in Australia. This information is essential to quantify the childhood injury burden, resource planning and to identify and evaluate priorities for injury prevention.

To address this significant gap, a nation-wide study of injuries sustained by Australia's children was commissioned by the Day of Difference Foundation. To achieve this, a retrospective epidemiological analysis of injury-related hospitalisations involving children aged 16 years or less in Australia during the financial years 1 July 2002 to 30 June 2012 was conducted. Linked hospitalisation and mortality records were used to describe the characteristics of injury hospitalisations. Binomial regression was used to examine temporal trends and Cox proportional hazard regression was used to examine factors associated with 30-day and 12-month survival post injury. Hospital treatment costs were also estimated.

The results are alarming.

- Child injury hospitalisation rates **have not decreased over a ten year period.**
- There were 686,409 injury-related hospitalisations, which equates to an age-standardised injury hospitalisation rate of 1489 per 100,000 children in Australia.
- For every severely injured child, there are at least 13 children hospitalised with minor or moderate injuries.
- The total hospital cost of injury hospitalisations of children during the ten year period was **$2.1 billion**. $212 million annually, and a mean cost per child of $3,119.
- Falls (38.4%), most often from playground equipment (8.3%) were the most common injury mechanism.
- Sporting activities (19.0%) were the most common specified activity performed at the time of the incident.
- The child's home (24.5%) was the most common specified place of the incident.
- Fractures (41.9%) were the most common type of injury.
- A higher proportion of injured children resided in areas of socioeconomic disadvantage.
- Children had a higher risk of dying from their injuries if they;

- lived in regional/remote Australia
- were aged ≤10 years
- were more severely injured
- were injured in a transport incident or following drowning and submersion or other threats to breathing or following self-harm
- sustained a head injury.

- The number and cost of child injury hospitalisations is likely to be underestimated. Both ACT and Tasmanian hospital costs were unable to be calculated for 2002-03 and 2003-04, and 20.4% of Victorian records (up to 3,975 child injury hospitalisations per year) were not able to be included.
- The logistics of linking national hospitalisation and mortality data were convoluted, time consuming, involved nine ethics applications and ten data custodian approvals, resulting in this one off "snapshot" report taking over four years to complete.

For the first time in Australia, we have a national profile of childhood injury causes, descriptions, costs and mortality. Childhood injury is costly, life changing, but preventable.

The development of a national multi-sectorial evidence informed childhood injury prevention strategy is urgently needed.

Routine, Australia wide injury surveillance using record linkage of existing data sources should commence as a priority.

Injury surveillance should be in real time, so that injury prevention strategy can be evidence informed.

Injury prevention strategies need to target developmental stages, because as children age, their patterns of injury change.

Monitoring of consistency and quality of care for severe injury is essential to ensure that no matter where a child sustains their injury, they have timely access to the best care. This could be achieved by enhancing the Australian Trauma Quality Improvement Program.

Childhood injury is catastrophic for families. Up to 47% of parents of critically injured children develop PTSD. Parent wellbeing is essential to their capacity to support their child's wellbeing. Introduction of a major injury family support coordinator role, to coordinate physical and psychosocial care for children and their family from the acute hospital to 2 years post-discharge would ensure better psychosocial outcomes for families.

# 1. Introduction

Worldwide injury is a leading cause of death among children and accounts for around 950,000 deaths and many millions of non-fatal hospitalisations each year [1]. The effects of childhood injury can be far reaching. Beyond the initial injuries sustained, an injured child may face ongoing limitations related to their physical abilities, experience chronic pain and psychological issues, such as post-traumatic stress disorder [2-4]. Not only is the injured child affected, but their injury can also impact on their family and their community networks [4, 5].

Medical advances, pre-hospital intervention and trauma management, legislative change and the introduction of safety initiatives (such as swimming pool fencing, helmet use, child-proof medicine containers, non-flammable clothing, hot water tempering) and mechanical safety advances (including motor vehicle safety assisted technologies, such as rear-review cameras) have all contributed to increasing the survival of children following traumatic injury and/or in the reduction of the severity of the injury sustained [6-13]. Yet, in Australia there has been no comprehensive examination of injury characteristics and health outcomes, including injury severity and survival over time for injured children at a national-level.

This sort of in-depth information on childhood injury is essential for identifying the injury burden, priority setting of injury prevention strategies, determining resource planning, identifying temporal changes in injury trends, determining health care costs, and for evaluating the impact of injury prevention measures [14-16]. Future gains in improved survival following child injury and in the promotion of injury prevention strategies will likely stem from continued improvements in pre-hospital care and trauma management [17, 18] and in advocacy efforts towards effective child injury prevention measures [1, 19].

The overall objective of this research is to describe the burden of hospitalised childhood injury in Australia during 1 July 2002 to 30 June 2012 and to determine the health outcomes and severity of the injuries experienced and factors influencing survival. The specific aims are to:

- determine the number, incidence and temporal trends of hospitalised injury involving children in Australia;
- describe the type and characteristics of hospitalised injury involving children in Australia;
- describe the health outcomes of children hospitalised following an injury in Australia, including hospital treatment costs; and
- examine factors associated with survival at 30-days and 12-months post-injury.

# 2. Method

This section describes the data collections used, the data linkage process conducted by the Australian Institute of Health and Welfare (AIHW) and the Western Australian (WA) Data Linkage Unit. Ethics approval for this project was obtained from nine ethics committees: the Australian Capital Territory (ACT) Health Human Research Ethics Committee (HREC) (Approval number: ETH.7.13.149), the AIHW HREC (Approval number: EO 2013/4/66), the New South Wales (NSW) Population and Health Services Research Ethics Committee (Approval number: 2013/07/466), the Menzies School of Health Research HREC (Approval number: 2013-2048), the Queensland Department of Health HREC (Approval number: HREC/13/QHC/23), the South Australian (SA) Department of Health HREC (Approval number: HREC/13/SAH/61), the University of Tasmania HREC (Approval number: H0013335), the Victorian Department of Health and Human Services HREC (Approval number: 19/13), and the WA Department of Health HREC (Approval number: 2014/09)

## 2.1 Data sources

A retrospective analysis of children aged 16 years or less who were injured and hospitalised in Australia during 1 July 2002 to 30 June 2012 was conducted. Linked hospitalisation and mortality data collections were examined.

### 2.1.1 Hospital data

Australian hospitalisation data was obtained from the National Hospital Morbidity Database (NHMD) for Queensland, the Northern Territory and SA. The ACT, NSW, Tasmanian, Victorian Department of Health and Human Services and the WA Department of Health provided their hospitalisation records directly from their jurisdiction-based data collections. Hospitalisation data includes information on all inpatient separations from all public and private hospitals in Australia, but the scope of private hospital inclusion varied slightly over time [20]. The hospitalisation data 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, 10$^{th}$ Revision, Australian Modification (ICD-10-AM) [21].

Hospitalisation data is based on episodes of care in hospitals. Therefore, a single injury may result in multiple hospital episodes of care if the child was transferred to a different mode of care

(e.g. from acute to rehabilitation care) or to a different hospital. During the study timeframe, some children may have been hospitalised for several injury events. All hospital episodes of care related to the one injury event were linked to form a period of care (i.e. all episodes of care related to the injury until discharge from the health system). The first injury admission per child was identified (i.e. the index injury admission) and additional episodes of care were treated as related to the index admission. Where a child had a non-continuous hospital admission (i.e. there was a break from the hospital system), these admissions were treated as new admissions. Injury-related admissions were defined as having a principal diagnosis indicated as an injury (i.e. ICD-10-AM range: S00-T78). Hospitalisation data from the ACT was only available from 1 July 2004.

Hospitals with Level 1 trauma centres were identified as hospitals providing 24-hour full spectrum of care for the most critically injured patients, from initial reception and resuscitation to discharge and rehabilitation, as well as conducting research, education, quality improvement programs, prevention and outreach programs [22].

### 2.1.2 Mortality data

Australian mortality data were obtained from the National Death Index (NDI), the WA Registry of Births Deaths and Marriages (RBDM) and the Tasmanian hospitalisation records. The NDI obtains mortality information from the Cause of Death Unit Record File (COD-URF) mortality data files with mortality information provided by the RBDM in each State and Territory, the Australian Bureau of Statistics (ABS) and the National Coronial Information System (NCIS) [23]. All deaths in Australia are registered with a RBDM and information collected from death certificates (certified by a medical practitioner or pathologist) includes demographic data, cause and fact of death. Date of death post-discharge is recorded within the Tasmanian hospitalisation data as staff manually maintain this information using death notices and through notification from the Tasmanian RBDM.

## 2.2 Data linkage

The AIHW Data Linkage Unit used identifying information, such as name, address, date of birth and gender, to construct a linkage key for each unique person with a hospitalisation record. As the NHMD does not contain any identifying information, each State and Territory Health Department, or their delegated authority, provided the AIHW Data Linkage Unit with identifying information from their hospitalisation data for records that met the case inclusion criteria. This information was provided to enable the linkage of multiple hospital episodes of care for each injured child and to conduct the linkage of the hospitalisation data to the NDI. The hospital record and NDI linkage was conducted for all States and Territories, except Tasmania and Western

Australia. The identifying information for the WA hospitalisation data was considered as not able to leave WA, therefore, the WA Data Linkage Unit conducted a separate linkage of the WA hospital records to WA mortality data from the WA RBDM. In Tasmania, the Tasmanian unique record identifiers from their hospitalisation records that match to the data held in the NHMD were not able to be supplied. Tasmania provided the investigators with Tasmanian hospitalisation data and a unique patient identifier for all child injuries during the study time period and the investigators linked records that occurred within the same period of care, with date of death post-discharge recorded within the Tasmanian hospitalisation data.

For the jurisdictions where data linkage was possible, the record linkage between the hospital records and mortality data was conducted using probabilistic methods. The AIHW Data Linkage Unit created a weight to compare record pairs across all the passes using the combined results from 15 linkage passes (using first and last name, date of birth and gender). The record pairs with a weight above 35.0 were considered links while those with a weight below 18.0 were considered non-links. The record pairs between these cut-offs were clerically reviewed.

For Victoria, 20.4% (n=41,482) of their child injury hospital records did not have any names on the record and these records were not able to be linked by the AIHW Data Linkage Unit. A review of these 'unlinked' records by the study investigators did not identify any consistent bias by financial year or by hospital. These unlinked Victorian records were excluded from the study results, but a summary of the characteristics of these unlinked records are provided in Appendix 1.

For South Australia, 0.07% (n=39) of their hospital records were not able to be matched with records in the NHMD. These South Australian records were in the 2002-03 (n=15), 2003-04 (n=10) and 2004-05 (n=14) financial years and were excluded from the analysis as no information was available to describe the hospitalisation.

## 2.3 Urban and regional/remote identification

The Australian Statistical Geographical Standard Remoteness Area (ASGS) was used to identify regional/remote and urban Australian residents. The ASGS 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 [24]. 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. The five categories were collapsed into two categories: urban (i.e. major cities) and regional/remote (i.e. inner regional, outer regional, remote, and very remote).

## 2.4 Identification of socioeconomic status

A measure of socioeconomic disadvantage for each hospitalisation was assigned using the index of relative socioeconomic disadvantage [25] and the postcode of residence from the hospitalisation data. The index consists of measures that reflect relative disadvantage. The indexes values were partitioned into quintiles from most (i.e. 1) to least disadvantaged (i.e. 5).

## 2.5 Identification of chronic health conditions

A number of chronic health conditions pertinent for young people were identified from the literature [26-32]. A chronic condition was considered to be a health condition that would reasonably be expected to last 12 months and that resulted in limitations for self-care, independent living or social interactions and/or resulted in the need for ongoing health care using medical services or specialist equipment [31]. A chronic condition also had to be able to be identified using diagnosis classifications from ICD-10-AM (Table 2.1).

Chronic health conditions were treated as a categorical variable and categorised as no reported chronic health condition, a mild-moderate chronic health condition (1 chronic health condition), and a severe chronic health condition (2 or more chronic health conditions).

## 2.6 Injury severity

The International Classification of Injury Severity Score (ICISS) was used to estimate injury severity. The ICISS is derived for each person by multiplying the probability of survival for each injury diagnosis using survival risk ratios (SRR) calculated for each injury diagnosis [33]. In the current study, injury severity was calculated using each individual's injury diagnosis classifications, using SRRs previously developed by Stephenson et al [33]. Dayal et al [34] 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) [35] and these injury severity definitions were used for this study.

## Table 2.1: Health conditions and ICD-10-AM classifications

| Health condition | ICD-10-AM classifications |
|---|---|
| **Circulatory system** | |
| Hypertension | I10-I15 |
| **Congenital malformations** | |
| All congenital malformations | Q00-Q99 |
| *Congenital malformation of the heart and great arteries* | Q20-Q25 |
| **Digestive system and allergies** | |
| Celiac disease and other serious allergies | K52.2, K90.0, T78.0, T78.2, T78.4 |
| **Endocrine, nutritional and metabolic conditions** | |
| Diabetes | E09-E14 |
| Obesity | E66 |
| Cystic fibrosis | E84 |
| **Immune system conditions and coagulation defects** | |
| Anaemia | D50-D53 and D55-D64 |
| Coagulation defects (e.g. haemophilia) | D65-C68 |
| **Mental health conditions** | |
| Autism spectrum disorders | F84 |
| Behavioural and emotional disorders of childhood | F90-F98 |
| Cognitive and behavioural delay | F80-F83 and F88-F89 |
| Eating disorders | F50 |
| Hyperkinetic disorder | F90 |
| Mental retardation | F70-F79 |
| Mood affective disorders | F30-F39 |
| Neurotic, stress-related and somatoform disorders | F40-F48 |
| Personality disorders | F60-F69 |
| Schizophrenia, schizotypal and delusions disorders | F20-F29 |
| **Neoplasms** | |
| All malignancies | C00-D48 |
| *Acute lymphoblastic leukaemia and acute myeloid leukaemia* | C91.0, C92.0 |
| *Brain cancer* | C71 |
| **Nervous system conditions** | |
| Cerebral palsy | G80 |
| Epilepsy | G40 |
| **Renal conditions** | I12.0, I13.1, NO3, NO5, N18-N19, N25.0, Z49, Z94.0, Z99.2 |
| **Respiratory conditions** | |
| Chronic lower respiratory disease | J40-J47 |
| *Asthma* | J45 |

## 2.7 Hospital costs

The Australian Refined-Diagnosis Related Groups (AR-DRGs), episode of care LOS and episode of care type (e.g. acute, rehabilitation) were used to estimate hospital costs. Rehabilitation-related episodes of care were identified using the AR-DRG classifications of Z60A, Z60B and Z60C [36] and/or an ICD-10-AM rehabilitation classification (i.e. Z50.1, Z50.8 and Z50.9).

Estimates of public hospital costs were obtained from the *National Hospital Costing Data Collection, Round 14 (2009-10)* [37]. 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 [37].

For admissions within a period of care related to the index injury hospital admission, 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 [36]. The *NSW Costs of Care Standards (2009-10)* [36] 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 children 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 treatment, where these treatments were provided within an index injury hospitalisation period of care.

For children 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. All costs are in 2009-10 Australian dollars.

## 2.8 Data management and analysis

Analysis was performed using SAS version 9.4 [38]. Descriptive statistics were conducted. Age-standardised incidence rates were calculated for the period 2002-03 to 2011-12 using PROC STDRATE for individuals aged 16 years or less, excluding the ACT. The jurisdiction-specific age-standardised incidence rates included the ACT from 2004-05. Denominator data for the number

of people aged 16 years or less residing in Australia were obtained from the ABS population estimates [39]. Direct age standardised rates per 100,000 population were calculated using the estimated Australian residential population at 30 June 2001 as the standard population [40]. Due to over-dispersion, negative binomial regression was used to examine the statistical significance of changes in the trend over time in the incidence of injury hospitalisation [41].

Thirty-day and 90-day mortality was calculated from the date of admission of the index injury-related hospital admission. Mortality at 12 months was calculated for the period 2002-03 to 2010-11 to allow for 12-month follow-up of children admitted to hospital in 2011.

Twenty-eight day hospital readmission was considered as readmission within 28 days of hospital discharge for any cause, excluding deaths. The calculation of hospital length of stay (LOS) included transfers between hospitals and both hospital LOS and age-adjusted hospital LOS were truncated to three standard deviations (SD) in order to exclude extreme outliers [42]. Linear regression was used to age-adjust for hospital LOS and logistic regression for 28-day readmission and mortality. T-tests were used to compare hospitalisations between males and females and unadjusted and age-adjusted hospital LOS [41]. The Cochran-Armitage trend test was used to examine trends in both unadjusted 30-day and 12-month mortality rates.

Cox proportional hazard regression was used to examine the effect of risk factors on survival at 30-days and 12-months following hospitalised injury. Variables were initially examined using univariate analyses and if significant at 0.25 were then entered into a multivariable model [43]. The variables included in the model were: age group, gender, number of health conditions (i.e. 0, 1+), injury severity (i.e. minor, moderate, serious), injury mechanism, location of residence, and principal injury type. A backwards stepwise regression was used to sequentially eliminate factors from the multivariable model that did not significantly contribute to mortality risk at 0.15. Hazard ratios (HR) and ninety-five percent (95%CI) were calculated.

Descriptive statistics were used to estimate the hospital treatment cost data in terms of the sum, mean and median hospital costs. Total hospital cost (i.e. acute and rehabilitation) was examined for key characteristics, including age group, gender, jurisdiction of hospitalisation, principal injury type, injury mechanism, injury severity, and nature of injury.

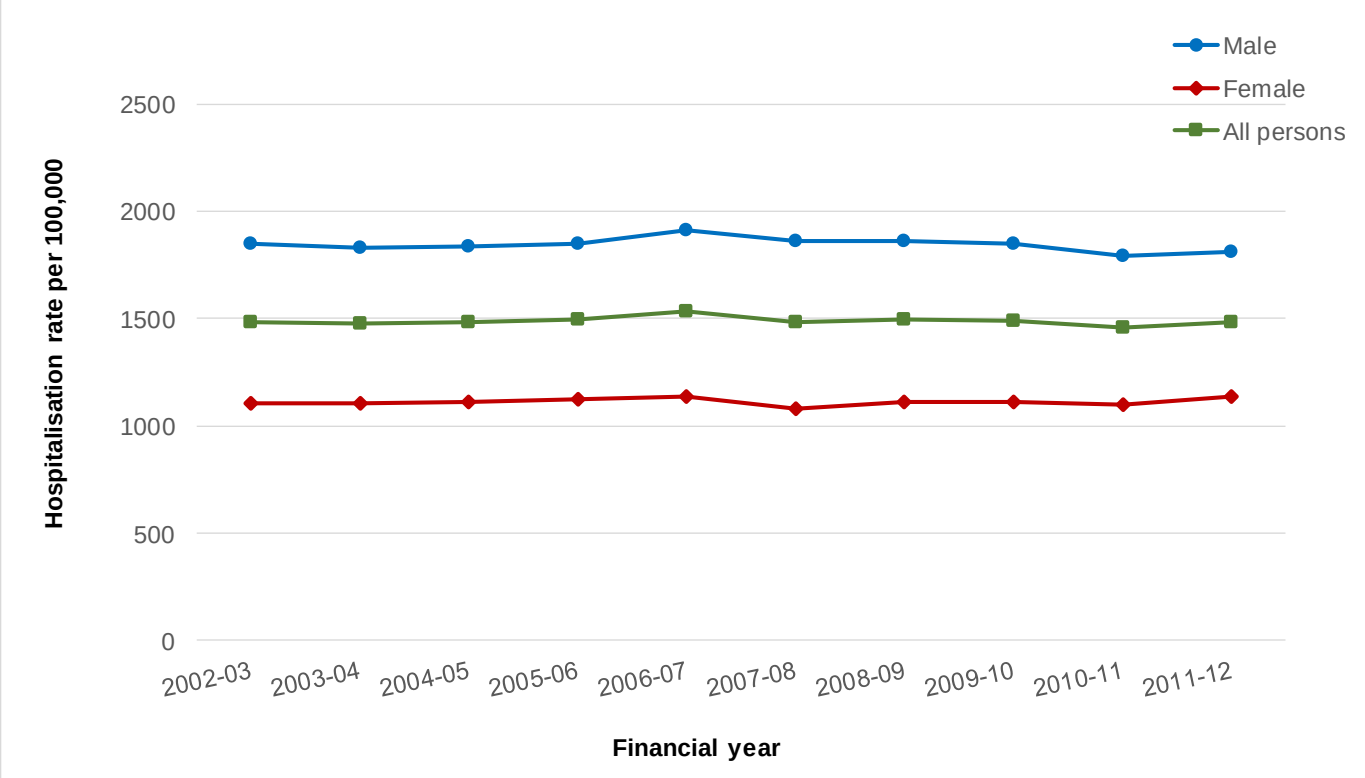
# 3. Results

The results are reported in three sections. Section 3.1 describes the number and temporal trends of injury-related hospitalisations in Australia of children aged 16 years or less and Section 3.2 identifies the characteristics of these injury-related hospitalisations. Section 3.3 describes the health outcomes of children aged 16 years or less hospitalised following an injury in Australia, identifies the factors influencing their survival and estimates hospital treatment costs.

## 3.1 Injury temporal trends

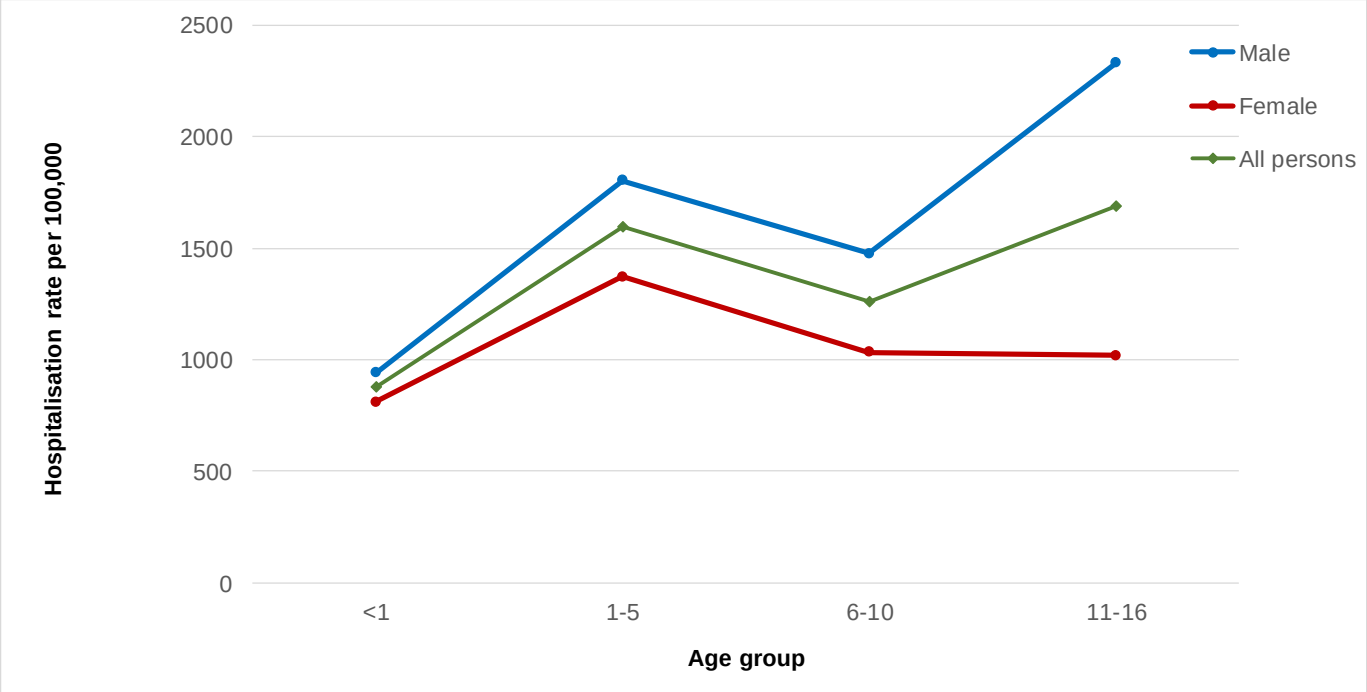
Between 1 July 2002 to 30 June 2012, there were 686,409 index injury-related hospitalisations for children aged 16 years or less in Australia. The number of child injury hospitalisations is likely to be under-enumerated as hospitalisation records were only available from the ACT from 1 July 2004 and 20.4% of Victoria child injury hospitalisation records (up to 3,975 child injury hospitalisations per year) were not able to be included in the study. The age-standardised injury hospitalisation rate (excluding ACT) was 1489 per 100,000 population (95%CI 1485.3-1492.4) and it decreased slightly by -0.1% per year (95%CI -1.10-0.89), but this decrease was not significant (p=0.8). The male injury hospitalisation rate was 1846 (95%CI 1840.0-1851.1) and the female injury hospitalisation rate was 1113 (95%CI 1108.6-1117.4) for the ten year period, excluding ACT. The injury hospitalisation rate for males was estimated to decrease by -0.2% per year (95%CI -0.45-0.09), but this decrease was not significant (p=0.2) and the injury hospitalisation rate for females was estimated to increase per year by 0.03% (95%CI -0.28-0.34), but the increase was not significant (p=0.9) (Figure 3.1). Overall, as age increased, the injury hospitalisation rate per 100,000 population increased, except for the rate decrease for children aged 6-10 years (Figure 3.2). Injury-related hospitalisation rates fluctuated over time in the jurisdictions (Figure 3.3).

**Figure 3.1: Incidence rate for injury-related hospitalisations for children aged ≤16 years by year, linked hospitalisation and mortality data, Australia, 1 July 2002 to 30 June 2012[1]**



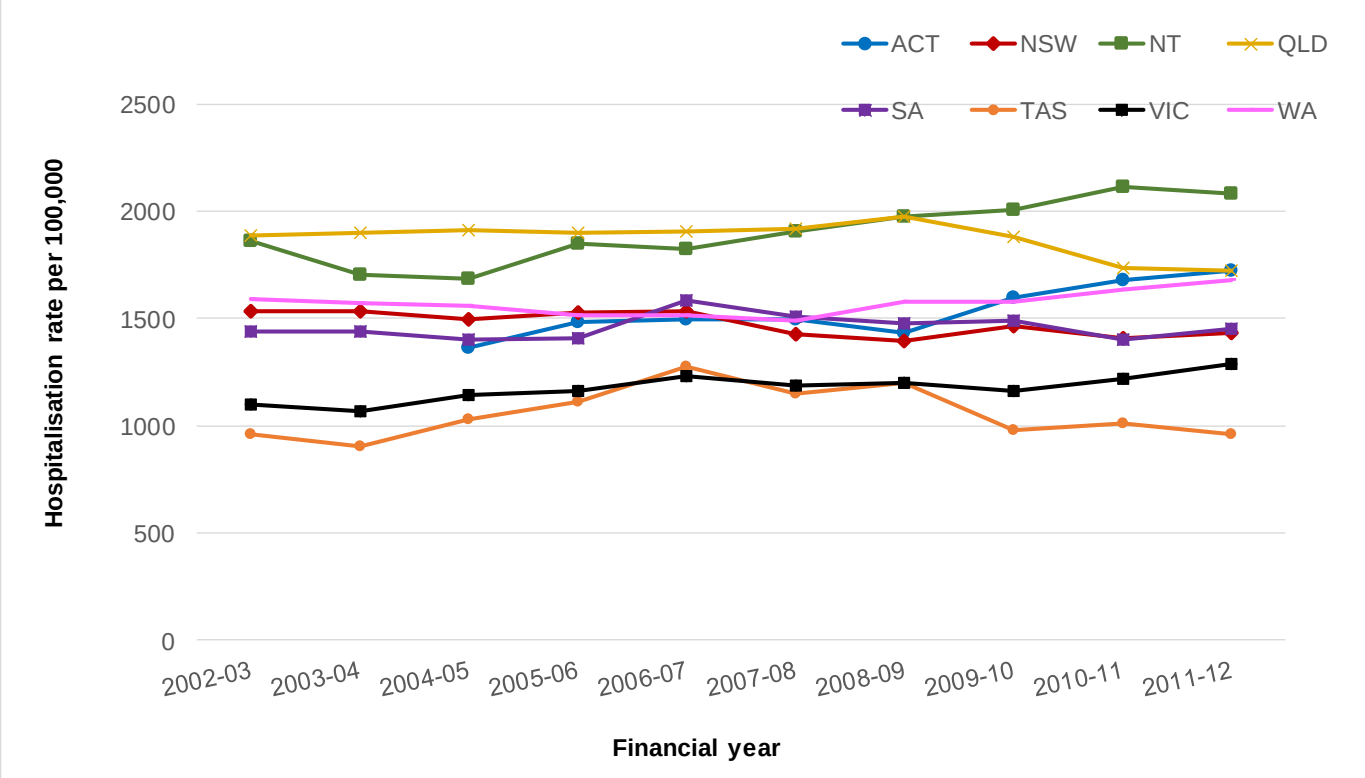

[1]Incidence rate excludes ACT.

**Figure 3.2: Incidence rate for injury-related hospitalisations for children aged ≤16 years by age group, linked hospitalisation and mortality data, Australia, 1 July 2002 to 30 June 2012**[1]




[1]Incidence rate excludes ACT.

**Figure 3.3: Incidence rate for injury-related hospitalisations for children aged ≤16 years by jurisdiction, linked hospitalisation and mortality data, Australia, 1 July 2002 to 30 June 2012**[1]




[1]Data only available from ACT from 1 July 2004 and VIC child injury hospitalisations likely to include up to an additional 3,975 hospitalisations per year.

## 3.2 Demographic and injury characteristics

Male children accounted for just less than two-thirds (63.6%) and female children accounted for 36.4% of injury hospitalisations. Forty-one percent of injury hospitalisations involved children aged 11-16 years, 30.9% involved children aged 1-5 years, 24.7% involved children aged 6-10 years and 3.5% involved children aged less than one year. The number of injury hospitalisations has fluctuated over time across the ten year period. NSW (32.6%) and Queensland (25.8%) accounted for over half of all childhood injury hospitalisations in Australia. Five percent of children had at least one chronic health condition recorded at the time of the injury hospitalisation. Seventy percent of children who were hospitalised with an injury resided in urban Australia. Child injury hospitalisations fluctuated by socioeconomic status, with a slightly higher proportion of injured children residing in areas of socioeconomic disadvantage. Half the injured children were treated at a level 1 trauma hospital (Table 3.1).

Falls accounted for over one-third (38.4%) and injuries involving inanimate mechanical forces (such as getting struck by or striking against objects; getting caught, crushed, jammed or pinched in or between objects) accounted for 17.6% of injury hospitalisations. Transport incidents accounted for 13.7% of injury hospitalisations, with males having a higher proportion of injuries as pedal cyclists (6.9% vs 2.9%, respectively) and motorcyclists (4.4% vs 1.1%, respectively) compared to females. Injuries involving animate mechanical forces (such as getting struck by another person, getting bitten by an animal) accounted for 5.7% and poisoning accounted for 3.7% of injury hospitalisations. Intentional self-harm accounted for 2.7% of injury hospitalisations, with females having a higher proportion of self-harm injuries than males (6.0% vs 0.8%) (Table 3.2).

Examining the fall injury sub-mechanisms identified that falls from playground equipment (8.3%), other falls on the same level (4.4%), falls on the same level from slipping, tripping and stumbling (4.2%), falls involving ice-skates, skis, roller skates, skateboards, scooters, and other pedestrian conveyances (3.6%), and other falls on same level due to collision with, or pushed by, another person (2.7%) were the most common specified falls involving young children who were hospitalised (Table 3.3).

## Table 3.1: Characteristics of children aged ≤16 years with an injury-related hospitalisation by gender, linked hospitalisation and mortality data, Australia, 1 July 2002 to 30 June 2012

| | Males (n=436,865) | | Females (n=249,536) | | Total[1] (n=686,409) | |
|---|---|---|---|---|---|---|
| | n | % | n | % | n | % |
| **Age group**[2] | | | | | | |
| <1 | 13,105 | 3.0 | 10,672 | 4.3 | 23,777 | 3.5 |
| 1-5 | 122,965 | 28.1 | 88,813 | 35.6 | 211,781 | 30.9 |
| 6-10 | 101,814 | 23.3 | 67,823 | 27.2 | 169,638 | 24.7 |
| 11-16 | 198,980 | 45.5 | 82,228 | 33.0 | 281,212 | 41.0 |
| **Admission year** (financial year)[3] | | | | | | |
| 2002-03 | 41,995 | 9.6 | 23,801 | 9.5 | 65,798 | 9.6 |
| 2003-04 | 41,627 | 9.5 | 23,900 | 9.6 | 65,528 | 9.5 |
| 2004-05 | 42,598 | 9.8 | 24,416 | 9.8 | 67,014 | 9.8 |
| 2005-06 | 43,257 | 9.9 | 24,820 | 9.9 | 68,078 | 9.9 |
| 2006-07 | 44,906 | 10.3 | 25,235 | 10.1 | 70,142 | 10.2 |
| 2007-08 | 44,221 | 10.1 | 24,162 | 9.7 | 68,384 | 10.0 |
| 2008-09 | 44,584 | 10.2 | 25,233 | 10.1 | 69,817 | 10.2 |
| 2009-10 | 44,905 | 10.3 | 25,574 | 10.2 | 70,479 | 10.3 |
| 2010-11 | 44,046 | 10.1 | 25,624 | 10.3 | 69,672 | 10.2 |
| 2011-12 | 44,726 | 10.2 | 26,771 | 10.7 | 71,497 | 10.4 |
| **Jurisdiction hospitalised**[3] | | | | | | |
| Australian Capital Territory | 5,917 | 1.4 | 3,080 | 1.2 | 8,997 | 1.3 |
| New South Wales | 144,219 | 33.0 | 79,391 | 31.8 | 223,616 | 32.6 |
| Northern Territory | 6,875 | 1.6 | 4,193 | 1.7 | 11,070 | 1.6 |
| Queensland | 112,324 | 25.7 | 64,661 | 25.9 | 176,985 | 25.8 |
| South Australia | 29,776 | 6.8 | 18,259 | 7.3 | 48,035 | 7.0 |
| Tasmania | 7,241 | 1.7 | 4,470 | 1.8 | 11,711 | 1.7 |
| Victoria | 82,564 | 18.9 | 48,139 | 19.3 | 130,703 | 19.0 |
| Western Australia | 47,949 | 11.0 | 27,343 | 11.0 | 75,292 | 11.0 |
| **Number of health conditions** | | | | | | |
| No child health conditions | 417,934 | 95.7 | 232,150 | 93.0 | 650,091 | 94.7 |
| 1 child health condition | 16,422 | 3.8 | 14,530 | 5.8 | 30,953 | 4.5 |
| ≥2 child health conditions | 2,509 | 0.6 | 2,856 | 1.1 | 5,365 | 0.8 |
| **Location of residence** | | | | | | |
| Urban | 305,744 | 70.0 | 174,959 | 70.1 | 480,705 | 70.0 |
| Regional/remote | 128,115 | 29.3 | 72,748 | 29.2 | 200,869 | 29.3 |
| Not known | 3,006 | 0.7 | 1,829 | 0.7 | 4,835 | 0.7 |
| **Socioeconomic index** | | | | | | |
| 1 Most disadvantaged | 84,434 | 19.3 | 48,960 | 19.6 | 133,394 | 19.4 |
| 2 | 90,659 | 20.8 | 51,151 | 20.5 | 141,810 | 20.7 |
| 3 | 90,921 | 20.8 | 50,954 | 20.4 | 141,875 | 20.7 |
| 4 | 80,132 | 18.3 | 46,154 | 18.5 | 126,286 | 18.4 |
| 5 Least disadvantaged | 86,239 | 19.7 | 49,559 | 19.9 | 135,798 | 19.8 |
| Not known | 4,480 | 1.0 | 2,758 | 1.1 | 7,238 | 1.1 |
| **Treated at a level 1 trauma centre** | | | | | | |
| No | 218,242 | 50.0 | 122,475 | 49.1 | 340,725 | 49.6 |
| Yes | 218,623 | 50.0 | 127,061 | 50.9 | 345,684 | 50.4 |

[1]Gender missing for 8 children. [2]Age missing for 1 child. [3]Data only available from ACT from 1 July 2004 and VIC child injury hospitalisations likely to include up to an additional 3,975 hospitalisations per year.

## Table 3.2: Injury mechanism of hospitalisations for children aged ≤16 years by gender, linked hospitalisation and mortality data, Australia, 1 July 2002 to 30 June 2012

| | Males (n=436,865) | | Females (n=249,536) | | Total[1,2] (n=686,409) | |
|---|---|---|---|---|---|---|
| | **n** | **%** | **n** | **%** | **n** | **%** |
| **Injury mechanism** | | | | | | |
| Transport incident | 66,380 | 15.2 | 27,395 | 11.0 | 93,778 | 13.7 |
| *Pedestrian* | 4,970 | 1.1 | 2,768 | 1.1 | 7,738 | 1.1 |
| *Pedal cyclist* | 30,197 | 6.9 | 7,184 | 2.9 | 37,382 | 5.4 |
| *Motorcyclist* | 19,118 | 4.4 | 2,643 | 1.1 | 21,761 | 3.2 |
| *Motor vehicle occupant* | 7,485 | 1.7 | 6,824 | 2.7 | 14,310 | 2.1 |
| *Heavy vehicle occupant* | 93 | 0.02 | 49 | 0.02 | 142 | 0.02 |
| *Bus occupant* | 167 | 0.04 | 156 | 0.1 | 323 | 0.05 |
| *Other land transport* | 4,350 | 1.0 | 7,771 | 3.1 | 12,122 | 1.8 |
| Water, air and other and unspecified transport | 1,713 | 0.4 | 832 | 0.3 | 2,545 | 0.4 |
| Falls | 165,879 | 38.0 | 97,380 | 39.0 | 263,260 | 38.4 |
| Inanimate mechanical forces | 78,423 | 18.0 | 42,423 | 17.0 | 120,846 | 17.6 |
| Animate mechanical forces | 28,034 | 6.4 | 10,937 | 4.4 | 38,971 | 5.7 |
| Drowning and submersion | 1,729 | 0.4 | 1,113 | 0.4 | 2,842 | 0.4 |
| Other threats to breathing | 1,497 | 0.3 | 1,050 | 0.4 | 2,547 | 0.4 |
| Electric current, radiation, extreme ambient air temperature and pressure | 483 | 0.1 | 252 | 0.1 | 735 | 0.1 |
| Smoke, fire and flames | 3,354 | 0.8 | 1,202 | 0.5 | 4,556 | 0.7 |
| Heat and hot substances | 9,882 | 2.3 | 7,327 | 2.9 | 17,209 | 2.5 |
| Venomous animals and plants | 4,394 | 1.0 | 2,435 | 1.0 | 6,829 | 1.0 |
| Exposure to forces of nature | 257 | 0.1 | 198 | 0.1 | 455 | 0.1 |
| Poisoning | 13,481 | 3.1 | 12,017 | 4.8 | 25,498 | 3.7 |
| Intentional self-harm | 3,391 | 0.8 | 14,887 | 6.0 | 18,278 | 2.7 |
| Assault | 9,649 | 2.2 | 4,227 | 1.7 | 13,877 | 2.0 |
| Other and unspecified injury mechanism | 48,319 | 11.1 | 25,861 | 10.4 | 74,183 | 10.8 |

[1]Gender missing for 8 children. [2]Data only available from ACT from 1 July 2004.

## Table 3.3: Fall injury sub-mechanism of injury-related hospitalisations of children aged ≤16 years by gender, linked hospitalisation and mortality data, Australia, 1 July 2002 to 30 June 2012

| | Males (n=436,865) | | Females (n=249,536) | | Total[1,2] (n=686,409) | |
|---|---|---|---|---|---|---|
| | **n** | **%** | **n** | **%** | **n** | **%** |
| **Fall injury sub-mechanism** | | | | | | |
| Fall on same level from slipping, tripping and stumbling | 17,491 | 4.0 | 11,250 | 4.5 | 28,741 | 4.2 |
| Fall involving ice-skates, skis, roller skates, skateboards, scooters, and other pedestrian conveyances | 17,957 | 4.1 | 6,500 | 2.6 | 24,458 | 3.6 |
| Other fall on same level due to collision with, or pushed by, another person | 16,311 | 3.7 | 2,227 | 0.9 | 18,538 | 2.7 |
| Fall while being carried or supported by other persons | 2,326 | 0.5 | 2,047 | 0.8 | 4,373 | 0.6 |
| Fall involving wheelchair | 141 | 0.03 | 90 | 0.04 | 231 | 0.03 |
| Fall involving bed | 6,107 | 1.4 | 5,103 | 2.0 | 11,210 | 1.6 |
| Fall involving chair | 6,123 | 1.4 | 5,418 | 2.2 | 11,541 | 1.7 |
| Fall involving other furniture | 3,150 | 0.7 | 2,383 | 1.0 | 5,533 | 0.8 |
| Fall involving playground equipment | 30,875 | 7.1 | 25,848 | 10.4 | 56,723 | 8.3 |
| Fall on and from stairs and steps | 4,630 | 1.1 | 3,312 | 1.3 | 7,942 | 1.2 |
| Fall on and from ladder or scaffolding | 686 | 0.2 | 320 | 0.1 | 1,006 | 0.1 |
| Fall from, out of or through building or structure | 7,072 | 1.6 | 3,055 | 1.2 | 10,127 | 1.5 |
| Fall from tree | 5,650 | 1.3 | 2,283 | 0.9 | 7,933 | 1.2 |
| Fall from cliff | 407 | 0.1 | 181 | 0.1 | 588 | 0.1 |
| Diving or jumping into water causing injury other than drowning or submersion | 889 | 0.2 | 439 | 0.2 | 1,328 | 0.2 |
| Other fall from one level to another | 10,800 | 2.5 | 6,681 | 2.7 | 17,481 | 2.5 |
| Other fall on same level | 19,782 | 4.5 | 10,582 | 4.2 | 30,364 | 4.4 |
| Unspecified fall | 15,482 | 3.5 | 9,661 | 3.9 | 25,143 | 3.7 |
| Total fall-related hospitalisations | 165,879 | 38.0 | 97,380 | 39.0 | 263,260 | 38.4 |

[1]Gender missing for 8 children. [2]Data only available from ACT from 1 July 2004.

Where the activity at the time of the injurious incident was specified, sporting activities (19.0%) and leisure activities (6.6%) were the most common types of activities conducted. A higher proportion of males (22.9%) were injured during sporting activities than females (12.1%). The six most common sports where injuries occurred were team ball, bat and stick sports, during individual water sports or equestrian activities, and during wheeled motor and non-motor sports. Males had a higher proportion of hospitalised injuries following team ball sports (11.1% vs 3.0%), wheeled motor (1.8% vs 0.4%) and non-motor (5.3% vs 2.4%) sports than females. Females (1.6%) had a higher proportion of hospitalised injuries during equestrian activities than males (0.2%).

The home (24.5%), schools, other institutions and public administrative areas (9.7%), and sports and athletic areas (8.6%) were the most common specified place of occurrence of the injury that resulted in hospitalisation (Table 3.4).

Fractures (41.9%), open wounds (16.0%), and injuries to internal organs (5.5%) were the three most common principal nature of injuries for children. There were a higher proportion of fracture-related injuries for males (44.5%) compared to females (37.3%). Poisoning (5.0%) was the fourth most common nature of injury for children, with three times higher proportion of hospitalisations occurring for females (9.1%) than males (2.7%). Head (23.9%), elbow and forearm (21.6%), wrist and hand (10.8%) and knee and lower leg (7.7%) injuries were the most common principal types of injury for children. Males had a higher proportion of wrist and hand injuries compared to females (12.0% versus 8.8%, respectively) (Table 3.5).

## Table 3.4: Activity and place of occurrence for injury-related hospitalisations for children aged ≤16 years by gender, linked hospitalisation and mortality data, Australia, 1 July 2002 to 30 June 2012

| | Males (n=436,865) | | Females (n=249,536) | | Total[1,2] (n=686,409) | |
|---|---|---|---|---|---|---|
| | **n** | **%** | **n** | **%** | **n** | **%** |
| **Activity at time of incident** | | | | | | |
| Sports activity | 99,894 | 22.9 | 30,272 | 12.1 | 130,167 | 19.0 |
| *Team ball sports* | 48,542 | 11.1 | 7,571 | 3.0 | 56,113 | 8.2 |
| *Team bat or stick sports* | 2,970 | 0.7 | 887 | 0.4 | 3,857 | 0.6 |
| *Individual water sports* | 3,206 | 0.7 | 1,553 | 0.6 | 4,759 | 0.7 |
| *Equestrian activities* | 942 | 0.2 | 3,944 | 1.6 | 4,887 | 0.7 |
| *Wheeled motor sports* | 7,996 | 1.8 | 904 | 0.4 | 8,900 | 1.3 |
| *Wheeled non-motor sports* | 23,147 | 5.3 | 5,917 | 2.4 | 29,064 | 4.2 |
| Leisure activity | 27,758 | 6.4 | 17,552 | 7.0 | 45,310 | 6.6 |
| Working for income | 2,368 | 0.5 | 461 | 0.2 | 2,829 | 0.4 |
| Other types of work | 4,918 | 1.1 | 2,409 | 1.0 | 7,327 | 1.1 |
| Resting, sleeping, eating or engaging in other vital activities | 11,049 | 2.5 | 8,735 | 3.5 | 19,784 | 2.9 |
| Engaged in other specified activities | 65,831 | 15.1 | 49,867 | 20.0 | 115,700 | 16.9 |
| During unspecified activity | 225,047 | 51.5 | 140,240 | 56.2 | 365,292 | 53.2 |
| **Place of occurrence** | | | | | | |
| Home | 93,691 | 21.5 | 74,439 | 29.8 | 168,130 | 24.5 |
| Residential institution | 433 | 0.1 | 497 | 0.2 | 930 | 0.1 |
| School, other institution and public administrative area | 42,784 | 9.8 | 23,581 | 9.5 | 66,365 | 9.7 |
| Sports and athletics area | 47,944 | 11.0 | 11,129 | 4.5 | 59,073 | 8.6 |
| Street and highway | 23,313 | 5.3 | 11,916 | 4.8 | 35,229 | 5.1 |
| Trade and service area | 4,603 | 1.1 | 3,126 | 1.3 | 7,729 | 1.1 |
| Industrial and construction area | 854 | 0.2 | 127 | 0.1 | 981 | 0.1 |
| Farm | 3,814 | 0.9 | 1,592 | 0.6 | 5,406 | 0.8 |
| Other specified places | 21,676 | 5.0 | 10,562 | 4.2 | 32,238 | 4.7 |
| Unspecified place | 197,753 | 45.3 | 112,567 | 45.1 | 310,320 | 45.2 |

[1]Gender missing for 8 children. [2]Data only available from ACT from 1 July 2004.

## Table 3.5: Principal nature and type of injury for injury-related hospitalisations of children aged ≤16 years by gender, linked hospitalisation and mortality data, Australia, 1 July 2002 to 30 June 2012

| | Males (n=436,865) | | Females (n=249,536) | | Total[1,2] (n=686,409) | |
|---|---|---|---|---|---|---|
| | **n** | **%** | **n** | **%** | **n** | **%** |
| **Principal nature of injury** | | | | | | |
| Fracture | 194,575 | 44.5 | 93,066 | 37.3 | 287,646 | 41.9 |
| Open wound | 70,363 | 16.1 | 39,155 | 15.7 | 109,518 | 16.0 |
| Injury to internal organs | 26,845 | 6.1 | 11,157 | 4.5 | 38,003 | 5.5 |
| Poisoning by drugs, medicaments and biological substances | 11,698 | 2.7 | 22,586 | 9.1 | 34,284 | 5.0 |
| Superficial injuries | 18,834 | 4.3 | 12,371 | 5.0 | 31,206 | 4.5 |
| Foreign body entering through natural orifice | 13,853 | 3.2 | 11,334 | 4.5 | 25,187 | 3.7 |
| Burns | 15,505 | 3.5 | 9,593 | 3.8 | 25,098 | 3.7 |
| Dislocations, sprains & strains | 13,318 | 3.0 | 7,435 | 3.0 | 20,753 | 3.0 |
| Toxic effects of substances chiefly nonmedicinal as to source | 7,529 | 1.7 | 5,129 | 2.1 | 12,658 | 1.8 |
| Injury to muscle, fascia and tendon | 8,058 | 1.8 | 3,064 | 1.2 | 11,122 | 1.6 |
| Traumatic amputation | 3,890 | 0.9 | 2,000 | 0.8 | 5,890 | 0.9 |
| Injury to nerves and spinal cord | 3,133 | 0.7 | 1,463 | 0.6 | 4,596 | 0.7 |
| Injury of eye and orbit | 3,180 | 0.7 | 1,139 | 0.5 | 4,319 | 0.6 |
| Crushing injury | 1,008 | 0.2 | 601 | 0.2 | 1,609 | 0.2 |
| Injury to blood vessels | 1,109 | 0.3 | 433 | 0.2 | 1,542 | 0.2 |
| Other and unspecified injuries[3] | 43,967 | 10.1 | 29,010 | 11.6 | 72,978 | 10.6 |
| **Principal bodily location of injury** | | | | | | |
| Head | 107,456 | 24.6 | 56,666 | 22.7 | 164,126 | 23.9 |
| Neck | 6,427 | 1.5 | 4,027 | 1.6 | 10,454 | 1.5 |
| Thorax | 3,569 | 0.8 | 1,769 | 0.7 | 5,338 | 0.8 |
| Abdomen, lower back, lumbar spine and pelvis | 12,993 | 3.0 | 7,311 | 2.9 | 20,304 | 3.0 |
| Shoulder and upper arm | 27,535 | 6.3 | 18,023 | 7.2 | 45,558 | 6.6 |
| Elbow and forearm | 97,500 | 22.3 | 50,962 | 20.4 | 148,465 | 21.6 |
| Wrist and hand | 52,452 | 12.0 | 21,887 | 8.8 | 74,339 | 10.8 |
| Hip and thigh | 11,516 | 2.6 | 5,116 | 2.1 | 16,633 | 2.4 |
| Knee and lower leg | 37,899 | 8.7 | 15,208 | 6.1 | 53,107 | 7.7 |
| Ankle and foot | 17,001 | 3.9 | 9,906 | 4.0 | 26,907 | 3.9 |
| Other injuries[4] | 62,517 | 14.3 | 58,661 | 23.5 | 121,178 | 17.7 |

[1]Gender missing for 8 children. [2]Data only available from ACT from 1 July 2004. [3]Other and unspecified injuries include frostbite, injury sequelae and other and unspecified effects of trauma. [4]Other injuries include: injuries 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.

There were 235,558 (34.3%) hospitalised injuries of individuals aged 0-5 years, 169,638 (24.7%) hospitalised injuries of individuals aged 6-10 years and 281,212 (41.0%) hospitalised injuries of individuals aged 11-16 years in Australia. Males had a higher proportion of hospitalised injuries compared to females in each of the three age groups examined. The proportion of child injury admissions by age group fluctuated by financial year. The age group with the highest proportion of reported child health conditions was the 11-16 year olds (7.1%). Over two-thirds of each age group were residents of urban areas. Child injury hospitalisations varied by socioeconomic status, with a higher proportion of injured children in all age groups residing in areas of socioeconomic disadvantage. The proportion of injury-related hospitalisations that were treated at a level 1 trauma hospital was highest amongst the 0-5 year age group (56.3%) (Table 3.6).

Where the type of activity was specified, sports activities were the most common activity being performed by children aged 6 to 16 years and leisure activities were the most common activity for children aged five years or less. Higher proportions of hospitalised injuries occurred for children aged 11-16 years in all of the six most common sports where injuries occurred i.e. team ball, bat and stick sports, individual water sports, equestrian activities, and during wheeled motor and non-motor sports.

The home was the most common place of occurrence for children aged 0-5 years (43.4%) and 6-10 years (18.1%). Sports and athletic areas were the most common place of occurrence for children aged 11-16 years (16.9%) (Table 3.7).

## Table 3.6: Demographic characteristics for injury-related hospitalisations of children aged ≤16 years by age group, linked hospitalisation and mortality data, Australia, 1 July 2002 to 30 June 2012

| Characteristics | 0-5 years (n= 235,558) | | 6-10 years (n=169,638) | | 11-16 years[1] (n=281,212) | |
|---|---|---|---|---|---|---|
| | n | % | n | % | n | % |
| **Gender** | | | | | | |
| Male | 136,070 | 57.8 | 101,814 | 60.0 | 198,980 | 70.8 |
| Female | 99,485 | 42.2 | 67,823 | 40.0 | 82,228 | 29.2 |
| **Admission year**[2] | | | | | | |
| 2002-2003 | 22,717 | 9.6 | 17,410 | 10.3 | 25,671 | 9.1 |
| 2003-2004 | 22,008 | 9.3 | 16,991 | 10.0 | 26,529 | 9.4 |
| 2004-2005 | 22,256 | 9.4 | 17,224 | 10.2 | 27,534 | 9.8 |
| 2005-2006 | 22,751 | 9.7 | 16,683 | 9.8 | 28,644 | 10.2 |
| 2006-2007 | 23,284 | 9.9 | 17,242 | 10.2 | 29,616 | 10.5 |
| 2007-2008 | 22,773 | 9.7 | 16,548 | 9.8 | 29,063 | 10.3 |
| 2008-2009 | 24,260 | 10.3 | 16,643 | 9.8 | 28,914 | 10.3 |
| 2009-2010 | 24,889 | 10.6 | 16,893 | 10.0 | 28,697 | 10.2 |
| 2010-2011 | 24,977 | 10.6 | 16,594 | 9.8 | 28,101 | 10.0 |
| 2011-2012 | 25,643 | 10.9 | 17,410 | 10.3 | 28,443 | 10.1 |
| **Jurisdiction hospitalised** | | | | | | |
| Australian Capital Territory[2] | 2,368 | 1.0 | 2,446 | 1.4 | 4,183 | 1.5 |
| New South Wales | 71,745 | 30.5 | 55,555 | 32.7 | 96,315 | 34.2 |
| Northern Territory | 4,253 | 1.8 | 3,087 | 1.8 | 3,730 | 1.3 |
| Queensland | 62,297 | 26.4 | 42,889 | 25.3 | 71,799 | 25.5 |
| Tasmania | 17,358 | 7.4 | 11,312 | 6.7 | 19,365 | 6.9 |
| South Australia | 3,761 | 1.6 | 3,154 | 1.9 | 4,796 | 1.7 |
| Victoria | 45,689 | 19.4 | 33,785 | 19.9 | 51,229 | 18.2 |
| Western Australia | 28,087 | 11.9 | 17,410 | 10.3 | 29,795 | 10.6 |
| **Total number of health conditions** | | | | | | |
| No child health conditions | 225,651 | 95.8 | 163,294 | 96.3 | 261,145 | 92.9 |
| 1 child health condition | 9,287 | 3.9 | 5,587 | 3.3 | 16,079 | 5.7 |
| 2+ child health conditions | 620 | 0.3 | 757 | 0.4 | 3,988 | 1.4 |
| **Location of residence** | | | | | | |
| Urban | 172,101 | 73.1 | 117,611 | 69.3 | 190,993 | 67.9 |
| Regional/remote | 61,704 | 26.2 | 50,927 | 30.0 | 88,237 | 31.4 |
| Not known | 1,753 | 0.7 | 1,100 | 0.6 | 1,982 | 0.7 |
| **Socioeconomic index** | | | | | | |
| 1 Most disadvantaged | 47,550 | 20.2 | 32,312 | 19.1 | 53,535 | 19.0 |
| 2 | 46,438 | 19.7 | 34,994 | 20.6 | 60,379 | 21.5 |
| 3 | 47,480 | 20.2 | 34,770 | 20.5 | 59,626 | 21.2 |
| 4 | 44,589 | 18.9 | 31,252 | 18.4 | 50,446 | 17.9 |
| 5 Least disadvantaged | 46,928 | 19.9 | 34,662 | 20.4 | 54,209 | 19.3 |
| Not known | 2,573 | 1.1 | 1,648 | 1.0 | 3,017 | 1.1 |
| **Treated at a level 1 trauma centre** | | | | | | |
| No | 103,032 | 43.7 | 84,984 | 50.1 | 152,708 | 54.3 |
| Yes | 132,526 | 56.3 | 84,654 | 49.9 | 128,504 | 45.7 |

[1]Age missing for 1 child. [2]Data only available from ACT from 1 July 2004.

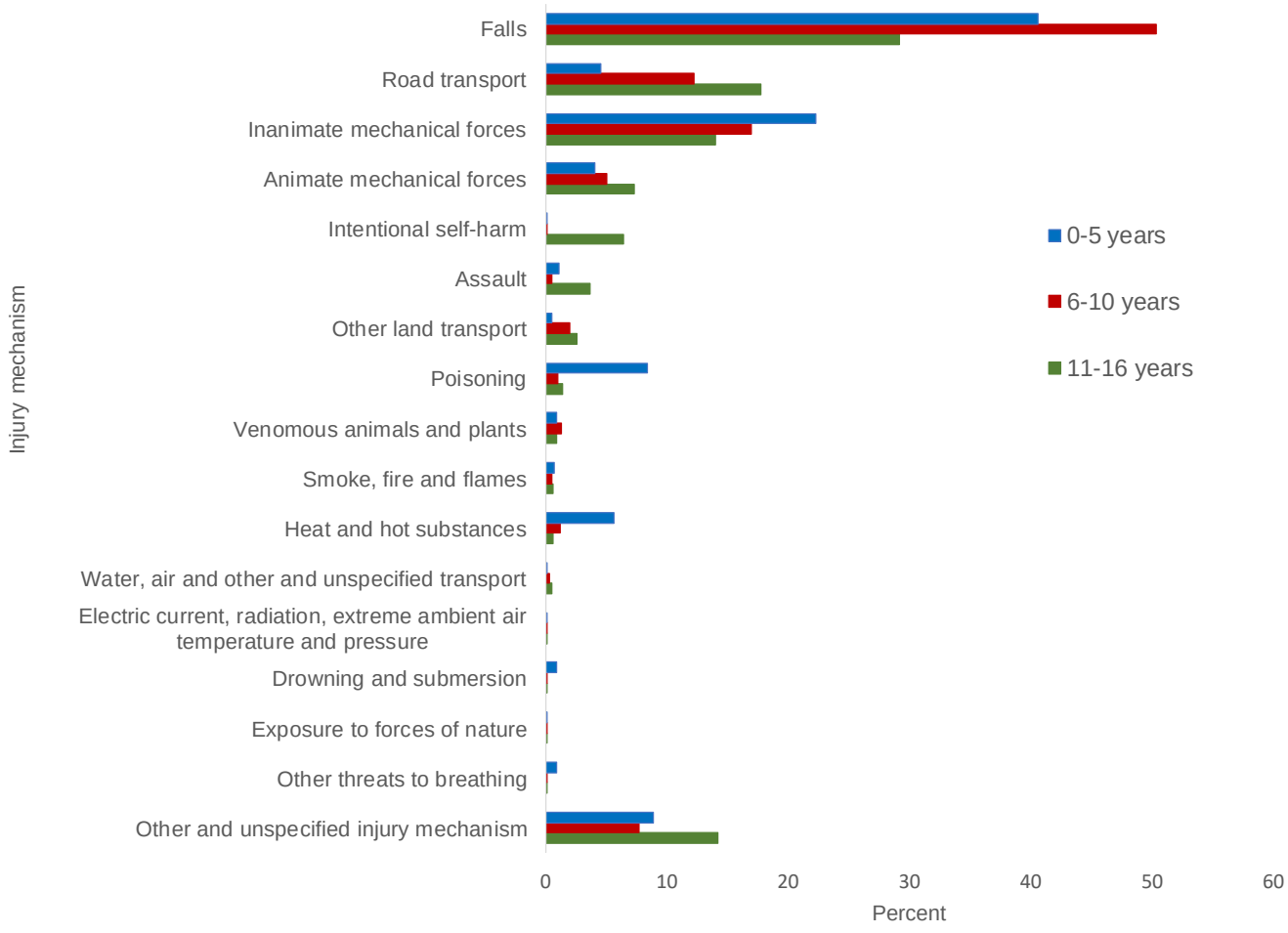
## Table 3.7: Activity and place of occurrence for injury-related hospitalisations of children aged ≤16 years by age group, linked hospitalisation and mortality data, Australia, 1 July 2002 to 30 June 2012

| | 0-5 years (n= 235,558) | | 6-10 years (n=169,638) | | 11-16 years[1,2] (n=281,212) | |
|---|---|---|---|---|---|---|
| | **n** | **%** | **n** | **%** | **n** | **%** |
| **Activity at time of incident** | | | | | | |
| Sports activity | 5,939 | 2.5 | 29,764 | 17.5 | 94,464 | 33.6 |
| *Team ball sports* | 510 | 0.2 | 8,086 | 4.8 | 47,517 | 16.9 |
| *Team bat or stick sports* | 68 | 0.03 | 730 | 0.4 | 3,059 | 1.1 |
| *Individual water sports* | 661 | 0.3 | 1,109 | 0.7 | 2,989 | 1.1 |
| *Equestrian activities* | 250 | 0.1 | 1,367 | 0.8 | 3,270 | 1.2 |
| *Wheeled motor sports* | 238 | 0.1 | 1,676 | 1.0 | 6,986 | 2.5 |
| *Wheeled non-motor sports* | 1,596 | 0.7 | 8,673 | 5.1 | 18,795 | 6.7 |
| Leisure activity | 16,720 | 7.1 | 17,929 | 10.6 | 10,661 | 3.8 |
| Working for income | 59 | 0.0 | 64 | 0.0 | 2,706 | 1.0 |
| Other types of work | 750 | 0.3 | 1,999 | 1.2 | 4,578 | 1.6 |
| Resting, sleeping, eating or engaging in other vital activities | 12,265 | 5.2 | 3,716 | 2.2 | 3,803 | 1.4 |
| Engaged in other specified activities | 42,988 | 18.2 | 30,134 | 17.8 | 42,578 | 15.1 |
| During unspecified activity | 156,837 | 66.6 | 86,032 | 50.7 | 122,422 | 43.5 |
| **Place of occurrence** | | | | | | |
| Home | 102,166 | 42.4 | 30,710 | 18.1 | 35,254 | 12.5 |
| Residential institution | 183 | 0.1 | 98 | 0.1 | 649 | 0.2 |
| School, other institution and public administrative area | 13,587 | 5.8 | 25,874 | 15.3 | 26,904 | 9.6 |
| Sports and athletics area | 1,831 | 0.8 | 9,636 | 5.7 | 47,606 | 16.9 |
| Street and highway | 5,193 | 2.2 | 8,462 | 5.0 | 21,575 | 7.7 |
| Trade and service area | 3,940 | 1.7 | 1,161 | 0.7 | 2,628 | 0.9 |
| Industrial and construction area | 147 | 0.1 | 100 | 0.1 | 734 | 0.3 |
| Farm | 820 | 0.4 | 1,336 | 0.8 | 3,251 | 1.2 |
| Other specified places | 8,062 | 3.4 | 9,053 | 5.3 | 15,124 | 5.4 |
| Unspecified place | 99,629 | 42.3 | 83,208 | 49.1 | 127,487 | 45.3 |

[1]Age missing for 1 child. [2]Data only available from ACT from 1 July 2004.

The injury mechanism varied for children by age group. Fall-related injuries accounted for half the hospitalised injuries for children aged 6-10 years (50.4%), for 40.6% of injuries of children aged 0-4 years, and for 29.2% of injuries involving children aged 11-16 years. Injuries from inanimate mechanical forces were common for children aged 0-5 years (22.3%) and those aged 6-10 years (17.0%). Road transport injuries were most common for children aged 11-16 years (17.8%) compared to those aged 6-10 years (12.3%) and those aged less than five years (4.5%). Being injured as a pedal cyclist (6.6% and 7.8%, respectively) or a motorcyclist (2.5% and 5.9%, respectively) was more common for children aged 6-10 years and 11-16 years than those aged five years or less. The proportion of injuries from animate mechanical forces was highest for children aged 11-16 years (7.3%) compared to the younger age groups. Injuries from intentional self-harm were most common for children aged 11-16 (6.4%) (Figure 3.4).

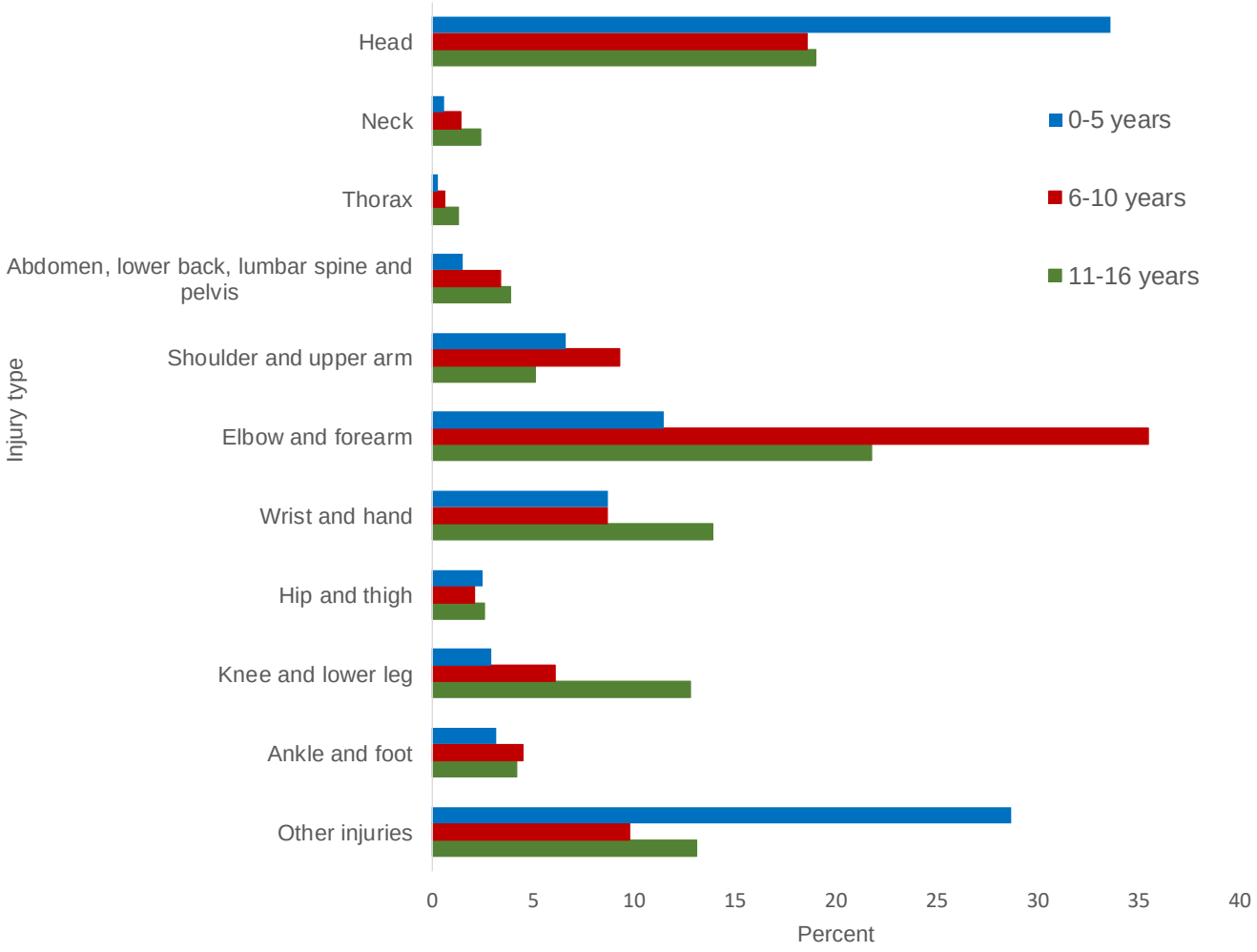
**Figure 3.4: Injury mechanism for injury-related hospitalisations of children aged ≤16 years by age group, linked hospitalisation and mortality data, Australia, 1 July 2002 to 30 June 2012[1]**




[1]Data only available from ACT from 1 July 2004 and age was missing for one child.

Head injuries were the most common principal injury resulting in hospitalisation of children aged 0-5 years (33.6%). Injuries to the elbow and forearm were the most common principal injuries for children aged 6-10 years (35.5%) and 11-16 years (21.8%) (Figure 3.5).

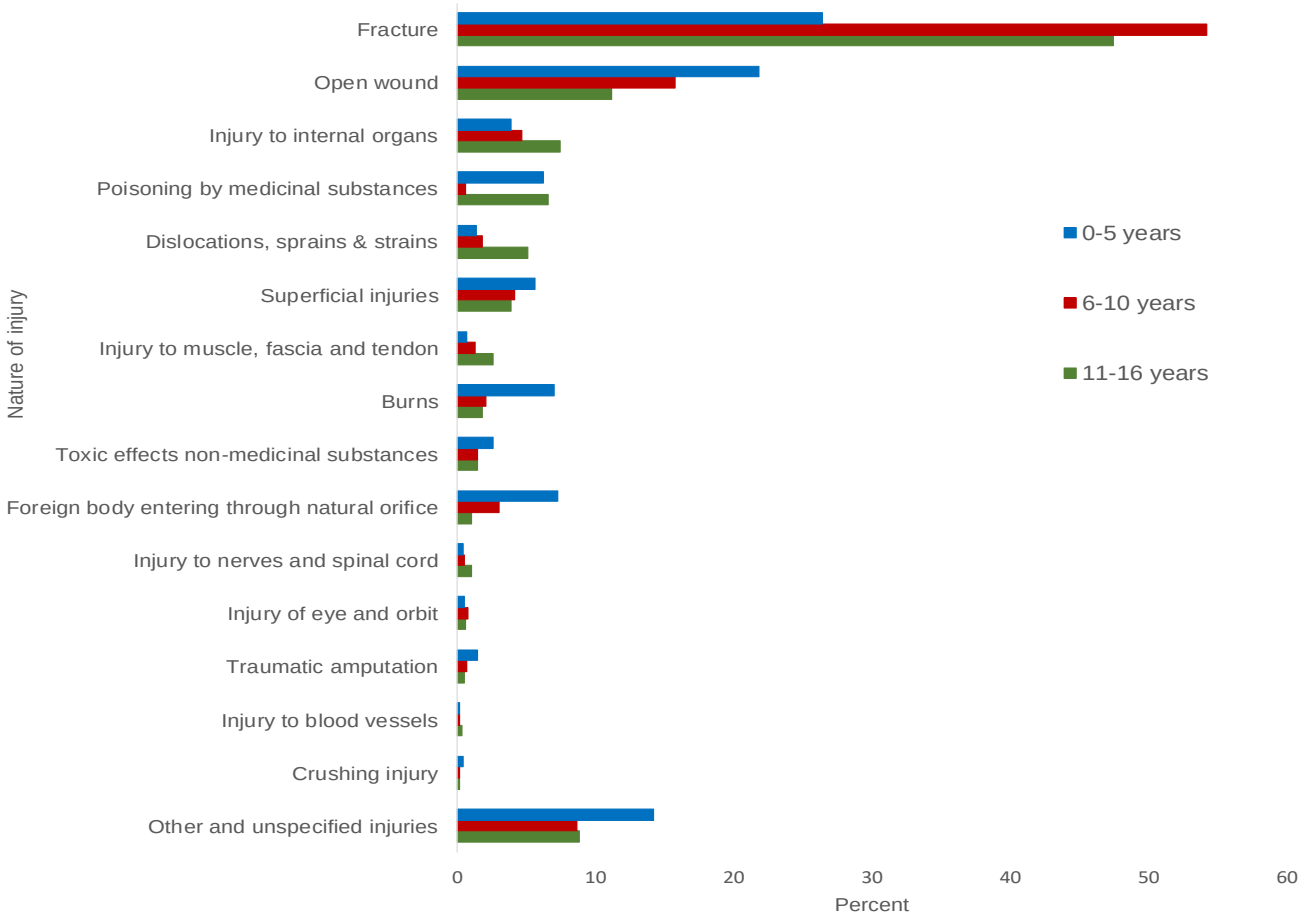
**Figure 3.5: Principal bodily location of injury for injury-related hospitalisations of children aged ≤16 years by age group, linked hospitalisation and mortality data, Australia, 1 July 2002 to 30 June 2012[1,2]**




[1]Data only available from ACT from 1 July 2004 and age was missing for one child. [2]Other injuries include: injuries 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 were the most common cause of injury hospitalisation among children aged 0-5 years (26.4%), those aged 6-10 years (54.2%) and those aged 11-16 years (47.5%). Open wounds were the second most common cause of hospitalisation among children in all age groups; 0-5 years (21.8%), 6-10 years (15.8%) and 11-16 years (11.2%). Injury to internal organs (7.5%) and dislocations, sprains and strains (5.1%) were common among children aged 11-16 years compared to the younger age groups. Poisoning was most common among the 0-5 year (6.2%) and the 11-16 year (6.6%) age groups compared to the 6-10 year olds (0.6%). Superficial injuries (5.6%), burns (7.0%), and foreign bodies entering through natural orifices (7.3%) were most common among children aged five years or less compared to the older age groups (Figure 3.6).

**Figure 3.6: Nature of principal injury for injury-related hospitalisations of children aged ≤16 years by age group, linked hospitalisation and mortality data, Australia, 1 July 2002 to 30 June 2012[1,2]**




[1]Data only available from ACT from 1 July 2004 and age was missing for one child. [2]Other and unspecified injuries include frostbite, injury sequelae and other and unspecified effects of trauma.

## 3.3 Injury outcomes and hospital treatment costs

Male and female children had similar proportions of both minor (60.3% vs 62.8%, respectively) and moderate (32.3% vs 31.0%, respectively) injuries resulting in hospitalisation. Males had a slightly higher proportion of serious injuries (7.4%) compared to females (6.2%). The proportion of hospital admissions by injury severity has not changed over the ten year period (Figure 3.7). After age-adjustment, males and females had similar 30- and 90-day mortality post injury admission, with females having slightly wider confidence intervals. Females had a higher age-adjusted 12-month mortality rate post the injury hospitalisation than males (0.17 versus 0.16, respectively). Males had a higher rate of readmission to hospital within 28 days following an injury-related hospital admission than females. Males had a higher mean hospital LOS and age-adjusted mean hospital LOS than females (Table 3.8). The unadjusted 30-day and 12-month mortality rates rose over the periods examined from 0.13% in 2002-03 to 0.19% in 2011-12 for 30-day mortality ($p<0.0001$) (Figure 3.8) and from 0.16% in 2002-03 to 0.21% in 2010-11 for 12-month mortality (Figure 3.9).

Minor injuries were the most common injury severity for each of the three age groups, ranging from 57.3% for those aged less than five years to 68.4% for those aged 6-10 years. Serious injuries were more common for those aged five years or less (7.7%) and those aged 11-16 years (7.5%) compared to those aged 6-10 years (4.9%). The proportion of 30-day, 90-day and 12-month mortality was similar within each age group. The 0-5 year (8.0%) and 6-10 year (8.4%) age groups had higher proportions of hospital readmission within 28 days compared to the 11-16 year (7.7%) age group. Mean hospital LOS was highest for those aged 11-16 years (Table 3.9). For children aged less than one year, there were 95 deaths (0.4%) within 30-days and 109 deaths (0.5%) within 90-days for the whole 10 year period. Between 2002-03 to 2010-11, there were 109 deaths (0.5%) within 12 months of children aged less than one year. There were 1,556 (7.4%) 28-day hospital all-cause readmissions and hospital LOS was 1.69 days (SD 2.0) for children aged less than one year.

**Table 3.8: Injury severity and health outcomes of children aged ≤16 years with an injury-related hospitalisation by gender, linked hospitalisation and mortality data, Australia, 1 July 2002 to 30 June 2012**

| | Males (n=436,865) | | Females (n=249,536) | | $\chi^2$ or t-test (df) |
|---|---|---|---|---|---|
| | **n** | **%** | **n** | **%** | |
| **Injury severity** | | | | | |
| Minor (ICISS ≤ 0.99) | 263,459 | 60.3 | 156,650 | 62.8 | 538.6 (2)* |
| Moderate (ICISS between 0.942-0.99) | 141,287 | 32.3 | 77,351 | 31.0 | |
| Serious (ICISS <0.942) | 32,119 | 7.4 | 15,535 | 6.2 | |
| **30-day mortality** | | | | | |
| Unadjusted | 602 | 0.14 | 381 | 0.15 | 2.5 (1) |
| Age-adjusted (95%CI) | | 0.13 (0.12-0.14) | | 0.14 (0.13-0.16) | t=-42.91 (481234)* |
| **90-day mortality** | | | | | |
| Unadjusted | 642 | 0.15 | 410 | 0.16 | 3.1 (1) |
| Age-adjusted (95%CI) | | 0.14 (0.13-0.15) | | 0.16 (0.14-0.17) | t=-41.96 (480995)* |
| **12-month mortality**[3] | | | | | |
| Unadjusted | 648 | 0.17 | 411 | 0.18 | 3.1 (1) |
| Age-adjusted (95%CI) | | 0.16 (0.15-0.17) | | 0.17 (0.16-0.19) | t=-32.31 (426516)* |
| **28-day readmission (any cause)** | | | | | |
| Unadjusted | 33,692 | 7.8 | 18,957 | 7.6 | 3.2 (1) |
| Age-adjusted (95%CI) | | 7.76 (7.7-7.8) | | 7.64 (7.5-7.8) | t=-55.7* |
| **Hospital length of stay** (days) | **Mean** | **(SD)** | **Mean** | **(SD)** | |
| Hospital length of stay | 1.53 | 1.6 | 1.46 | 1.5 | t=16.8* |
| Age-adjusted hospital length of stay | 1.52 | 0.1 | 1.49 | 0.1 | t=105.4* |

[1]Gender missing for 8 children. [2]Data only available from ACT from 1 July 2004. [3]12-month mortality was calculated for the period 2002-03 to 2010-11.

*p<0.0001; ** p<0.04.

**Figure 3.7: Injury hospitalisations of children aged ≤16 years by injury severity, linked hospitalisation and mortality data, Australia, 1 July 2002 to 30 June 2012[1]**

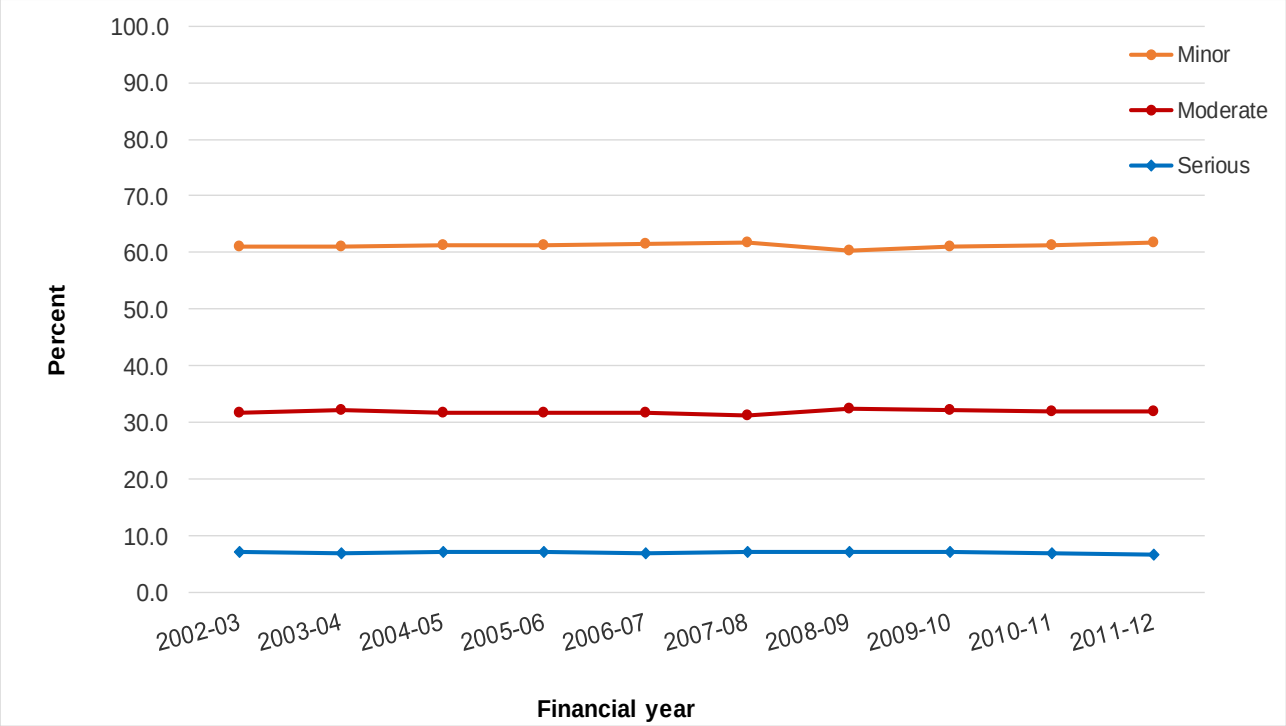
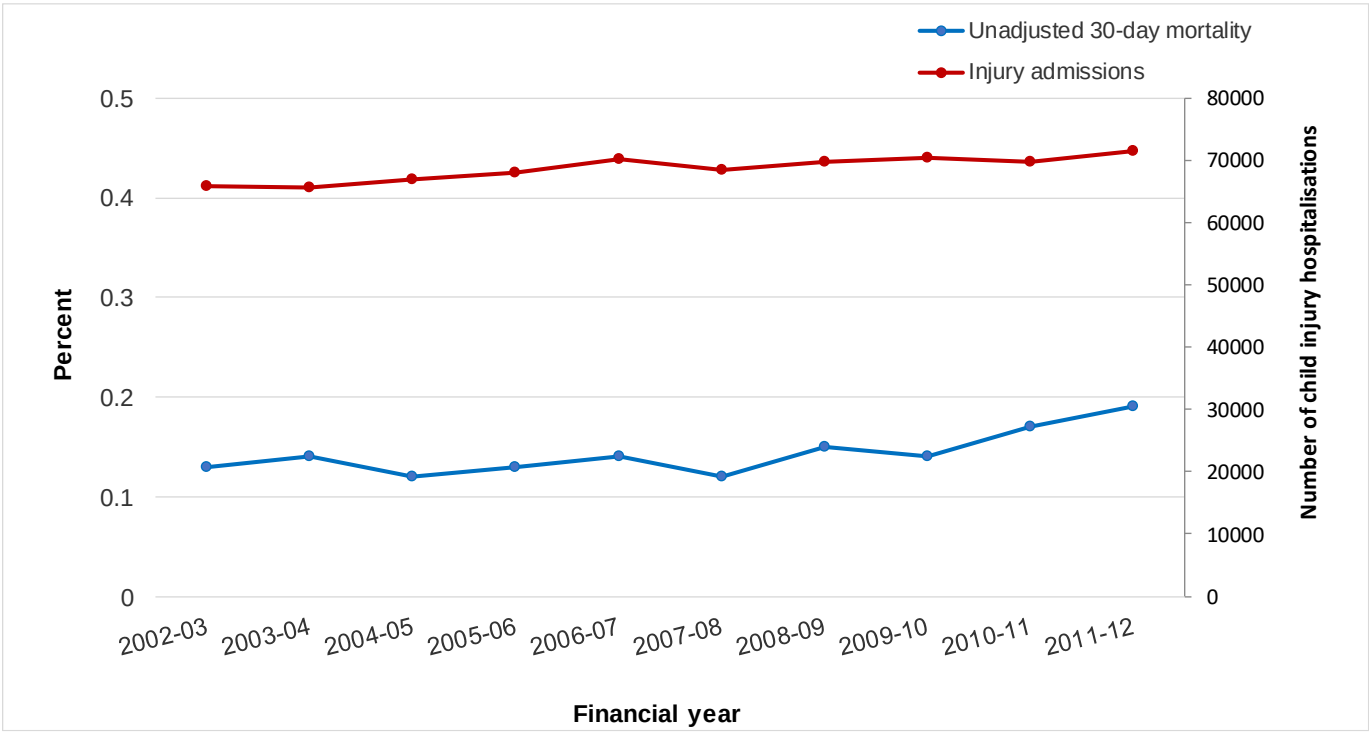
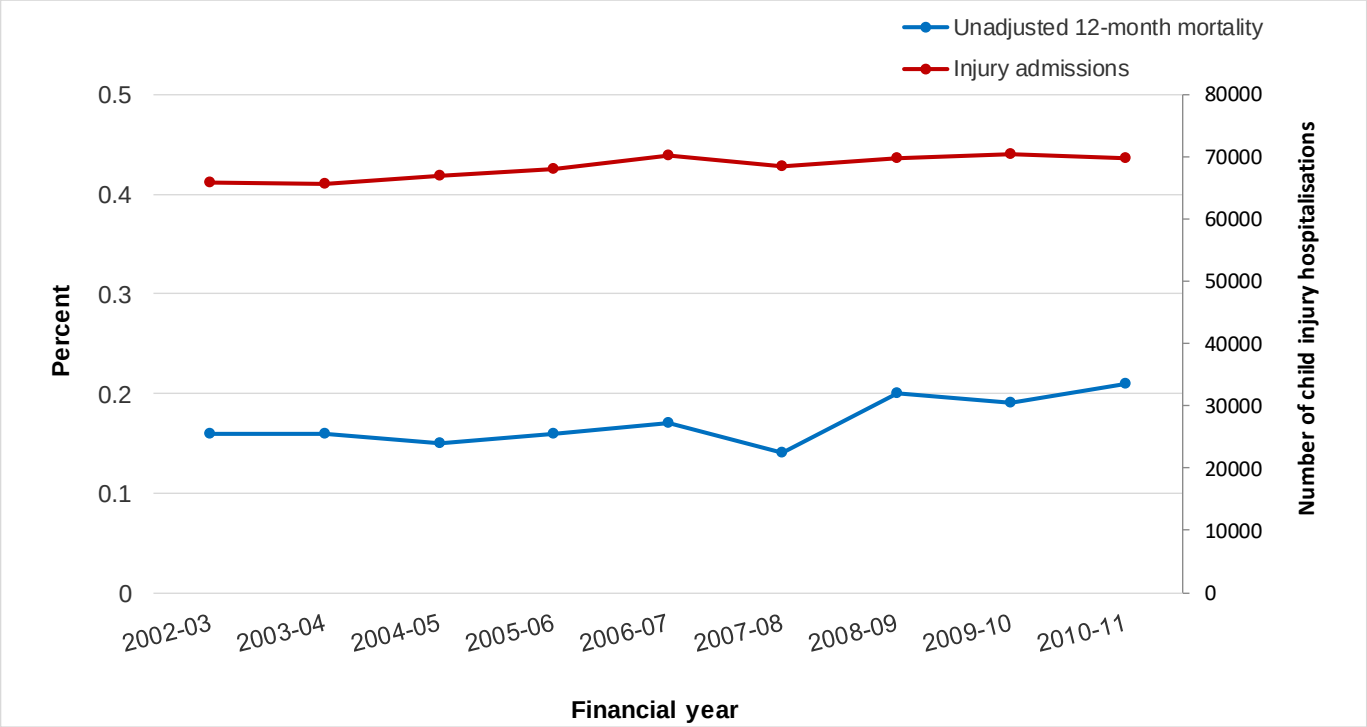



**Figure 3.8: Unadjusted thirty-day mortality rate following injury hospitalisations of children aged ≤16 years by financial year, linked hospitalisation and mortality data, Australia, 1 July 2002 to 30 June 2012[1]**




[1]Data only available from ACT from 1 July 2004.

## Figure 3.9: Unadjusted 12-month mortality rate following injury hospitalisations of children aged ≤16 years by financial year, linked hospitalisation and mortality data, Australia, 1 July 2002 to 30 June 2012[1]




[1]Data only available from ACT from 1 July 2004.

## Table 3.9: Injury severity and health outcomes of children aged ≤16 years with an injury-related hospitalisation by age group, linked hospitalisation and mortality data, Australia, 1 July 2002 to 30 June 2012

| | 0-5 years (n= 235,558) | | 6-10 years (n=169,638) | | 11-16 years[1,2] (n=281,212) | |
|---|---|---|---|---|---|---|
| | **n** | **%** | **n** | **%** | **n** | **%** |
| **Injury severity** | | | | | | |
| Minor (ICISS ≤ 0.99) | 135,036 | 57.3 | 116,096 | 68.4 | 168,979 | 60.1 |
| Moderate (ICISS between 0.942-0.99) | 82,370 | 35.0 | 45,228 | 26.7 | 91,043 | 32.4 |
| Serious (ICISS <0.942) | 18,152 | 7.7 | 8,314 | 4.9 | 21,190 | 7.5 |
| **Health outcomes** | | | | | | |
| 30-day mortality | 476 | 0.2 | 149 | 0.1 | 358 | 0.1 |
| 90-day mortality | 508 | 0.2 | 159 | 0.1 | 385 | 0.1 |
| 12-month mortality[3] | 499 | 0.2 | 156 | 0.1 | 404 | 0.2 |
| 28-day readmission (any cause) | 16,695 | 8.0 | 12,759 | 8.4 | 19,443 | 7.7 |
| | **Mean** | **(SD)** | **Mean** | **(SD)** | **Mean** | **(SD)** |
| Hospital length of stay (days) | 1.41 | 1.54 | 1.42 | 1.38 | 1.64 | 1.72 |

[1]Age missing for 1 child. [2]Data only available from ACT from 1 July 2004. [3]12-month mortality was calculated for the period 2002-03 to 2010-11.

### 3.3.1 Mortality risk

The multivariable Cox regression model identified that younger children (i.e. aged 10 years or less) had a higher mortality risk within 30-days compared to children aged 11-16 years. Moderately and severely injured children had a higher risk of mortality in 30-days compared to children with minor injuries. Children injured in transport incidents, following drowning and submersion or other threats to breathing and those injured as a result of intentional self-harm had a higher risk of mortality within 30-days compared to other and unspecified injury mechanisms. Children whose location of residence was in regional/remote Australia had a higher risk of mortality within 30-days compared to children who resided in urban areas. Children who sustained a head or thorax injury had a higher risk of mortality within 30-days compared to children who sustained other injuries. All injury types, except for neck injuries, were associated with a significantly lower risk of mortality at 30-days compared to other injuries.

At 12-months after the injury hospitalisation, females had a higher risk of mortality than males, children aged 0-5 years had twice the risk of mortality and children aged 6-10 years had a 31% higher mortality risk than children aged 11-16 years. Children with severe injuries had a higher risk of mortality at 12 months after the injury hospitalisation compared to children with minor injuries. Children injured in transport incidents had twice the mortality risk, children who died following drowning and submersion or other threats to breathing had three times the mortality risk, and children injured as a result of intentional self-harm had four times the risk of mortality at 12 months compared to other and unspecified injury mechanisms. Children residing in regional/remote areas had a higher risk of mortality at 12 months compared to children who resided in urban areas. Children who sustained a head injury had a higher risk of mortality at 12 months compared to children who sustained other injuries (Table 3.10).

## Table 3.10: Multivariable predictors of mortality at 30-days and 12 months following an injury hospitalisation for children aged ≤16 years, linked hospitalisation and mortality data, Australia, 1 July 2002 to 30 June 2012

| | 30-days | | 12 months[1] | |
|---|---|---|---|---|
| **Characteristics[2]** | **Hazard ratio** | **95% CI** | **Hazard ratio** | **95% CI** |
| **Gender[3]** | | | | |
| Male | 1 | | 1 | |
| Female | 1.16 | 1.00-1.34*** | 1.19 | 1.03-1.36*** |
| **Age group[4]** | | | | |
| 0-5 | 2.02 | 1.66-2.46* | 2.15 | 1.79-2.57* |
| 6-10 | 1.28 | 1.01-1.64*** | 1.31 | 1.05-1.63*** |
| 11-16 | 1 | | 1 | |
| **Number of health conditions** | | | | |
| None | 1 | | 1 | |
| One or more | 0.70 | 0.57-0.86* | 0.73 | 0.60-0.87* |
| **Injury severity** | | | | |
| Minor (ICISS ≤ 0.99) | 1 | | 1 | |
| Moderate (ICISS between 0.942-0.99) | 2.61 | 1.58-4.32* | 1.28 | 0.98-1.68 |
| Serious (ICISS <0.942) | 57.51 | 36.60-90.36* | 13.42 | 10.55-17.08* |
| **Injury mechanism** | | | | |
| Transport incidents | 2.42 | 1.74-3.37* | 2.17 | 1.63-2.89* |
| Falls | 0.45 | 0.30-0.67* | 0.63 | 0.46-0.87** |
| Inanimate mechanical forces | 1.05 | 0.71-1.56 | 1.11 | 0.81-1.52 |
| Animate mechanical forces | 0.70 | 0.36-1.36 | 0.78 | 0.46-1.32 |
| Drowning and submersion or other threats to breathing | 3.06 | 2.30-4.06* | 3.09 | 2.36-4.05* |
| Poisoning | 1.02 | 0.52-2.00 | 1.22 | 0.75-1.97 |
| Intentional self-harm | 5.00 | 3.41-7.33* | 4.22 | 3.01-5.92* |
| Assault | 0.98 | 0.61-1.58 | 1.02 | 0.68-1.53 |
| Other and unspecified injury mechanism | 1 | | 1 | |
| **Location of residence** | | | | |
| Urban | 1 | | 1 | |
| Regional/remote | 1.16 | 1.00-1.35*** | 1.17 | 1.01-1.34*** |
| Not known | 1.78 | 1.02-3.10*** | 1.98 | 1.20-3.27** |
| **Principal injury type** | | | | |
| Head | 1.54 | 1.14-2.08** | 1.65 | 1.27-2.15* |
| Neck | 0.94 | 0.53-1.66 | 1.22 | 0.73-2.03 |
| Thorax | 1.65 | 1.03-2.64*** | 1.33 | 0.81-2.19 |
| Abdomen, lower back, lumbar spine and pelvis | 0.59 | 0.37-0.92*** | 0.65 | 0.42-1.00*** |
| Upper extremities | 0.19 | 0.09-0.40* | 0.49 | 0.33-0.72* |
| Lower extremities | 0.14 | 0.06-0.28* | 0.52 | 0.36-0.76* |
| Other injuries[5] | 1 | | 1 | |

[1]12-month mortality was calculated for the period 2002-03 to 2010-11. [2]Data only available from ACT from 1 July 2004. [3]Gender missing for 8 children. [4]Age missing for 1 child. [5]Other injuries include: injuries 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.

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

### 3.3.2 Hospital treatment costs

The estimated total hospital costs of child injury hospitalisations and any subsequent rehabilitation hospital treatment was $2.1 billion over the ten year period. Annually, hospital treatment cost an estimated $212 million, with a mean cost per injured child of $3,119 (median $1,262). The total hospital cost is likely to be an underestimate as hospitalisation data was only available from the ACT from 1 July 2004, Tasmanian cost information was not available for two financial years (i.e. 2002-03 and 2003-04) and the number of child injury hospitalisations in Victoria is likely to be under-enumerated by up to 3,975 per year.

Males ($3,214) and children aged 11-16 years ($3,603) had higher mean hospital costs than females ($2,952) and younger children, respectively. The mean hospital cost varied by jurisdiction, with the lowest mean cost in Queensland ($2,779) and the highest mean cost in the Northern Territory ($5,675). Head injuries ($469 million), injuries to the elbow and forearm ($296 million) and knee and lower leg injuries ($228 million) represented the highest total principal injury costs for children. Injuries to the hip and thigh had the highest mean ($9,881) and median costs ($4,214) (Table 3.11).

Fall-related injuries ($638 million) and transport-related injuries ($504 million) were the costliest mechanisms of injury for children. Pedal cyclists ($131 million) and motor vehicle occupants ($126 million) represented the costliest type of transport incidents for children. Burns and injuries related to smoke, fire and flames ($12,035) and pedestrian-related injuries ($10,440) had the highest mean hospital costs for children (Table 3.12).

Fractures ($942 million), open wounds ($252 million) and injuries to internal organs ($237 million) were the most costliest principal nature of injuries for children. Injury to nerves and the spinal cord ($7,378), burns ($6,730), injury to blood vessels ($6,539), and injury to internal organs ($6,267) had the highest mean hospital costs for children. Total hospital costs varied by injury severity, with the minor injuries accounting for the highest cost ($915 million) and serious injuries accounting for the highest mean cost ($12,671) (Table 3.13).

## Table 3.11: Total hospital costs by demographic and principal injury characteristics of children aged ≤16 years with an injury-related hospitalisation, linked hospitalisation and mortality data, Australia, 1 July 2002 to 30 June 2012

| | Injury hospitalisations (n=684,330) | | | |
|---|---|---|---|---|
| | n[1] | Mean ($) | Median ($) | Total ($) |
| **Gender**[2] | | | | |
| Male | 433,371 | 3,214 | 1,262 | 1,392,843,559 |
| Female | 247,545 | 2,952 | 1,262 | 730,774,810 |
| **Age group**[3] | | | | |
| 0-5 | 232,821 | 2,750 | 1,262 | 640,322,465 |
| 6-10 | 168,453 | 2,825 | 1,175 | 475,840,867 |
| 11-16 | 279,642 | 3,603, | 1,262 | 1,007,455,038 |
| **Jurisdiction hospitalised**[4] | | | | |
| Australian Capital Territory | 8,906 | 3,908 | 2,103 | 34,804,826 |
| New South Wales | 223,609 | 3,215 | 1,262 | 718,952,313 |
| Northern Territory | 10,990 | 5,675 | 2,103 | 62,369,452 |
| Queensland | 175,378 | 2,779 | 1,175 | 487,388,869 |
| South Australia | 47,673 | 3,273 | 1,262 | 156,020,499 |
| Tasmania[5] | 9,641 | 3,486 | 1,286 | 33,605,852 |
| Victoria | 129,942 | 2,879 | 1,262 | 374,109,320 |
| Western Australia | 74,777 | 3,428 | 1,262 | 256,367,239 |
| **Principal injury type** | | | | |
| Head | 160,997 | 2,913 | 1,106 | 468,928,972 |
| Neck | 10,428 | 3,597 | 1,106 | 37,513,369 |
| Thorax | 5,317 | 5,781 | 1,268 | 30,736,345 |
| Abdomen, lower back, lumbar spine and pelvis | 20,240 | 5,437 | 1,989 | 110,047,837 |
| Shoulder and upper arm | 45,401 | 2,980 | 2,483 | 135,283,631 |
| Elbow and forearm | 147,951 | 2,001 | 1,051 | 296,075,859 |
| Wrist and hand | 74,103 | 2,738 | 2,523 | 202,923,716 |
| Hip and thigh | 16,561 | 9,881 | 4,214 | 163,634,298 |
| Knee and lower leg | 52,954 | 4,301 | 2,227 | 227,740,322 |
| Ankle and foot | 26,844 | 3,042 | 1,642 | 81,653,167 |
| Other injuries[6] | 120,120 | 3,073 | 1,262 | 369,080,854 |

[1]Where valid AR-DRG was present. [2]Gender missing for 8 children. [3]Age missing for 1 child. [4]Data only available from ACT from 1 July 2004 and VIC child injury hospitalisations likely to include up to an additional 3,975 hospitalisations per year. [5]AR-DRGs not available for Tasmania during 2002-03 and 2003-04. [6]Other injuries include: injuries 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

## Table 3.12: Total hospital costs by injury mechanism of children aged ≤16 years with an injury-related hospitalisation, linked hospitalisation and mortality data, Australia, 1 July 2002 to 30 June 2012

| | Injury hospitalisations[1,2] (n=684,330) | | | |
|---|---|---|---|---|
| | **n[3]** | **Mean ($)** | **Median ($)** | **Total ($)** |
| **Injury mechanism** | | | | |
| Transport incidents | 92,950 | 5,421 | 1,267 | 503,885,766 |
| *Pedestrian* | 7,612 | 10,440 | 2,227 | 79,468,886 |
| *Pedal cyclist* | 37,026 | 3,529 | 1,175 | 130,646,773 |
| *Motorcyclist* | 21,661 | 5,334 | 2,103 | 115,544,464 |
| *Motor vehicle occupant* | 14,157 | 8,899 | 1,175 | 125,977,905 |
| *Heavy vehicle occupant* | 138 | 4,804 | 1,175 | 662,955 |
| *Bus occupant* | 320 | 5,356 | 1,147 | 1,713,916 |
| *Other land transport* | 12,036 | 4,143 | 1,175 | 49,870,868 |
| Water, air and other and unspecified transport | 2,517 | 4,781 | 1,267 | 12,033,538 |
| Falls | 260,817 | 2,446 | 1,106 | 637,899,083 |
| Inanimate mechanical forces | 119,615 | 2,716 | 1,441 | 324,828,873 |
| Animate mechanical forces | 38,745 | 2,725 | 1,250 | 105,569,148 |
| Drowning and submersion | 2,837 | 3,885 | 1,294 | 11,020,852 |
| Other threats to breathing | 2,508 | 3,476 | 1,255 | 8,718,660 |
| Electric current, radiation, extreme ambient air temperature and pressure | 733 | 4,685 | 1,294 | 3,434,438 |
| Smoke, fire and flames | 4,541 | 12,035 | 2,438 | 54,651,210 |
| Heat and hot substances | 17,146 | 4,849 | 1,277 | 83,134,315 |
| Venomous animals and plants | 6,819 | 1,839 | 1,262 | 12,542,269 |
| Exposure to forces of nature | 452 | 2,878 | 1,294 | 1,300,655 |
| Poisoning | 25,381 | 1,788 | 1,262 | 45,374,564 |
| Intentional self-harm | 18,220 | 3,523 | 1,262 | 64,183,722 |
| Assault | 13,705 | 4,423 | 1,267 | 60,613,673 |
| Other and unspecified injury mechanism | 73,930 | 2,630 | 1,262 | 194,427,603 |

[1]AR-DRGs not available for Tasmania during 2002-03 and 2003-04. [2]Data only available from ACT from 1 July 2004. [3]Where valid AR-DRG was present.

## Table 3.13: Total hospital costs by nature of principal injury and injury severity of children aged ≤16 years with an injury-related hospitalisation, linked hospitalisation and mortality data, Australia, 1 July 2002 to 30 June 2012

| | Injury hospitalisations[1,2] (n=684,330) | | | |
|---|---|---|---|---|
| | n[3] | Mean ($) | Median ($) | Total ($) |
| **Nature of principal injury** | | | | |
| Fracture | 283,928 | 3,317 | 1,267 | 941,916,418 |
| Open wound | 109,231 | 2,307 | 1,267 | 252,007,874 |
| Poisoning by medicinal substances | 34,152 | 2,373 | 1,262 | 81,039,050 |
| Superficial injuries | 31,099 | 1,746 | 1,175 | 54,310,440 |
| Dislocations, sprains and strains | 20,721 | 3,021 | 1,286 | 62,589,861 |
| Injury to muscle, fascia and tendons | 11,089 | 3,987 | 2,999 | 44,214,134 |
| Injury to internal organs | 37,892 | 6,267 | 813 | 237,476,926 |
| Burns | 24,992 | 6,730 | 1,838 | 168,183,604 |
| Foreign body entering through natural orifice | 24,452 | 1,838 | 1,239 | 44,937,939 |
| Injury to nerves and spinal cord | 4,585 | 7,378 | 3,110 | 33,826,525 |
| Toxic effects of non-medicinal substances | 12,625 | 1,990 | 1,262 | 25,129,897 |
| Traumatic amputation | 5,851 | 4,426 | 2,523 | 25,896,938 |
| Injury to blood vessels | 1,538 | 6,539 | 2,523 | 10,057,266 |
| Injury of eye and orbit | 4,307 | 4,956 | 2,743 | 21,346,591 |
| Crushing injury | 1,601 | 2,872 | 2,523 | 4,598,069 |
| Other and unspecified injuries[4] | 72,853 | 1,593 | 1,106 | 116,086,836 |
| **Injury severity** | | | | |
| Minor | 418,118 | 2,189 | 1,210 | 915,341,206 |
| Moderate | 217,849 | 2,932 | 1,224 | 638,732,538 |
| Serious | 44,949 | 12,671 | 3,227 | 569,544,626 |

[1]AR-DRGs not available for Tasmania during 2002-03 and 2003-04. [2]Data only available from ACT from 1 July 2004. [3]Where valid AR-DRG was present. [4]Other and unspecified injuries include frostbite, injury sequelae and other and unspecified effects of trauma.

# 4. Discussion

Traumatic injury is a leading cause of hospital admission and ongoing disability among children worldwide [27, 44-50]. Injuries can leave many young children experiencing ongoing disabilities that affect their health-related quality of life and often necessitate continued access to healthcare services [51]. Injuries can also affect the psychological health of the injured child [2, 52], along with the child's parents, with many parents of severely injured children experiencing signs of post-traumatic stress disorder [3, 52].

During 2002-03 to 2011-12, there were 686,409 index injury-related hospitalisations of children aged 16 years or less in Australia. This number is likely to be higher as hospitalisation records were only available from the ACT from 1 July 2004 and 20.4% of Victoria child injury hospitalisation records (up to 3,975 child injury hospitalisations per year) were not able to be included in the study. The overall injury hospitalisation rate was 1489 per 100,000 population (excluding the ACT), with young males (1845.5 per 100,000 population) having higher injury hospitalisations rates than females (1113.0 per 100,000 population). There was no significant temporal trend in the injury hospitalisation rate of children over the ten year period. As injury prevention has been a national public health priority area in Australia for 30 years [53], it is disappointing that there has been no apparent reduction in child injury hospitalisations over the ten year period this study examined. In 2006, the World Health Organization (WHO) released a global child injury prevention strategy [54], and in 2008, a World Report on Child Injury Prevention [1], and has continued to promote the implementation of child injury prevention strategies. In Australia, the national injury prevention strategy expired in 2014 [55]. With injury continuing to represent a substantial burden to the Australian community [56] and as it is the highest cause of death and hospitalisation in Australian children aged one to six years, the development of a current national injury prevention strategy in Australia is long overdue.

The total hospital cost of injury hospital admissions of children in Australia was estimated to be $2.1 billion for the ten year period. Annually, injury-related hospital costs were $212 million, with a mean hospital cost of $3,119 (median $1,262). The total hospital cost of child injury hospitalisations in Australia is underestimated as costs were not able to be calculated for a two year period in Tasmania and the ACT and 20.4% of Victorian child injury hospitalisations were not able to be included in the cost calculations. Falls and transport-related injuries represented the costliest injury mechanisms for children, as had been found in previous studies examining the cost of hospitalised injury for children [14, 57-59].

Overall, 63.6% of the injury-related hospital admissions were of young males, with gender-based differences in the proportion of injury hospitalisation becoming more pronounced for the two older age groups (i.e. 6-10 years and 11-16 years). Males have previously been found to have a higher proportion and incidence rate of injury hospital admissions compared to females [44, 47, 50], which is likely to be as a consequence of their higher risk taking compared to females [60].

The three most common injury mechanisms for child injury hospitalisation were falls, injuries due to inanimate mechanical forces (such as being struck by/ striking against objects), and injuries as a result of road transport-related incidents. These mechanisms of injury have also been identified as the most frequent for children in other countries [44, 47, 49]. Falls represented almost 40% of injury hospital admissions and were the most common injury mechanism for children across all age groups. Falls from playground equipment was the most common fall sub-mechanism identified for children. While play is an important part of childhood and learning how to evaluate injury risk is considered a part of child development [61], routine playground safety audits should be conducted to identify worn equipment and that play equipment adheres to safety standards, including restricting the free-height of fall from play equipment, and that impact attenuated surfacing is used [62]. These sorts of injury prevention measures, coupled with use of age-appropriate play equipment and adult supervision are likely to go some way to reducing falls from play equipment [61].

Road transport-related injuries were more common among children aged 11-16 years than the younger age groups, particularly for children being injured as a pedal cyclist or a motorcyclist. Injuries following road transport incidents are some of the most common injuries experienced by young people worldwide [1]. Injury prevention measures aimed at reducing injuries to pedal cyclists include introducing environmental changes, such as traffic calming methods like speed bumps to slow vehicle speed, creating mechanisms to separate pedal cyclists from vehicles, such as cycle pathways, and increasing a child's road safety knowledge and traffic skills. Helmet use during cycling was not able to be examined in the current study, however previous research has found a protective effect of helmet wearing if a crash occurs while cycling for both head and facial injuries [63-65]. Injuries involving young motorcyclists have been identified as a common cause of hospitalisation for young people, particularly young males [66-68]. Injury prevention strategies aimed at reducing motorcycle injuries among young people can include ensuring that the motorcycle is well-maintained, skills and risk awareness training for novice riders, motorcyclist mentoring programmes, and ensuring the use of protective clothing and helmets [67, 68].

Poisoning was most common among young children aged 5 years or less whether from ingestion of pharmaceutical medications or of other toxic substances, such as detergents, button batteries, or other chemicals. Young children do not recognise the hazard associated with ingesting these substances, with poisoning also identified as a frequent cause of mortality and morbidity in other studies of childhood injury [46, 69, 70]. Child-resistant packaging, the safe storage of medications and other substances away from a young child's reach, preventing young children from removing button batteries from products through redesign, and adult supervision are all advocated to prevent the risk of ingestion [46, 70-72].

Compared to the younger age groups, there was a high proportion of self-harm among those aged 11-16 years, particularly females. Self-harm has been an increasing public health issue among young adolescents [73, 74]. A multi-country survey of adolescents aged 14-17 years regarding self-harm found that 8.9% of females and 2.6% of males reported an episode of self-harm in the last year [75]. Common factors associated with self-harm among adolescents are exposure to self-harm by friends or family members, psychosocial issues, substance abuse, and self-blaming coping strategies [74, 76-78], along with experience of mental health issues, including depression, or bullying [74, 78, 79]. Therapeutic interventions, including cognitive behaviour-based therapy, have been shown to be effective in reducing self-harm among adolescents [80].

Sporting activities were the most common type of activities being performed at the time of the injury for children. Australia is a sporting nation and participation in physical activity is encouraged for health and well-being. In Australia, an estimated 1.7 million children aged 5-14 years participate in organised sporting activities outside of school hours each year [81]. While participating in sport is a popular pastime, it can result in unintended injury [47, 50]. Prevention strategies for sport-related injures depend on the type of sport, but skills training, pre-game warm-up and stretching, use of protective equipment, such as helmets, mouthguards and protective padding have all been advocated during contact-based team ball and bat sports [82].

That the home was the most common place of occurrence of the injury for children aged 0-5 and 6-10 years is likely to be associated with where young children spend most of their time [46, 83-85]. As aged increased, the proportion of injuries occurring in the school environment (for 6-10 year olds) and at sport and athletic areas (for 11-16 year olds) increased.

Just over 40% of hospitalised injuries of children involved a principal diagnosis of a fracture. Fractures are a common nature of injury among young people [47]. Head injuries were the most common region injured among children 0-5 years and injuries to the upper and lower extremities among those aged 6-16 years. The head is a common body region injured for young children [83,

86] and head injuries are one of the most common causes of both mortality and hospitalisation [87] and ongoing disability [86] experienced by children.

The examination of unadjusted 30-day and 12-month mortality rates over time indicated that mortality rates had risen across the time periods examined. This increase may be due to changes in case-mix within the hospitals over time and/or better ascertainment of data linkage between the hospitalisation and mortality records over time.

Factors associated with a higher risk of both 30-day and 12-month mortality after the injury hospitalisation were the child was aged ≤10 years, they were severely injured, they were injured in a transport incident or following drowning and submersion or other threats to breathing, their usual residence was regional/remote Australia, and they sustained a head injury. Road trauma represents some of the most severe injuries seen for children in Australian hospitals [6, 88, 89], so it is not surprising that road transport crashes had a higher risk of mortality. Neither is it surprising that drowning and submersion was associated with a higher risk of mortality[90]. In terms of residential location, children living in regional/remote Australia can also be exposed to occupational hazards, as their home and play area is often a regional/remote workplace [91-94].

In terms of prevention measures to reduce mortality and injury risk for childhood drowning, the installation and maintenance of swimming pool fencing is recommended as a key prevention strategy as it restricts access a pool. However, enforcement of swimming pool fencing legislation is still needed [95, 96]. Active adult supervision of children around water, whether swimming pools or bathtubs, is recommended [97], along with water safety awareness training and water survival skills [98]. On regional/remote properties, the creation of safe play areas for young children aged five years or less has been advocated as a strategy to separate children from any potential occupational hazards and to reduce the rate of childhood injury on regional/remote properties [99].

While injury hospitalisations represent one piece of the child injury burden in Australia, there are many more children who present to emergency departments and general practitioner (GP) surgeries for treatment [44, 47, 100]. During the ten year period examined for this study, there were also 1,759 injury deaths of children aged 16 years or less in Australia [101], some of which are captured by this study, if the child was admitted to hospital prior to death. Many of the serious injuries sustained by children can have long-term implications for ongoing care and treatment, affecting the child's health-related quality of life and also posing stress on caregivers and other family members [5, 52, 102, 103]. Having timely and accurate information on child injury hospitalisations is essential to monitor temporal trends in childhood injury and in evaluating the impact of injury prevention initiatives [14-16]. The Australian national trauma registry will go some

way to addressing this for which the Australian Government is providing $450,000 over three years. This complements a total in-kind contribution of $1.85 million from participating hospital sites, and a $50,000 contribution from The Alfred Foundation [104]. However funding is not secured past 2020, and the registry captures only the acute hospitalisation information of those children who are most severely injured and treated at one of Australia's 27 major trauma centres (which equates to approximately half of Australia's injured children). In addition, being able to capture the longer-term effects, particularly of serious injury, on children and their families at a national-level would enable the quantification of the longer-term impact of the injury on both the child and their family and would be instrumental in identifying any unmet family needs related to the child's injury and any ongoing treatment [105].

The Australian national trauma registry will go some way to addressing this for which the Australian Government is providing $450,000 over three years. This complements a total in-kind contribution of $1.85 million from participating hospital sites, and a $50,000 contribution from The Alfred Foundation [104]. However funding is not secured past 2020, and, the registry captures only the acute hospitalisation information of those children who are most severely injured and treated at one of Australia's 27 major trauma centres (which equates to approximately half of Australia's injured children).

There were several limitations of the current research. Not having information on injury-related hospitalisations in the ACT prior to 1 July 2004 and that 20.4% of the injury hospitalisations in Victoria were not able to be linked and included in the analysis has resulted in under-enumeration of injury-related hospitalisations involving children in Australia. Unplanned hospital readmissions were not able to be examined and data validity was not able to be assessed and it is possible there could be some misclassification in hospitalisation records. There were 45.2% place of occurrence and 53.2% activities conducted at the time of the incident unspecified in the hospitalisation data. If these unspecified places and activities were able to be identified, they may have altered the proportions of places where the injury occurred and activities conducted at time of injury data. For the identification of child health conditions, only health conditions that were relevant to the current hospital episode of care are reported in each hospitalisation record. As a result, it is likely that health conditions experienced by injured children are under-enumerated.

The calculation of injury hospitalisation costs excluded two years of hospitalisations in the ACT and in Tasmania and 20.4% of Victorian injury hospitalisation records for children, so will underestimate the true cost of injury hospitalisations of children in Australia. In addition, the estimation of hospital costs only included hospital treatment costs, so will underestimate personal

(e.g. lost parental earnings) and societal (e.g. compensation, property damage) costs and other treatment costs, such as treatment provided by GPs and/or allied health professionals. When using record linkage techniques to link hospitalisation and mortality records there is likely to be some degree of error in the data linkage process.

The logistics of obtaining access to the hospitalisation and mortality records to conduct this research was time consuming. It involved obtaining ethical approval in all states and territories and from the AIHW and required the Health Department in each jurisdiction to provide identifying information (e.g. name, address, date of birth) from their hospitalisation records to the AIHW Data Linkage Unit for the purpose of linking hospitalisation and mortality records. Some strategies have been recommended to reduce research timeframes where record linkage is involved, such as recognition of prior ethics approval, as is conducted for multi-jurisdiction clinical trials under the National Health and Medical Research Council's (NHMRC) national approach to single ethics review [17] or the development of a national ethics committee with capacity to provide ethics approval recognised by all jurisdictions [106]. The lengthy AIHW hospitalisation data release procedures that require data custodian approval from each jurisdiction also resulted in significant delay in the investigators obtaining the data for analysis. In total, this study took four years to complete, with the delays somewhat compromising the timeliness of the report findings, but nonetheless this is the most comprehensive analysis of child injury hospitalisations and health outcomes in Australia across a ten year period.

# 5. Conclusion

Childhood injury is preventable. This study has identified that childhood injury hospitalisation rates have not decreased over a ten year period and that child injury remains a costly and tragic public health issue in Australia. Therefore, reducing hospitalised childhood injury remains a national priority. As young children age, their patterns of injury change and priorities for injury prevention alter according to their developmental stages and their exposure to injurious situations. Child injury prevention strategies need to be targeted accordingly. This research indicates that the development of a national multi-sectorial childhood injury prevention strategy in Australia is long overdue.

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# 7. Appendix 1

In Victoria, 20.4% (n=41,482) of the child injury hospital records did not have any names on the record and these hospital records were not able to be linked by the AIHW Data Linkage Unit.

Where these hospitalisations related to transfers or statistical discharges, they were excluded from this summary analysis in order to attempt to partly eliminate 'multiple counts'. These exclusions refer to transfers between hospitals or changes in the service category (e.g. a change from acute to rehabilitation) for a patient during one episode of care in a single facility.

There were 39,747 potential additional child injury hospitalisations during 2002-03 to 2011-12. There were on average, 3,975 child injury hospitalisations each year. Just over two-thirds of the hospitalisations were of males (64.1%) and 35.9% were of females. There were 769 (1.9%) children aged less than 1 year, 9,369 (23.6%) aged 1-5 years, 9,299 (23.4%) aged 6-10 years and 20,310 (51.1%) aged 11-16 years. Falls (27.2%), inanimate mechanical forces (12.2%), animate mechanical forces (4.1%) and being injured as a pedal cyclist (4.0%) were the most mechanisms of injury. Fractures (41.0%) and open wounds (15.7%) were the most common principal nature of injury. Head injuries (19.9%), injuries to the elbow and forearm (19.2%), injuries to the wrist and hand (12.7%) and injuries to the knee and lower leg (9.2%) were the most common principal bodily locations of the injury.

It is not known whether these unlinked hospital records in Victoria represent new injury hospital admissions or hospital admissions that have already been partly captured within a 'period of care' in the results section of this report.