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Hospital care for Australian sports injury

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Abbreviations

ABS	Australian Bureau of Statistics
AIHW	Australian Institute of Health and Welfare
AR-DRG	Australian Refined Diagnosis Related Groups
CURF	Confidentialised Unit Record File
HTTL	high threat to life
ICD	International Classification of Diseases
ICD-10-AM	International Classification of Diseases, Tenth revision, Australian modification
LFS	Labour Force Survey
MDC	major diagnostic categories
MLOS	mean length of stay
MPHS	Multipurpose Household Survey
NHMD	National Hospital Morbidity Database
NISU	National Injury Surveillance Unit
Obs	number of observations
PSPRA	Participation in Sport and Physical Recreation, Australia
RADL	Remote Access Data Laboratory
RSE	relative standard error
SE	standard error
TBI	traumatic brain injury

Symbols

—	nil or does not have a ranking

Summary

This report analyses Australian hospitalisations data for 2012–13 to provide an insight into the impact of sports injury on 1 part of the Australian health system, and to improve understanding of the types of sport-related injury conditions for which people are admitted to Australian hospitals. In particular, the report focuses on the acute care services provided by hospitals for sports injuries.

Cases of sports injury are examined in terms of the body region injured and the type of injury sustained. Information is presented on the main sporting activities associated with the injuries, the care provided in hospital, the number of days that patients spent in hospital for the acute care for each injury type, and estimated costs of the hospital care.

Ten types of injury are described in some detail. These injuries were selected because they were comparatively frequent and/or were prominent in the sport-related injury literature. Together, the selected injury types account for more than two-thirds of all cases of identifiable hospitalised sport-related injury.

Head injury

Of the selected injury types, *Head injury* was the most common, accounting for 16% of all hospitalised sport-related cases. It was associated with the greatest number of days spent in hospital by patients (over 14,000 days in total). The highest proportions of head injuries were sustained while playing rugby or while cycling. The average cost of acute public hospital care for sport-related *Head injury* was $5,300 per case.

Knee injury

Injury to the knee accounted for 12% of hospitalised sports injury. Acute hospital care for *Knee injury* accounted for around 9,500 days spent in hospital. *Knee injury* was most commonly sustained in the course of playing soccer or netball. The average cost of acute public hospital care for sport-related *Knee injury* was $6,800.

Wrist injury

Wrist injury accounted for 13% of hospitalised sports injury, and was associated with around 8,300 days spent in hospital. More than 9 in 10 injuries to the wrist were fractures. Roller sports were the leading cause of *Wrist fracture* for both males and females. The average cost of acute public hospital care for sport-related *Wrist fracture* was $4,500.

Spinal injury

Injury to the spinal column and cord, although accounting for around 3% of all of the sport-related injury cases, accounted for 7,700 days spent in hospital. The average cost of acute public hospital care for sport-related cases of *Injury to the spinal cord* was $25,000 for injury at the thoracic-lumbosacral level and $42,800 for injury to the cervical spine.

1 Introduction

This report analyses Australian hospitalisations data for 2012–13 to improve understanding of the types of sport-related injury conditions for which people are admitted to Australian hospitals; and to gain an insight into the impact of sports injury on 1 part of the Australian health system. Cases of sports injury are examined in terms of the body region injured, with a focus on common and prominent types of injury sustained in sport (for example, cruciate ligament injury and concussion). Published literature has been used to provide context in relation to factors such as long-term outcomes, incidence and socio-economic impact.

The costs of acute care for each of the injuries in public hospitals have also been estimated.

This report builds on a previous publication, *Australian sports injury hospitalisations 2011–12*, which provided information on hospitalised cases of injury sustained in selected sports played in Australia.

Cost of sport-related injury

It has been estimated that around 5.2 million Australians sustain sport-related injuries each year (Medibank Private 2006), and that, in 2002 and 2005, sports injuries cost the Australian community $1.65 and $2 billion per year, respectively (Orchard & Finch 2002; Sports Injury Prevention Taskforce 2013).

A lack of population-wide data on sports injuries and on sports participation has restricted measurement of the cost of sport-related injury to approximate estimates (Finch 2012).

Information about the cost to the health system and health expenditure on sports injury tends to be piecemeal, as some examples from Australian and overseas literature make plain. A study of the cost of reconstruction surgery for anterior cruciate ligament injury in Australia, a commonly sustained sporting injury, arrived at a figure of $75 million per year (Janssen et al. 2012). A New Zealand study of claims made against the country's no-fault accident compensation scheme found that, over a 10-year period, around 21,000 claims had been made for sport-related concussion, costing over $16 million (King et al. 2014). Sports injury is the principal cause of emergency department presentations for children, and hospital treatment for sport-related injury among children under 15 now imposes a significantly greater impact than do injuries sustained by children in road accidents (Shee et al. 2014).

Prevention

Certain measures can prevent sports injury. For example, certain training programs have been shown to assist in the prevention of lower limb injuries (Olsen et al. 2005). A systematic review of randomised controlled trials of sports injury prevention interventions has found evidence for the efficacy of some measures, such as external joint supports (Leppänen et al. 2013). The adoption of guidelines for the better management of concussion in sport can help to prevent the serious outcomes associated with this type of injury (McCrory et al. 2017). The wider promotion of some already familiar interventions, such as the use of mouthguards in some sports where their use is low, could also assist injury prevention (Sports Injury Prevention Taskforce 2013).

Use of hospital data to measure sports injury

Finch (2012) has argued that sports injury attracts disproportionately little attention in public health agendas and that there is a need for good-quality population-level data which will satisfy policymakers (Finch 2012). Routinely collected hospitalisations data are one such information source.

Hospital separations data can identify a small proportion of all cases of sports injury. The NSW Population Health Survey found that around 3% of sports-injured respondents had been admitted to hospital for their injury (Finch 2012). In order to identify hospitalised cases of sports injury in Australia, one must rely upon the International Classification of Diseases activity codes—which have been shown to significantly underestimate hospital admissions resulting from injuries sustained in sport (Finch & Boufous 2008). The estimates of sport-related injury in this report are likely to be underestimates for 3 main reasons:

- a non-specific activity code is assigned to some hospitalised injury cases that are, in fact, due to sport
- sport-related hospitalised cases may be coded to conditions other than injury and, if so, they are not normally assigned an activity code and cannot be identified as sport-related (for example, knee disruption may be coded as a musculoskeletal condition; see Box 2.2)
- most sport-related injuries are treated without admission to a hospital.

While the introduction of activity codes was a major step forward for reporting on sport-related injury, their utility is hampered by the fact that, in a substantial proportion of sports injury cases, hospitalisation records have been found to have either a missing or 'unspecified activity' code (Finch & Boufous 2008; Langley et al. 2007; Soo et al. 2009). In addition, activity codes are not used for admissions because conditions may be due to injury but coded as *Musculoskeletal diseases*. A 2008 examination by Finch and Boufous of New South Wales hospital separations data for the period 2003–04 led them to conclude that the use of activity codes to identify sports and leisure-related injury results in a significant underestimation of the number of cases involved. They found that, in over 30% of cases, an activity code was either missing or unspecified. Their analyses showed that, for the full set of injury hospitalisations, 13.9% had a specific activity code for sports and leisure. After adjustment for the underreporting associated with 'unspecified' or missing activity codes, this proportion rose to 20% of all sports injury hospitalisations (Finch & Boufous 2008).

Soo et al. (2009) suggest that the large number of sports injury cases with missing or 'unspecified' activity codes may, in part, be due to some hospitals and clinicians not giving sufficient priority to recording the information necessary for the assignment of these codes. McKenzie et al. (2009) also point to the absence of Australian coding standards to guide clinical coders in assigning activity codes. As with other information on the causes and circumstances of injury, disclosure of detail by patients and carers to hospital staff will vary.

Based on the findings described above, the results reported here are likely to be an underestimate of the true extent of hospitalised sports injury in Australia. It is also possible that the quality of activity-code data varies from sport to sport. For this reason, comparisons between different sports need to be interpreted with caution.

For further information on data issues, see Appendix A.

Despite its limitations, the hospital separations data collection currently provides the best means of gaining an insight into the more severe and costly cases of sports injury.

Structure of this report

Chapter 1 of the report contains an introduction to the topic of the impact of sports injury and describes the methods used to analyse the data that underlie the following chapters.

Chapters 2 to 11 focus on aspects of prominent and common sport-related injury conditions for which hospital care is provided. Specifically, the analyses include:

- the nature of the major injuries sustained
- the types of sport most commonly associated with these injuries
- population-based and participation-based rates of injury
- indicators of severity such as mean length of stay, proportion of cases that were considered high threat to life, and transfers to other acute care hospitals
- the procedures most frequently used to address the injuries.

Chapter 12 presents an overview of the average estimated cost of hospital care associated with a sport-related injury in 2012–13, based on Australian Refined Diagnosis Related Groups (AR-DRGs). These estimates are limited to costs directly incurred as an admitted patient receiving acute care in a public hospital.

'Appendix A: Data issues' provides further information on the National Hospital Morbidity Database (NHMD), and notes on the presentation of data, the population estimates used to calculate population rates and analysis methods.

'Appendix B: Participation-based rates' includes the denominators used for calculating participation-based rates, as well as the highest sport-specific participation-based rates for each type of injury.

'Appendix C: Additional tables' consists of tables of the data underpinning results presented in the report.

Most values reported in the text are drawn from a table, which is referenced. At some points in the text, additional values are reported which are not drawn from a table presented in the report; in general, these are reported as '(Results not tabulated)'.

Methods and data sources

To achieve consistency with the previous AIHW NISU publication on sports injury, this report used data from the NHMD for 2012–13. The data used in both reports was coded to the 7th edition of ICD-10-AM. Diagnoses and information on the external causes of injuries for the hospital separations reported here were coded according to the International Statistical Classification of Diseases and Related Health Problems, Tenth Revision, Australian Modification (ICD-10-AM) (NCCH 2010).

Important terms regarding the data used in this report are summarised in Box 1.1.

Box 1.1: Summary of terms relating to hospitalised injury

Statistics on admitted patients are compiled when an **admitted patient** (a patient who undergoes a hospital's formal admission process) completes an episode of admitted patient care and 'separates' from the hospital. This is because most of the data on the use of hospitals by admitted patients are based on information provided at the end of the patients' episodes of care, rather than at the beginning. The length of stay and the procedures carried out are then known and the diagnostic information is more accurate.

Separation is the term used to refer to the episode of admitted patient care, which can be a total hospital stay (from admission to discharge, transfer or death) or a portion of a hospital stay beginning or ending in a change of type of care (for example, from acute care to rehabilitation). 'Separation' also means the process by which an admitted patient completes an episode of care by being discharged, dying, transferring to another hospital or changing type of care.

The **principal diagnosis** is the diagnosis established, after study, to be chiefly responsible for occasioning the patient's episode of admitted patient care.

An **external cause** is defined as the environmental event, circumstance or condition that was the cause of injury or poisoning. Whenever a patient has a principal or additional diagnosis of an injury or poisoning, an external cause code should be recorded.

The **injury separation records** included in this report are those that have a *Principal diagnosis* code in the ICD-10-AM range S00–T75 or T79. Whenever a patient has a principal or additional diagnosis of an injury or poisoning, an external cause code should be recorded. This includes records where the main reason for the episode in hospital was a recent injury, such as a fracture, laceration or burn to any part of the body, or poisoning. It also includes a small number of episodes mainly due to complications of surgical and medical care or due to sequelae present a year or more after injury, or other late effects.

Records are included as to whether the injury was caused unintentionally (accidents) or intentionally (intentional self-harm or assault). Records where intent was not determined are also included.

Injury cases are estimated on the basis of the number of injury separations, not including those records where the mode of admission was 'inward transfer', which are omitted to reduce over-counting.

The **mean length of stay** (MLOS) is the average number of days each patient stayed in hospital. This is calculated by dividing the total number of patient days for **injury separations** by the number of **injury cases,** estimated as described above. Patients who were admitted and discharged from hospital on the same day are counted as staying for 1 day. Separations for rehabilitation after acute care are also included in the calculation.

Injuries can be classified according to the likelihood that a patient with that injury will die in hospital. The method used refers to cases with a predicted mortality risk of about 6% or higher as having a **high threat to life** (Stephenson et al. 2003). Injuries of this severity are likely to have a large impact on the patient, often with persisting problems and ongoing need for health-care services.

Identifying sports injury

The ICD-10-AM includes codes to indicate the type of activity being engaged in at the time of injury (U50–U73). A block of activity codes refers to types of sport (U50–U71) and these codes were used to select cases of hospitalised injury for inclusion in this report and to group cases according to types of sport.

Although the available activity codes are reasonably comprehensive, they do not distinguish between professional sports and community-based sports. They also don't differentiate, for example, between playing amateur team cricket and backyard cricket during the course of a social event such as a barbecue, or cycling to commute to work and cycling for recreation.

Overall, in the NHMD for 2012–13, 61% of estimated injury cases for which an activity code should have been reported did not have the type of activity reported, or had reported the activity as 'unspecified'. Information is also sometimes reported with relatively non-specific information. An example from this report was that 2,688 cases were assigned the code U50.09 *Football, unspecified*; almost as many as were assigned codes for U50.00 *Australian Rules football* or U50.04 *Soccer*.

The groups of ICD-10-AM activity codes used in this report are shown in Table A1.1 (Appendix A).

Calculation of rates

Two types of sports injury hospitalisation rates were calculated using 2 different denominators:

- population-based sports injury hospitalisation rates where the denominator is the estimated resident population for Australia as at December 2012
- participation-based sports injury hospitalisation rates which use, as the denominator, estimates for the number of participants in Australia who engage in a range of sports and activities reported in the Participation in Sport and Physical Recreation (PSPRA) Survey.

ABS Survey on Participation in Sport and Physical Recreation (PSPRA), Australia, 2011–12

The ABS conducted the PSPRA Survey as part of the Multipurpose Household Survey (MPHS) throughout Australia. The survey was designed to provide annual statistics for a number of small, self-contained topics, and in 2011–12, 1 of those topics was participation in sport and physical recreation.

Respondents to the survey were asked for details about sport or physical recreational activity that they had participated in at least once during the 12 months prior to interview. For the survey, ABS defines the term 'participant' as a player, competitor or person who takes part in some other physically active role. Participation in the PSPRA Survey was restricted to people aged 15 and over.

The PSPRA Survey was not conducted in 2012–13. For this report, data from the 2011–12 PSPRA Survey were used for the denominators in calculating participation-based rates for this report.

The groups of ICD-10-AM activity codes included in this report are shown in Table A1.1 (Appendix A). Table A1.1 also includes the groups of sports reported for the PSPRA Survey. The correspondence between the ICD-10-AM groups and the survey groups, as detailed in

the table, is not exact, and this should be borne in mind when interpreting participation-based rates given in this report.

More details about the use of the PSPRA Survey in this report can be found in Appendix A.

Prominent and common conditions

The focus of this report is prominent types of injury cases that were recorded as being due to sport. Ten types of injury condition were selected for attention (Table 2.1), and sport-related cases of each of these are described in some detail. These injuries were selected because they were comparatively frequent in the admitted-patient data collection and were prominent in the sport-related injury literature. Together, the selected injury types account for more than two-thirds of cases.

When compared with other hospitalised cases of sport-related injury, the cases selected for closer examination had a similar sex distribution, with males accounting for around three-quarters of cases. The ten types of injury focussed on in the report also had a similar age distribution to cases of other-sport related injury. As an indication of relative severity, similar proportions of the cases in both subsets were transferred to another acute care hospital; and less than 1% of people in both subsets died while in hospital (data not shown).

Table 1.1: Cases of hospitalisation for selected hospitalised sport-related conditions, Australia, 2012–13

Nature of injury	Number of cases	% of all sport-related cases	Days spent in hospital	% of all days spent in hospital for sport-related injury
Knee injury	5,555	11.2	9,486	8.5
Head injury	7,523	15.1	14,230	12.7
Shoulder injury	3,330	6.7	4,982	4.4
Ankle injury	2,949	5.9	8,844	7.9
Hip injury	898	1.8	4,632	4.1
Wrist injury	5,831	11.7	8,262	7.4
Spinal injury	1,507	3.0	7,700	6.9
Injury to internal organs	887	1.8	4,174	3.7
Elbow injury	1,685	3.4	2,918	2.6
Long bone fractures	2,020	4.1	6,551	5.8
Other sport-related injury	17,497	35.2	40,277	35.9
All sport-related injury	**49,682**	**100**	**112,056**	**100**

Note: Cases were grouped on the basis of *Principal diagnosis* codes. See Table A1.2 for the ICD-10-AM codes included in each category.

Box 1.2: Relative standard error

The estimates based on data from the PSPRA Survey that are presented in the report are supplemented by a relative standard error (RSE) measure, which appears in the tables in Appendix B.

'Sampling error' is the difference between the published estimates, derived from a sample of persons, and the value that would have been produced if the total population (as defined for the scope of the survey) had been included in the survey.

One measure of the likely difference is given by the standard error (SE), which indicates the extent to which an estimate might have varied by chance because a sample of persons was included. There are about 2 chances in 3 (67%) that a sample estimate will differ by less than 1 SE from the number that would have been obtained if all persons had been surveyed, and about 19 chances in 20 (95%) that the difference will be less than 2 SEs.

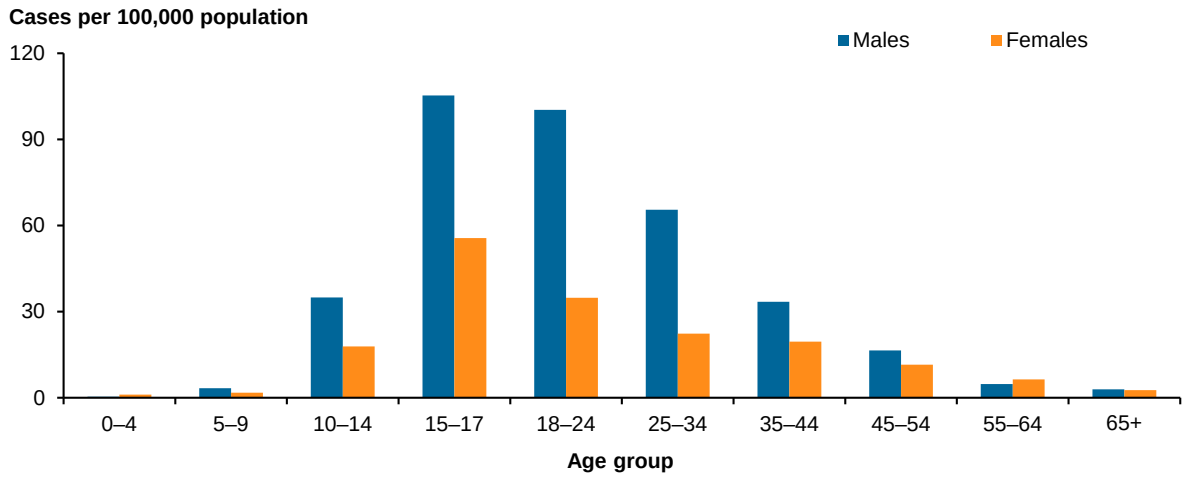
Another measure of the likely difference is the RSE, which is obtained by expressing the SE as a percentage of the estimate. Estimates were not reported in relevant tables if RSE was greater than 50.

2 Knee injury

Over 5,500 cases of knee injury that were admitted to hospital in 2012–13 were recorded as being sport-related (Table 1.1). This is likely to underestimate hospitalised cases of knee injury during sport for 3 main reasons:

- activity codes are not assigned to all knee injury cases
- some cases would be diagnosed with musculoskeletal conditions (for example, knee disruption) which do not require coding of the activity being undertaken when the condition arose (see Box 2.2)
- most knee injuries are treated without admission to a hospital.

Knee injury affected males (69% of cases) more than females. For both sexes, cases were most common between the ages of 15 and 24. The highest age-specific rates for males were 106 and 101 cases per 100,000 population in the 15–17 and 18–24 age groups, respectively. The highest rates for females (56 and 35 per 100,000, respectively) occurred in the same age groups (Figure 2.1).



Note: The data underlying this chart can be found in Appendix C, tables C1.1 and C1.2.

Figure 2.1: Age-specific rates for hospitalised sport-related knee injury cases, by age, by sex, Australia, 2012–13

Length of stay

The mean length of stay (MLOS) in hospital for knee injuries for all ages was 1.7 days (Table 2.1). Between ages 15 and 54, males had a slightly longer MLOS than their female peers. From age group 55–64 onwards, the MLOS was higher for females than for males. Knee injury accounted for 9,486 hospital days spent in hospital (Table C1.3).

Table 2.1: Mean length of stay (in days) for all hospitalised sport-related hospitalised cases of knee injury, by age, by sex, Australia, 2012–13

	Age group										
Sex	**0–4**	**5–9**	**10–14**	**15–17**	**18–24**	**25–34**	**35–44**	**45–54**	**55–64**	**65+**	**All ages**
Males	1.0	1.8	1.7	1.8	1.5	1.8	2.1	2.2	2.2	3.3	1.8
Females	1.0	1.5	1.7	1.2	1.3	1.6	1.6	1.6	2.3	3.6	1.6
Persons	**1.0**	**1.7**	**1.7**	**1.6**	**1.4**	**1.7**	**1.9**	**1.9**	**2.3**	**3.4**	**1.7**

Types of sport

For males and females combined, *Soccer*, *Other and unspecified football* and *Netball* were the 3 sports most commonly associated with cases of knee injury (16%, 10% and 10%, respectively) (Table 2.2). However, rankings varied with sex. While *Soccer* was also the sport most frequently associated with male knee injury hospitalisations (19%), for females, knee injury was most commonly associated with *Netball* (29%). For males, football (all codes combined) accounted for over half (54%) of knee injuries.

Table 2.2: Ten sports most commonly associated with hospitalised sport-related knee injury, Australia, 2012–13

		Males			Females		
Rank	**Sport**	**Rank**	**Number**	**% of cases**	**Rank**	**Number**	**% of cases**
1	Soccer	1	716	18.7	3	144	8.3
2	Football, other and unspecified	2	522	13.6	16	22	1.3
3	Netball	17	29	0.8	1	500	29.0
4	Rugby	3	381	10.0	15	28	1.6
5	Australian Rules football	4	325	8.5	17	22	1.3
6	Basketball	5	236	6.2	4	88	5.1
7	Ice and snow sports	7	124	3.2	2	191	11.1
8	Wheeled motor sports	6	195	5.1	14	28	1.6
9	Touch football	9	105	2.7	5	64	3.7
10	Cycling	8	108	2.8	11	33	1.9
	Total		**2,741**	**71.6**		**1,120**	**64.9**

Note: Sports are sorted by the number of cases for males and females combined.

Some sports, although having comparatively smaller numbers of cases, had high participation-based rates of knee injury. For example, for males aged 15 and over, *Wheeled motor sports* (with around 73,000 participants) was associated with 175 cases and had a rate of 240 per 100,000 participants, compared with 128 per 100,000 for *Soccer* (535,200 participants and 687 cases) (Table B1.2).

For females aged 15 and over, the highest participation-based rate with a reliable denominator (RSE ≤ 25%) was for *Ice and snow sports* (384 per 100,000 participants). This compared with a much lower rate of 116 per 100,000 for *Netball,* where it is estimated that there were around 406,500 participants and 472 cases (Table B1.3).

Types of knee injury

Cruciate ligament injury comprised over half of all cases of knee injury recorded as being due to sport. In 98% of cases of cruciate ligament injury, the anterior ligament was involved Some analyses, such as the one cited above, are reported in the text, but are not tabulated. This applies throughout the report. A slightly higher proportion of female sport-related knee injury cases were injuries to the cruciate ligament (58% compared with 51% for men) (Table 2.3).

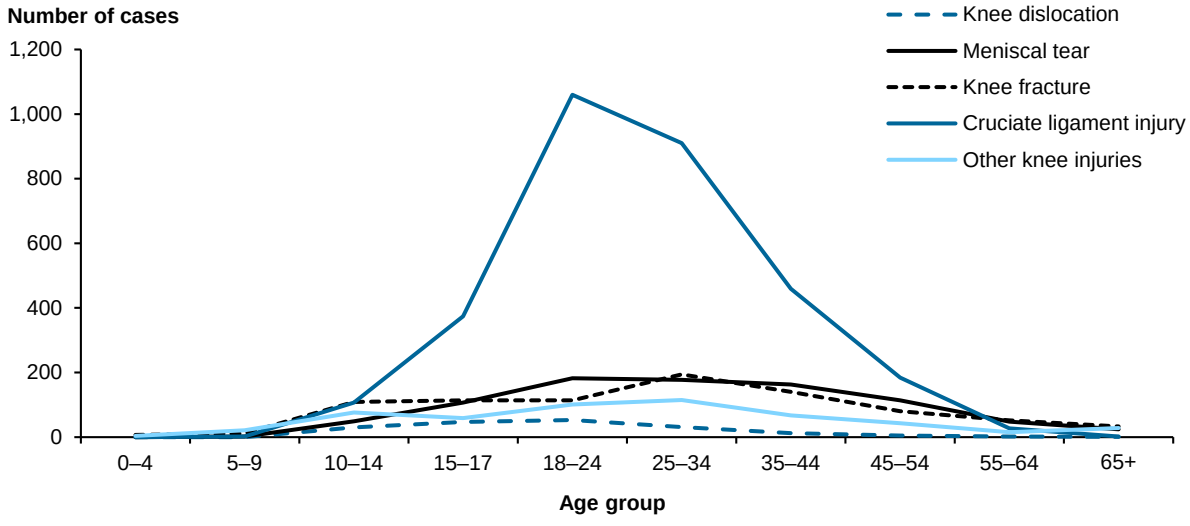
(Proportions of mechanisms most commonly involved in particular subsets of the cases are reported in the text, as here, but are not tabulated. This applies throughout the report.)

Further information is provided on cruciate ligament injury and its treatment in Box 2.1 and Appendix D. The information in the boxes illustrates the range and complexity of issues that underlie statistical description and measurement of this frequent type of sport-related injury condition. For reasons of feasibility, the report does not examine other types in such depth.

Table 2.3: Hospitalised sport-related knee injury by nature of injury sustained, by sex, Australia, 2012–13

	Males		Females		Persons	
Nature of injury	**Number**	**%**	**Number**	**%**	**Number**	**%**
Knee dislocation	116	3.0	65	3.8	181	3.3
Meniscal tear	641	16.7	225	13.0	866	15.6
Knee fracture	608	15.9	246	14.2	854	15.4
Cruciate ligament injury	2,071	54.1	1,054	61.0	3,125	56.3
Other knee injuries	392	10.2	137	7.9	529	9.5
Total	**3,828**	**100**	**1,727**	**100**	**5,555**	**100**

The age distribution of cases of cruciate ligament injury differed markedly from those for other types of knee injury, with the highest rate in the 18–34 age range (Figure 2.2).



Note: The data underlying this chart can be found in Appendix C, tables C1.1 and C1.2.

Figure 2.2: All hospitalised sport-related knee injury, by nature of injury, by age, Australia, 2012–13

Cruciate ligament injury

Box 2.1: Cruciate ligament injury

Injury to a cruciate ligament is often treated using a knee reconstruction procedure (Spindler & Wright 2008). In 2000, it is estimated that 175,000 such reconstructions were undertaken in the United States, costing in excess of $2 billion (Spindler & Wright 2008). A 2009 study from New Zealand using data from the Accident Compensation Corporation, which administers a no-fault injury insurance scheme, found that over the 5-year period 2000–2005 there were 3,997 cases in which surgery was performed for sport-related injury to the anterior cruciate ligament (ACL). This equates to a rate of 36.9 procedures per 100,000 population (Gianotti et al. 2009).

A research study from Australia has established that, over the 5-year period 2003–2008, 50,187 ACL reconstructions were carried out (Janssen et al. 2012). The authors estimate that 36,337 (72%) of these ACL reconstructions were sport-related. They also estimate that the direct costs for ACL reconstruction surgery in this country are over $75 million per annum. They point out that further costs are incurred for rehabilitation, disability, and time away from work which they estimate to exceed $100 million per year. The methodology employed by Janssen and colleagues differs from that used in preparing this report. Both methods use the NHMD for case data. Both also use AR-DRG costs weights, which are applicable to public hospitals but not private hospitals. Because cost weights were not available for private hospitals, we restricted our reporting of costs to public hospital cases. Janssen et al. used a different basis to estimate costs for cases treated in private hospitals. Perhaps related to that, they limited their public hospital values to AR-DRG *direct* costs of providing patient care, while this analysis uses AR-DRG *total* estimated costs, which also include, as overheads, amounts for cost centres in hospitals that do not directly provide care.

Injury to the cruciate ligament is associated with long-term problems. For example, it has been estimated that around 50% of people who sustain this injury will develop premature osteoarthritis within 10–20 years (Spindler & Wright 2008). Two follow-up studies of male and female soccer players have found a high prevalence of radiographic osteoarthritis of the knee. Fourteen years after their injury, radiographic changes were apparent in 75% of injured male soccer players, with more advanced changes observable in 41% of the cohort (von Porat et al. 2004). Twelve years after injury to a cruciate ligament, 82% of a cohort of female soccer players had radiographic changes to the knee and 51% were assessed as having radiographic knee osteoarthritis. Seventy-five per cent of the female subjects also reported that knee-related symptoms were affecting their quality of life (Lohmander et al. 2007).

In this report, the direct, acute care costs associated with the repair of a cruciate ligament injury have been estimated (that is the cost of the hospital stay and surgery). It should be recognised, however, that cruciate ligament reconstruction normally also entails other costs such as physiotherapy, rehabilitation, time off work, impaired quality of life and time away from sport.

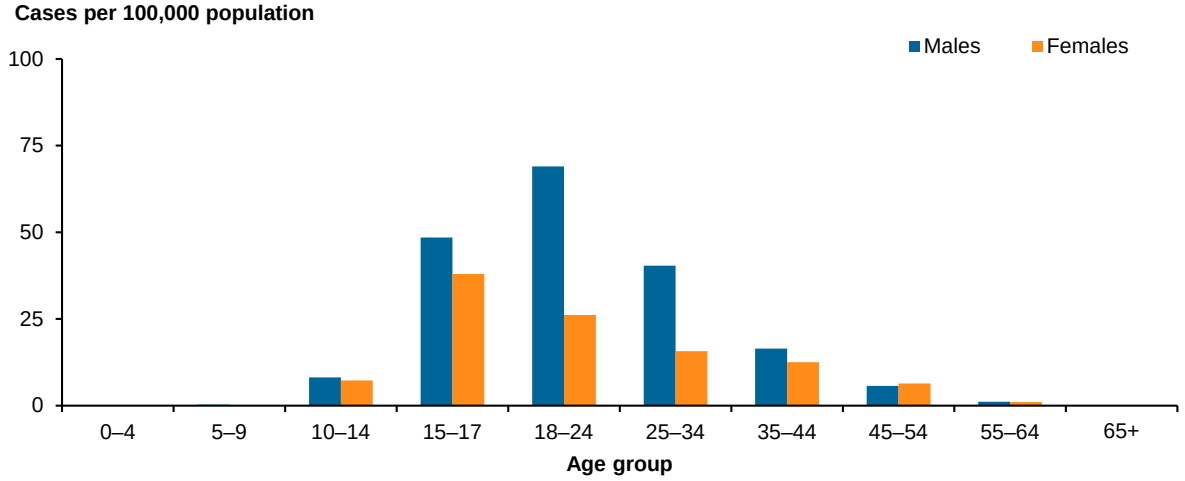
Some cruciate ligament reconstructions are carried out in an outpatient or ambulatory setting. We do not have data that enable us to estimate the number of procedures in these settings in Australia.

Further information on coverage of sport-related cases of cruciate ligament injury is provided in Appendix D.

Cruciate ligament injury, particularly injury to the ACL, is a common outcome of playing sports. This type of injury was found, in our study, to be by far the most common type of knee injury sustained while playing sport (Table 2.3). It accounted for almost 6 in 10 of the hospitalised injuries to the knee, and in 2012–13, there were 3,125 cases of in-hospital acute care for ACL injury.

Rates of cruciate ligament injury were higher for males than for females in almost all age groups. The exception was those aged 45–54 (Figure 2.3).

Rates of cruciate ligament injury were highest for young men aged 18–24 (69 cases per 100,000 population) and for young women aged 15–17 (38 cases per 100,000). Although there were fewer than 5 cases among children under the age of 10, older boys and girls aged 10–14 had rates of 8 and 7 cases per 100,000, respectively (Figure 2.3).



Note: The data underlying this chart can be found in Appendix C, tables C1.1 and C1.2.

Figure 2.3: Age-specific rates for hospitalised cases of sport-related cruciate ligament injury, by age, by sex, Australia, 2012–13

Length of stay

The MLOS for cruciate ligament injury was 1.2 days, slightly less than for knee injury as a whole (Table 2.4). There was little difference in MLOS between the sexes.

Table 2.4: Mean length of stay (in days) for hospitalised sport-related cruciate ligament injury, by age, by sex, Australia, 2012–13

	Age group										
Sex	**0–4**	**5–9**	**10–14**	**15–17**	**18–24**	**25–34**	**35–44**	**45–54**	**55–64**	**65+**	**All ages**
Males	0.0	1.5	1.3	1.1	1.2	1.1	1.2	1.1	1.2	1.0	1.2
Females	0.0	0.0	1.1	1.1	1.1	1.1	1.2	1.2	1.4	1.0	1.1
Persons	**0.0**	**1.5**	**1.2**	**1.1**	**1.2**	**1.1**	**1.2**	**1.2**	**1.3**	**1.0**	**1.2**

Types of sport

Overall, *Soccer* and *Netball* were the 2 sports most frequently associated with cruciate ligament injury (17% and 14%, respectively). For males, *Soccer* was the most common cause (21% of cases). Nearly two-thirds (62%) of male cases of cruciate ligament injury were associated with playing football (all codes). For females, over one-third (38%) of cruciate ligament injuries were sustained while playing netball.

For males 15 and over, the highest participation-based rates were for various football codes: *Rugby, Australian Rules football* and *Soccer* (99, 90 and 82 cases per 100,000 participants, respectively; Table B1.2). For females, the highest rate was for *Ice and snow sports* (280 per 100,000; Table B1.3).

Table 2.5: Ten sports most commonly associated with hospitalised sport-related cruciate ligament injury, Australia, 2012–13

		Males			Females		
Rank	Sport	Rank	Number	% of cases	Rank	Number	% of cases
1	Soccer	1	443	21.4	3	98	9.3
2	Netball	11	21	1.0	1	401	38.0
3	Football, other and unspecified	2	352	17.0	9	16	1.5
4	Rugby	3	208	10.0	7	23	2.2
5	Australian Rules football	4	205	9.9	8	17	1.6
6	Basketball	5	154	7.4	4	66	6.3
7	Ice and snow sports	7	66	3.2	2	139	13.2
8	Touch football	6	81	3.9	5	48	4.6
9	Hockey	14	17	0.8	6	38	3.6
10	Wheeled motor sports	8	35	1.7	15	7	0.7
	Total		**1,582**	**76.4**		**853**	**80.9**

Note: Sports are sorted by the number of cases for males and females combined.

Mechanism of injury

The most common mechanism reported for cases of cruciate ligament injury was *Overexertion and strenuous or repetitive movements* (19%), followed by *Falls* (10%). It should be noted that a mechanism of injury was not specified for nearly two-thirds of all cases (62%). (Results not tabulated.)

Treatments

By far the most common intervention for cruciate ligament injury was a knee reconstruction (93%; Table 2.6).

Table 2.6: The 5 most common interventions for hospitalised sport-related cruciate ligament injury, Australia, 2012–13

Procedure	Number	%
Reconstruction procedures on knee	2,876	93.1
Other revision procedures on knee	70	2.3
Arthroscopic excision of knee	37	1.2
Arthroscopic meniscectomy of knee with repair	27	0.9
Generalised allied health interventions	21	0.7
Other procedures	57	1.8
Total	**3,088**	**100**

Note: There was no procedure code for 37 cases.

Other knee injuries

Knee fracture

Of the 854 cases of knee fracture recorded as occurring during sport, 71% involved males. The highest age-specific rate, of 23 cases per 100,000 population, was found among young men aged 15–17 (Table C1.1). Age-standardised rates were 7 and 2 cases per 100,000 for males and females, respectively (tables C1.1 and C1.2).

The overall MLOS for knee fractures was 4.2 days (Table C1.3).

Overall, the 2 sports that most commonly led to knee fractures were *Wheeled motor sports* and *Soccer* (14% and 12% of cases, respectively). This was also the case for males, for whom *Wheeled motor sports* and *Soccer* were the most prominent causes of this type of injury (18% and 14%, respectively). Females most frequently sustained a knee fracture during *Ice and snow sports* (13%) and *Walking and running* (13%). The participation-based rates for persons aged 15 and over were highest for *Wheeled motor sports, Roller sports* and *Ice and snow sports* (137, 49 and 43 cases per 100,000 participants; Table B1.4). The rate for *Soccer* was lower, at 14 per 100,000. (Results not tabulated.)

For around two-fifths of cases (37%), the mechanism of injury was *Fall*. The next most frequent mechanism was a transport crash involving, for example, bicycles, motorised vehicles or horses (25% of cases). The *Transport* mechanism most commonly took the form of *Wheeled motor sports*, although some cases were associated with *Boating* or *Equestrian activities*. A mechanism of injury was not specified for 8% of cases. (Results not tabulated.)

The most common procedures that were used to treat knee fracture cases were *Open reduction of fracture of tibial plateau* (35%); *Generalised allied health interventions* such as physiotherapy (11%); and *Internal fixation of fracture of femoral condyle* (10%). (Results not tabulated.)

Knee dislocation

There were 181 cases of knee dislocation in 2012–13 that were recorded as being sport-related. The majority of these (64%) involved males (Table 2.3). The highest age-specific rate, of 7 cases per 100,000 population, was for young men aged 15–17 (Table C1.1).

The MLOS in hospital for a dislocation of the knee joint was 2.1 days (Table C1.3).

A wide range of sports were associated with the cases of knee dislocation. The most common overall were *Soccer* (19%) and *Dancing* (10%). For males, *Soccer* was the most common cause, accounting for nearly one-quarter (24%) of male cases. One-quarter (25%) of female cases involved *Dancing*, while a further 20% were associated with *Netball*. For persons 15 and over, the highest crude participation-based rates were for *Rugby, Dancing* and *Australian Rules football* (7, 6 and 5 cases per 100,000 participants, respectively; Table B1.4).

The mechanism of this type of injury was most frequently *Falls* (31%), followed by *Overexertion and strenuous or repetitive movements* (28%). A mechanism was not specified for 21% of cases. (Results not tabulated.)

The most commonly used procedure to treat these injuries was *Reduction of dislocation of knee or patella* (37%). (Results not tabulated.)

Meniscal tear

Of 866 cases of meniscal tears, nearly three-quarters (74%) were males (Table 2.3). Cases were most numerous in the 15–17 and 18–24 age groups (21% and 20%, respectively). Males had higher age-specific rates than did females in almost all age groups, and the highest age-specific rate was for young men in the 15–17 age range (17 cases per 100,000 population) (tables C1.1 and C1.2).

Meniscal tears resulted in a MLOS of 1.1 days (Table C1.3).

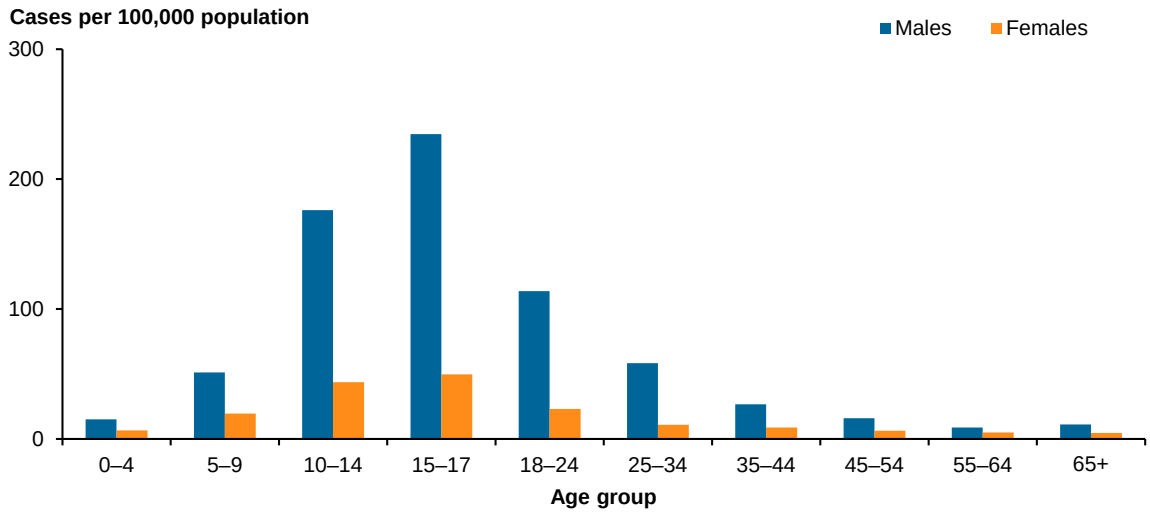
The 2 sports most commonly associated with meniscal tearing were *Soccer* (14%) and *Other and unspecified football*, which includes codes other than *Soccer, Rugby, Australian Rules* and *Touch football* (10%). Nearly half (49%) of male cases involved playing football (all codes). One in 5 female cases (20%) were associated with *Netball*. In the context of participation, the highest rates of meniscal tears for people aged 15 and older were due to *Rugby, Ice and snow sports, Australian Rules football* and *Soccer* (24, 21, 20 and 17 cases per 100,000 participants, respectively; Table B1.4).

For nearly one-third of cases, the mechanism of injury was *Overexertion and strenuous or repetitive movements*. However, it should be noted that a mechanism was not specified for over half of the meniscal tear *cases* (53%). (Results not tabulated.)

Two procedures were most commonly used for meniscal tears: *Arthroscopic meniscectomy of knee with repair* (43%) and *Arthroscopic excision of knee* (31%). (Results not tabulated.)

3 Head injury

Head injury was the most common hospitalised sport-related injury in 2012–13, resulting in over 7,500 people being admitted to hospital (Table 1.1). Head injury was more common among men, who accounted for 8 in 10 cases. The highest age-specific rate for Head injury for both males and females was for the 15–17 age group (235 and 50 cases per 100,000 population, respectively). Rates were also high in the 10–14 age group (176 and 44, respectively for boys and girls) (Figure 3.1).



Note: The data underlying this chart can be found in Appendix C, tables C1.1 and C1.2.

Figure 3.1: Age-specific rates for all hospitalised sport-related head injury, by age, by sex, Australia, 2012–13

Length of stay

The overall MLOS in hospital for head injury at all ages was 1.9 days. The MLOS tended to rise with age (Table 3.1). Sport-related head injury resulted in a total of 14,230 days spent in hospital (Table C1.3).

Table 3.1: Mean length of stay (in days) for all hospitalised sport-related head injury, by age, by sex, Australia, 2012–13

	Age group										
Sex	**0–4**	**5–9**	**10–14**	**15–17**	**18–24**	**25–34**	**35–44**	**45–54**	**55–64**	**65+**	**All ages**
Males	1.3	1.4	1.4	1.5	1.9	1.6	2.5	3.9	4.9	4.7	1.9
Females	1.1	1.2	1.6	1.4	1.8	1.8	2.0	2.8	2.9	3.7	1.9
Persons	**1.3**	**1.3**	**1.4**	**1.5**	**1.9**	**1.6**	**2.4**	**3.6**	**4.2**	**4.4**	**1.9**

Around 550 cases of sport-related head injury were transferred to another acute care hospital. In 1,157 cases (15%), the injuries sustained were life-threatening. Seventeen people died as the result of their head injury while in hospital. (Results not tabulated.)

Types of sport

For males and females combined, cases of sport-related head injury were most commonly sustained while playing *Rugby* or *Cycling* (13% and 12% of all head injuries, respectively) (Table 3.2).

Table 3.2: Ten sports most commonly associated with hospitalised sport-related head injury, Australia, 2012–13

		Males			Females		
Rank	Sport	Rank	Number	% of cases	Rank	Number	% of cases
1	Rugby	1	947	15.7	15	24	1.6
2	Cycling	3	752	12.5	2	182	12.1
3	Australian Rules football	2	851	14.1	14	28	1.9
4	Roller sports	5	496	8.2	4	89	5.9
5	Football, other and unspecified	4	569	9.5	19	14	0.9
6	Soccer	6	405	6.7	8	55	3.7
7	Water sports	8	304	5.0	3	133	8.8
8	Equestrian activities	12	97	1.6	1	321	21.4
9	Wheeled motor sports	7	341	5.7	12	37	2.5
10	Basketball	10	180	3.0	10	50	3.3
	Total		**4,942**	**82.1**		**933**	**62.1**

Note: Sports are sorted by the number of cases for males and females combined.

The rankings by case numbers varied somewhat with sex. For males, *Rugby, Australian Rules football* and *Cycling* were the 3 sports most commonly associated with head injury hospitalisations (Table 3.2). All codes of football, combined, accounted for 40% of male head injuries sustained during sport. When viewed in terms of the estimated number of participants, the risk of sustaining a head injury was comparatively high for some sports. For example, *Roller sports*, which had around 49,600 participants, had a male participation-based injury rate of 999 cases per 100,000 participants, and *Rugby*, with around 189,000 participants, had a male participation-based injury rate of 502 cases per 100,000 (Table B1.2). These rates compared with 86 cases per 100,000 for *Cycling* (872,000 participants) and 382 cases per 100,000 for *Australian Rules football* (223,000).

For females, *Equestrian activity* was the type of sport associated with the largest number of head injury cases, followed by *Cycling* and *Water sports* (Table 3.2). However, this ranking changed completely when the risk of head injury was examined in terms of participation-based rates. The highest rate for females was 990 cases per 100,000 for *Wheeled motor sports*, which had an estimated 3,700 participants, and ranked 12th in terms of case numbers. This was followed by 421 per 100,000 for *Roller sports* (21,100 participants) and 294 per 100,000 for *Equestrian activity* (105,700 participants). It should be noted that the category for *Equestrian activity* in the 2011–12 PSPRA Survey specifically excluded horse racing and rodeo events; these types of cases were excluded in calculating the participation-based rate in order to optimise comparability between the survey category and the ICD-10-AM codes included in selecting cases of sports injury hospitalisation. This restriction reduced the number of cases from 418 to 382. (Elsewhere in the report, cases sustained during horse racing and rodeo are included.)

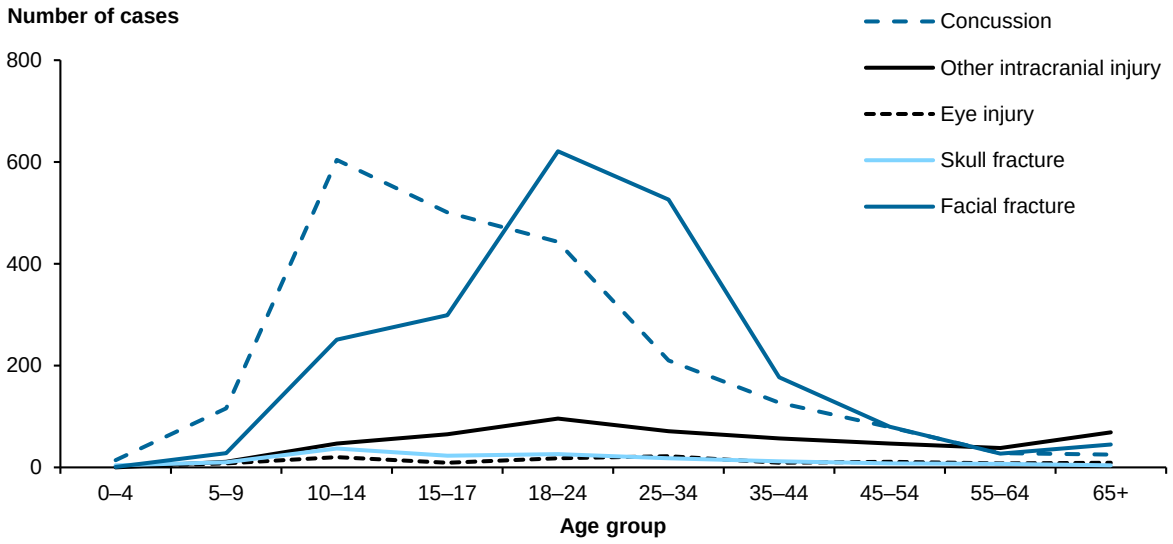
Types of head injury

The most common types of head injury were facial fractures and concussion (30% and 28%, respectively). The comparatively severe head injury category, other intracranial injury, comprised 7% of cases of head injury (Table 3.3).

Table 3.3: Hospitalised sport-related head injury by nature of injury sustained, by sex, Australia, 2012–13

	Males		Females		Persons	
Nature of injury	**Number**	**%**	**Number**	**%**	**Number**	**%**
Concussion	1,699	28.2	448	29.8	2,147	28.5
Other intracranial injury	398	6.6	103	6.9	501	6.7
Eye injury	99	1.6	17	1.1	116	1.5
Skull fracture	127	2.1	22	1.5	149	2.0
Facial fracture, including nose	1,793	29.8	262	17.4	2,055	27.3
Other and unspecified head injuries	1,904	31.6	651	43.3	2,555	34.0
Total	**6,020**	**100**	**1,503**	**100**	**7,523**	**100**

Concussion was most common among children and young people, reaching a peak in the 10–14 age group. Moderate to severe cases of other intracranial injury occurred most frequently between the ages of 18 and 34 (Figure 3.2).



Note: The data underlying this chart can be found in Appendix C, tables C1.1 and C1.2.

Figure 3.2: All hospitalised sport-related head injury, by nature of injury, by age, Australia, 2012–13

Concussion

Box 3.1: Concussion

Concussion results from an injury, such as a blow to the head, which causes jarring or shaking of the brain within the skull. Concussion can be accompanied by a period of loss of consciousness, usually brief. The typical symptoms of a concussion can include confusion, headache, blurred vision, nausea or disorientation.

Internationally, estimates of the annual incidence of traumatic brain injury (TBI) range from 60 to 250 cases per 100,000 population (Finch et al. 2013). Eighty to 90 of these are cases of 'mild' TBI, most likely concussion (Finch et al. 2013). An estimate of hospitalisation for concussion in Victoria found that around 17% of these, over a 9-year period, were sport-related (Finch et al. 2013). It was further estimated, by the same authors, that the hospital costs associated with concussion admissions over the 9-year period were nearly $18 million (Finch et al. 2013).

In general, concussion without prolonged unconsciousness has traditionally been regarded as a mild form of brain injury. However, there is increasing concern about the long-term consequences of concussion, particularly repeated episodes of concussion.

There is a growing body of evidence regarding the potential for concussion to have serious outcomes. For example, a Canadian study compared retired athletes with a history of concussion with matched controls without that same history, and found evidence of neurological anomalies in the first group. These anomalies were significantly correlated with cognitive decline when compared with the control group (Tremblay et al. 2014).
Post- concussion syndrome, which has a code in ICD-10, is associated with a wide range of physical, cognitive and other symptoms which usually resolve within a short period of time. It has been found, however, that around 15% of people continue to have deficits 1 year after their injury (Daneshvar et al. 2011). Another condition, chronic traumatic encephalopathy (CTE), is caused by repeated concussive impacts. CTE affects memory and executive function, as well as other negative outcomes such as mood disorders, depression, anger, and so forth, (Daneshvar et al. 2011; Gardner et al. 2014). An area of particular concern is recurrent episodes of concussion: a US study of football players suggests that those with a history of concussion are more likely than others to sustain further concussions (Guskiewicz et al. 2003), with the consequence of slower recovery of neurological function.

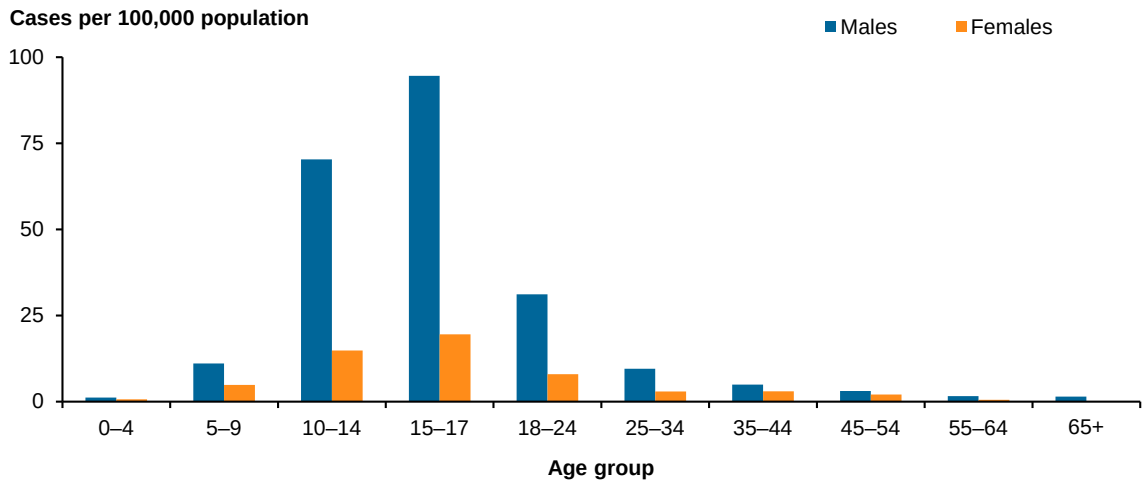
Children may be particularly vulnerable to sustaining concussion (Barlow et al. 2010). The symptoms of concussion can have a negative developmental impact on schooling, social and family relationships, and sports participation (Halstead & Walter 2010).

Concussion is associated with a range of sports, but is particularly related to football. Finch et al. (2013) point out that the high participation rates for football codes in Australia yield a concussion risk 10 to 15 times higher than for American football.

Finch et al. (2013) have observed a 61% increase in cases of sport-related concussion admitted to Victorian hospitals over the period 2002–03 to 2010–11. They speculate that this could be attributed to factors such as better recognition of the condition and faster game speeds, leading to greater force in impacts.

Only a minority of people recognise that the symptoms they are experiencing after a blow to the head are indicative of a concussion and, hence, many probably do not seek medical assistance (Delaney et al. 2002). Partly for this reason, the use of existing routinely collected datasets seriously underestimates cases of sport-related TBI, including concussion (Langlois et al. 2006). To address this issue, Professor Caroline Finch has called for the establishment of an Australian register of sports injury (MacKee 2014).

There were 2,147 cases of sport-related concussion admitted to hospital in 2012–13. Around 4 in 5 of these were males. The age-standardised rate of concussion for persons was 13 cases per 100,000 population. The highest age-specific rates for males were in the 10–14 and 15–17 age groups (70 and 95 cases per 100,000, respectively) (Figure 3.3). Rates were also highest for females in those age groups (15 and 20 cases per 100,000, respectively).



Note: The data underlying this chart can be found in Appendix C, tables C1.1 and C1.2.

Figure 3.3: Age-specific rates for hospitalised sport-related concussion, by age, by sex, Australia, 2012–13

Length of stay

The all-ages MLOS for concussion was 1.2 days (Table 3.4), but was slightly higher for people aged 45 and over. In 129 cases (6%), the patient was transferred to another acute care hospital, suggesting that the injury was severe; in 237 cases (11%), the injury was considered to be life-threatening. Sport-related concussion resulted in a total of 2,621 days spent in hospital.

Table 3.4: Mean length of stay (in days) for all hospitalised sport-related concussion, by age, by sex, Australia, 2012–13

	Age group										
Sex	**0–4**	**5–9**	**10–14**	**15–17**	**18–24**	**25–34**	**35–44**	**45–54**	**55–64**	**65+**	**All ages**
Males	1.2	1.2	1.2	1.2	1.2	1.2	1.3	1.6	1.6	1.7	1.2
Females	1.1	1.3	1.2	1.3	1.2	1.3	1.4	1.5	1.7	2.1	1.3
Persons	**1.2**	**1.2**	**1.2**	**1.2**	**1.2**	**1.2**	**1.3**	**1.5**	**1.6**	**1.8**	**1.2**

Types of sport

Overall, *Australian Rules football* was the sport most commonly linked to concussion (16% of all cases) (Table 3.5). For males, the types of sport most commonly associated with concussion were *Australian Rules football* (19%) and *Rugby* (18%). For females, injury during *Equestrian activities* was by far the most common cause of concussion *(*36%).

In terms of participation, the highest crude participation-based rates for persons aged 15 and over were for *Wheeled motor sports* and *Roller sports* (146 and 107 cases per 100,000 participants, respectively). This was also the case for males aged 15 and over (141 and 133

cases, respectively). For females in that age group, the highest reliable rate was for *Equestrian activity* (97 per 100,000 participants) (tables B1.2 and B1.3).

Table 3.5: Ten sports most commonly associated with hospitalised sport-related concussion, Australia, 2012–13

		Males			Females		
Rank	Sport	Rank	Number	% of cases	Rank	Number	% of cases
1	Australian Rules football	1	321	18.9	11	13	2.9
2	Rugby	2	302	17.8	15	8	1.8
3	Cycling	3	209	12.3	2	34	7.6
4	Equestrian activities	10	39	2.3	1	159	35.5
5	Roller sports	5	145	8.5	5	21	4.7
6	Wheeled motor sports	6	141	8.3	8	17	3.8
7	Football, other and unspecified	4	151	8.9	17	4	0.9
8	Soccer	7	110	6.5	6	21	4.7
9	Water sports	8	48	2.8	3	30	6.7
10	Basketball	9	45	2.6	9	16	3.6
	Total		**1,511**	**88.9**		**323**	**72.1**

Note: Sports are sorted by the number of cases for males and females combined.

Treatment

The most commonly coded medical procedure for cases of concussion was *Generalised allied health interventions* (61%), followed by *Repair of wound of skin and subcutaneous tissue* (19%). A medical procedure block code was not assigned in 1,842 (86%) cases of concussion. (Results not tabulated.)

Other intracranial injury

In this report, other intracranial injury encompasses moderate and severe TBI. Cases were selected for this subset if they had a principal diagnosis from the following list:

- S06.1 *Traumatic cerebral oedema*
- S06.2 *Diffuse brain injury*
- S06.3 *Focal brain injury*
- S06.4 *Epidural haemorrhage*
- S06.5 *Traumatic subdural haemorrhage*
- S06.6 *Traumatic subarachnoid haemorrhage*
- S06.8 *Other intracranial injuries*
- S06.9 *Intracranial injury, unspecified.*

Box 3.2: Traumatic brain injury

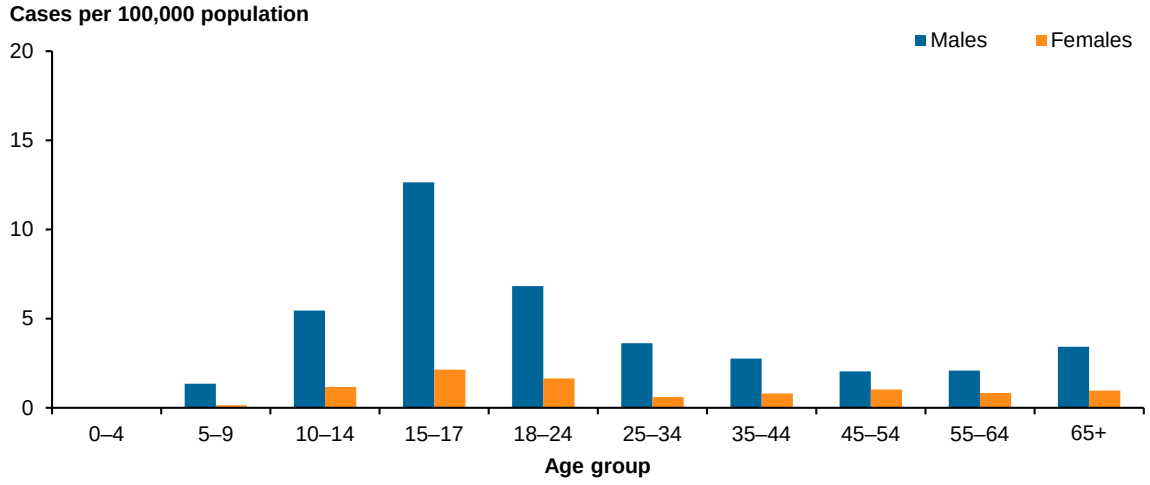
Traumatic brain injury (TBI) often results in long-term, sometimes life-long, physical, cognitive, behavioural and emotional impairments (Langlois et al. 2006). TBI has been associated with 14 times the loss in productivity of a spinal cord injury (Langlois et al. 2006).

Masel & DeWitt (2010) suggest that sustaining a moderate or severe brain injury should be regarded as the beginning of a chronic disease process, because the injury is related to increased long-term mortality and morbidity. They also report that TBI has been associated with a reduction in life expectancy of 7 years. It also contributes to various types of post-traumatic morbidity, including epilepsy, sleep disorders, neurogenerative diseases and psychiatric disease.

TBI can also affect the injured person's family. For example, Anderson et al. (2005), who followed a cohort of children with TBI for 30 months, found that ongoing problems create a significant family burden.

In a US study, at 3–5 years, 40% of a group of people admitted to a trauma centre with TBI, had regained their pre-injury level of cognitive competency and major activity (that is, work or school, and leisure and recreation) (Dikmen et al. 2003).

There were 501 cases of sport-related other intracranial injury admitted to hospital in 2012–13 (Table 3.3). Over three-quarters (79%) of these cases were male. Rates of other intracranial injury were comparatively low when compared with other types of head injury. The age-standardised rate for persons was 2 cases per 100,000 population. The highest age-specific rate was for young men aged 15–17 (13 cases per 100,000 population) (Figure 3.4).



Note: The data underlying this chart can be found in Appendix C, tables C1.1 and C1.2.

Figure 3.4: Age-specific rates for hospitalised sport-related other intracranial injury, by age, by sex, Australia, 2012–13

Length of stay

The overall MLOS in hospital after sustaining another intracranial injury was comparatively high, at 9.1 days. MLOS tended to rise with age from 35 onwards (Table 3.6). Sport-related other intracranial injury cases resulted in 4,537 days spent in hospital.

Table 3.6: Mean length of stay (in days) for hospitalised sport-related other intracranial injury, by age, by sex, Australia, 2012–13

	Age group										
Sex	**0–4**	**5–9**	**10–14**	**15–17**	**18–24**	**25–34**	**35–44**	**45–54**	**55–64**	**65+**	**All ages**
Males	3.1	9.5	5.9	8.1	9.2	8.7	10.0	12.8	11.4	11.9	9.1
Females	8.3	4.9	8.8	6.7	7.4	8.1	11.6	11.1	13.2	9.6	9.2
Persons	**4.2**	**8.3**	**6.4**	**7.9**	**8.9**	**8.6**	**10.4**	**12.3**	**11.9**	**11.3**	**9.1**

All cases of other intracranial injury met the criterion of being life-threatening. In 26% of cases, patients were transferred to another acute care hospital and, in 16 cases (3%), the person died while in hospital.

Types of sport

Overall, other intracranial injury was most commonly sustained in the course of *Cycling* or engaging in *Roller sports* (21% and 17%, respectively) (Table 3.7). For males, other intracranial injuries also occurred most commonly during these sports (22% and 18%, respectively). For females, over one-third (37%) of cases of other intracranial injury were associated with *Equestrian activity*.

Although cases of this type of injury were most commonly associated with *Cycling*, several sports had higher participation-based rates for persons aged 15 and over. *Roller sports* had the highest participation-based rate (85 cases per 100,000 participants), compared with a rate of 8 per 100,000 participants for *Cycling*. The same was true of male cases (Table B1.2).

For females aged 15 and over, *Equestrian activity* had the highest acceptably reliable participation-based rate within the injury category other intracranial injury (34 per 100,000 participants) (Table B1.3).

Table 3.7: Ten sports most commonly associated with hospitalised sport-related other intracranial injury, Australia, 2012–13

		Males			Females		
Rank	**Sport**	**Rank**	**Number**	**% of cases**	**Rank**	**Number**	**% of cases**
1	Cycling	1	86	21.6	2	18	17.5
2	Roller sports	2	73	18.3	3	10	9.7
3	Equestrian activities	6	20	5.0	1	38	36.9
4	Wheeled motor sports	3	56	14.1	9	2	1.9
5	Rugby	4	23	5.8	21	0	0.0
6	Walking and running	8	16	4.0	5	6	5.8
7	Soccer	7	18	4.5	6	3	2.9
8	Australian Rules football	5	21	5.3	22	0	0.0
9	Water sports	10	11	2.8	4	8	7.8
10	Ice and snow sports	9	12	3.0	8	2	1.9
	Total		**336**	**84.4**		**87**	**84.5**

Note: Sports are sorted by the number of cases for males and females combined.

Treatment

In nearly half of the cases where a procedure block code was specified, the medical procedure was *Generalised health interventions* (Table 3.8). *Ventilatory support* was provided to about 16% of these cases.

Table 3.8: Five most common procedures for hospitalised sport-related other intracranial injury, Australia, 2012–13

Medical procedure	Number	%
Generalised allied health interventions	181	48.8
Ventilatory support	59	15.9
Intracranial drainage	35	9.4
Insertion of intracranial cerebrospinal fluid devices	18	4.9
Removal of intracranial haematoma or abscess	14	3.8
Other medical procedures	64	17.3
Total	**371**	**100**

Note: There was no procedure code for 130 cases.

Facial fractures

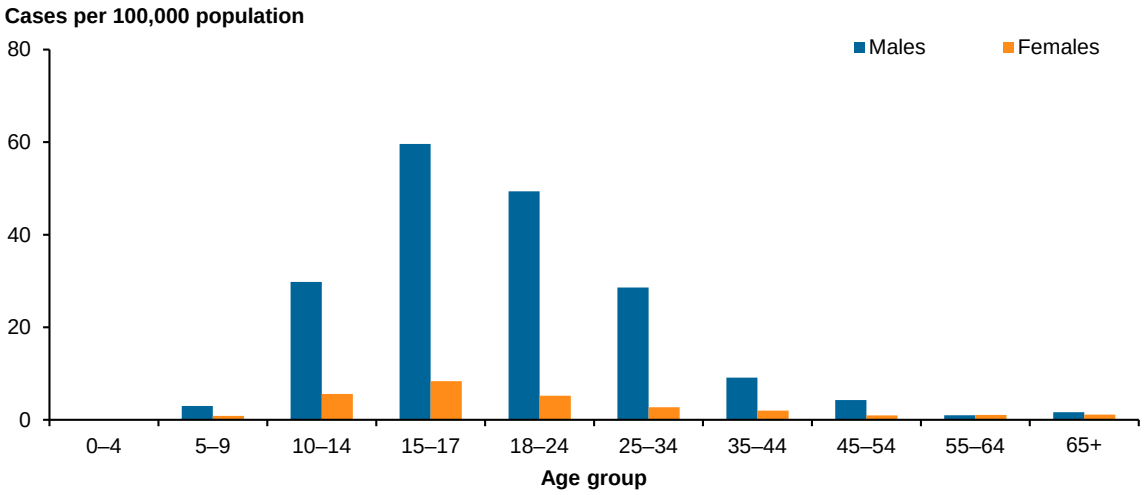
Box 3.3: Facial fractures

Facial fractures include fractures of the malar and maxillary bones that make up the facial structure, the orbital floor, the nose, and the mandible (jaw).

Facial fractures are commonly a less serious form of injury than the intracranial injuries discussed above. Most of these injuries are satisfactorily resolved, with either conservative treatment or a reduction of the fracture. There is always the possibility of surgical complications. For example, mandible complication rates have been estimated to range from 7% to 29% (Stacey et al. 2006), and a retrospective study of orbital floor reconstructions found a postoperative complication rate of 19% (Gosau et al. 2011).

In 2012–13, there were 2,055 cases admitted to hospital with facial fracture resulting from sporting activities. Nearly 9 in 10 (87%) of these cases were male.

The age-standardised rate of facial fracture for persons was 12 cases per 100,000 population. The highest age-specific rates were for young men aged 15–17 and 18–24 (60 and 49 cases per 100,000, respectively). Rates for females were comparatively low, the highest rate (8 cases per 100,000) being found in the 15–17 age group (Figure 3.5).



Note: The data underlying this chart can be found in Appendix C, tables C1.1 and C1.2.

Figure 3.5: Age-specific rates for hospitalised sport-related facial fracture, by age, by sex, Australia, 2012–13

Length of stay

The MLOS for sport-related facial fractures was 1.5 days (Table 3.9). Ninety-one cases (4%) were transferred to another acute care hospital, reflecting a greater level of injury severity. For 138 (7%) of cases, the injury was deemed to present a high threat to life.

Table 3.9: Mean length of stay (in days) for hospitalised sport-related facial fractures, by age, by sex, Australia, 2012–13

	Age group										
Sex	**0–4**	**5–9**	**10–14**	**15–17**	**18–24**	**25–34**	**35–44**	**45–54**	**55–64**	**65+**	**All ages**
Males	1.0	2.0	1.2	1.3	1.5	1.3	1.8	2.2	1.4	2.6	1.4
Females	0.0	1.0	1.1	1.2	1.3	1.6	1.8	1.6	1.4	4.1	1.6
Persons	**1.0**	**1.8**	**1.2**	**1.3**	**1.4**	**1.3**	**1.8**	**2.1**	**1.4**	**3.2**	**1.5**

Types of sport

Overall, facial fractures were most frequently sustained in *Rugby* and *Australian Rules football* (18% and 16%, respectively). Nearly two-thirds (63%) of male cases of facial fracture were associated with playing 1 of the codes of football. For females, cases were most commonly an outcome of *Hockey* (10%), *Cycling* (9%), *Netball* (8%) and *Equestrian activity* (8%) (Table 3.10).

When looked at in terms of participation, *Rugby* and *Australian Rules football* had the highest crude participation-based rates for males 15 and over (166 and 129 cases per 100,000 participants, respectively). For females, the most reliable participation-based rate (RSE ≤25%) was for *Hockey* (32 per 100,000) (tables B1.2 and B1.3).

Table 3.10: Ten sports most commonly associated with hospitalised sport-related facial fractures, Australia, 2012–13

		Males			Females		
Rank	Sport	Rank	Number	% of cases	Rank	Number	% of cases
1	Rugby	1	355	19.8	11	7	2.7
2	Australian Rules football	2	316	17.6	16	5	1.9
3	Football, other and unspecified	3	274	15.3	13	6	2.3
4	Soccer	4	164	9.1	14	6	2.3
5	Cycling	6	97	5.4	2	24	9.2
6	Cricket	5	103	5.7	12	6	2.3
7	Basketball	7	84	4.7	6	16	6.1
8	Water sports	8	61	3.4	5	18	6.9
9	Hockey	10	43	2.4	1	25	9.5
10	Combative sports	9	52	2.9	9	7	2.7
	Total		**1,549**	**86.4**		**262**	**45.8**

Note: Sports are sorted by the number of cases for males and females combined.

The most commonly reported mechanism of injury in relation to facial fractures was *Contact with another person* (45%). A mechanism of injury was not specified in 14% of cases. (Results not tabulated.)

Treatment

The most common medical procedure was a treatment for fractured nose (47%). *Reduction of fracture of mandible or maxilla* was also common (22%) (Table 3.11).

Table 3.11: Five most common procedures for hospitalised sport-related facial fractures, Australia, 2012–13

Procedure	Number	%
Reduction of fracture of nasal bone	781	46.9
Reduction of fracture of mandible or maxilla	364	21.8
Reduction of fracture of zygomatic bone[(a)]	258	15.5
Reconstruction of orbital cavity	101	6.1
Generalised allied health interventions	39	2.3
Other procedures	123	7.4
Total	**1,666**	**100**

(a) The term ‘zygomatic bone’ is synonymous with the malar bone.

Note: There was no procedure code for 389 cases.

Other types of head injury

Eye injury

Only 116 cases of sport-related eye injury were admitted to hospital in 2012–13. Eighty-five per cent of these were males. (Table C1.3.)

The rates of eye injury were also comparatively low, with an age-standardised rate for persons of 0.5 cases per 100,000 population.

The overall MLOS in hospital for sport-related eye injury was 2.3 days. In 21 cases (18%) the person was transferred to another acute care hospital. In 5% of cases, the eye injury met criteria to be considered life-threatening.

Eye injury cases were most frequently associated with *Fishing* (12%), *Racquet sports* (9%) and *Water sports* (9%).

For those cases where a procedure block code had been assigned, the 2 most common medical procedures were *Repair of perforating wound of eyeball* (10%) and a *Vitrectomy* (5%). A procedure block code was not assigned in 79 cases (68%). (Results not tabulated.)

Fractured skull

149 people were admitted to hospital in 2012–13 as the result of sport-related skull fracture. Eighty-five per cent of these were males (Table C1.3).

The overall MLOS for sport-related skull fracture was 3.7 days (Table C1.3). The MLOS was, however, markedly higher in the 2 oldest age groups (55–64, 5.6 days; 65+, 8.0 days). (Results not tabulated.)

All 149 cases of skull fracture met the criterion for presenting a high threat to life. In 19 cases (13%), the person was transferred to another acute care hospital.

Sport-related skull fracture occurred most commonly during *Roller sports* (22%) and *Cycling* (14%).

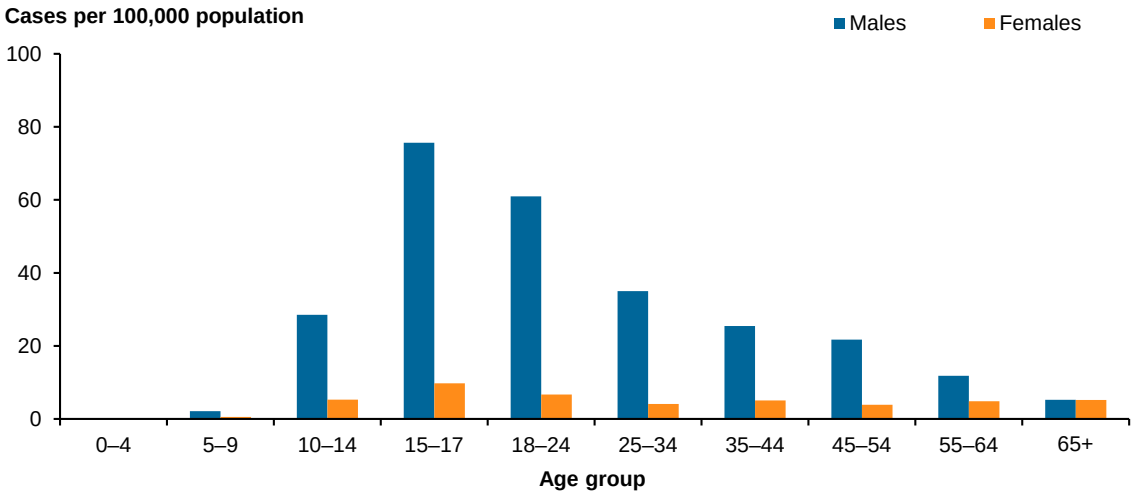
The most common medical procedures for skull fractures were *Generalised allied health interventions* (28%) and *Repair of wound of skin and subcutaneous tissue* (7%). There was no procedure code for 66 (44%) cases. (Results not tabulated.)

4 Shoulder injury

Box 4.1: Shoulder injury

Shoulder injury is a common and serious outcome of playing certain types of sport. For example, a study of upper limb injury among Australian Rugby players, from a cross-section of competition levels, found an overall incidence of 6.5 cases of shoulder injury per game (Usman & McIntosh 2013). A New Zealand study of professional Rugby players found that 56% had previously had surgery for a Rugby-related shoulder injury (Mohammed et al. 2015). Another study of professional Rugby players found that shoulder injuries were the most frequent motivation for retiring from the game (Brooks et al. 2005). There is also some indication that the occurrence of this type of injury is increasing. For example, there has been an increase in shoulder injury associated with Australian Rules football as the result of a growing number of tackles per game (Hrysomallis 2013).

Sport-related shoulder injury caused 3,330 people to be admitted to hospital in 2012–13 (Table 1.1). Over 8 in 10 (84%) of these people were male. The age-standardised rate for persons for all forms of shoulder injury was 19 cases per 100,000 population. For males, the highest age-specific rates were in the 15–17 and 18–24 age groups (76 and 61 cases per 100,000). Females had much lower rates, with the highest being for those aged 15–17 (9.8) (Figure 4.1).



Note: The data underlying this chart can be found in Appendix C, tables C1.1 and C1.2.

Figure 4.1: Age-specific rates for hospitalised sport-related shoulder injury, by age, by sex, Australia, 2012–13

Length of stay

The overall MLOS in hospital for shoulder injury at all ages was 1.5 days. The MLOS tended to rise with age (Table 4.1). Sport-related injuries to the shoulder resulted in a total of 4,982 days spent in hospital (Table C1.3).

Table 4.1: Mean length of stay (in days) for all hospitalised sport-related shoulder injury, by age, by sex, Australia, 2012–13

	Age group										
Sex	**0–4**	**5–9**	**10–14**	**15–17**	**18–24**	**25–34**	**35–44**	**45–54**	**55–64**	**65+**	**All ages**
Males	1.0	1.3	1.4	1.3	1.2	1.3	1.6	1.8	1.6	2.3	1.4
Females	0.0	1.0	1.3	1.5	1.2	1.7	1.6	1.6	2.5	2.7	1.8
Persons	**1.0**	**1.3**	**1.4**	**1.3**	**1.2**	**1.3**	**1.6**	**1.7**	**1.8**	**2.5**	**1.5**

Around 154 cases of sport-related shoulder injury were transferred to another acute care hospital. In 182 cases (5.5%), the injuries sustained were life-threatening. No deaths were recorded while in hospital.

Types of sport

For males and females combined, *Cycling* was the sport most commonly associated with cases of shoulder injury (19%) (Table 4.2). However, rankings varied with sex. While *Cycling* was also the sport most frequently associated with male shoulder injury hospitalisations (20%), for females, shoulder injury was most commonly associated with *Equestrian activities* (19%).

Table 4.2: Ten sports most commonly associated with hospitalised sport-related shoulder injury, Australia, 2012–13

		Males			Females		
Rank	**Sport**	**Rank**	**Number**	**% of cases**	**Rank**	**Number**	**% of cases**
1	Cycling	1	564	20.1	2	70	13.5
2	Wheeled motor sports	2	414	14.7	7	22	4.2
3	Rugby	3	299	10.6	16	8	1.5
4	Australian Rules football	4	238	8.5	18	5	1.0
5	Football, other and unspecified	5	217	7.7	11	11	2.1
6	Water sports	6	155	5.5	6	23	4.4
7	Equestrian activities	10	60	2.1	1	97	18.7
8	Ice and snow sports	7	113	4.0	3	30	5.8
9	Soccer	8	111	4.0	9	16	3.1
10	Roller sports	9	88	3.1	14	9	1.7
	Total		**2,259**	**80.4**		**291**	**56.0**

Note: Sports are sorted by the number of cases for males and females combined.

The risk of sustaining a shoulder injury was comparatively high for some sports. For example, *Wheeled motor sports*, which had around 73,000 participants, had a male participation-based rate of 522 cases per 100,000 participants, and *Roller sports*, with around 50,000 participants had a male participation-based rate of 131 cases per 100,000. These rates compared with 3 cases per 100,000 for *Racquet sports* (655,000 participants) and 1 case per 100,000 for *Golf* (732,000) (Table B1.2).

For females, *Equestrian activity* was the type of sport associated with the largest number of shoulder injury cases, followed by *Cycling* and *Ice and snow sports* (Table 4.2). However, the

first-ranked sport for risk of shoulder injury was *Wheeled motor sports*. The highest rate for females was 508 cases per 100,000 for *Wheeled motor sports,* which had an estimated 3,700 participants, and ranked 7th in terms of case numbers.

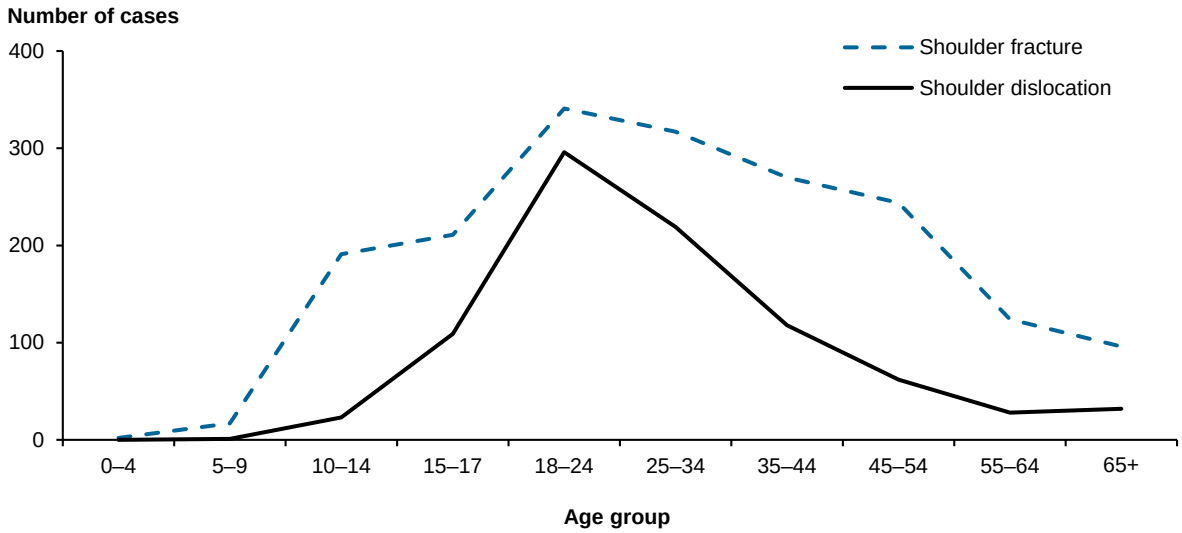
Types of shoulder injury

Fractures were the most common type of shoulder injury (54%). The relative proportions for males and females for each injury type were fairly similar (Table 4.3).

Table 4.3: Hospitalised sport-related shoulder injury nature of injury sustained, by sex, Australia, 2012–13

	Males		Females		Persons	
Nature of injury	**Number**	**%**	**Number**	**%**	**Number**	**%**
Shoulder fracture	1,522	54.2	291	56.0	1,813	54.4
Shoulder dislocation	768	27.3	120	23.1	888	26.7
Other shoulder injuries	520	18.5	109	21.0	629	18.9
Total	**2,810**	**100**	**520**	**100**	**3,330**	**100**

Both shoulder fractures and dislocations were most common in the 18–24 age group. Shoulder fractures were also common among older children and adolescents (Figure 4.2).



Note: The data underlying this chart can be found in Appendix C, tables C1.1 and C1.2.

Figure 4.2: All hospitalised sport-related shoulder injury, by nature of injury, by age, Australia, 2012–13

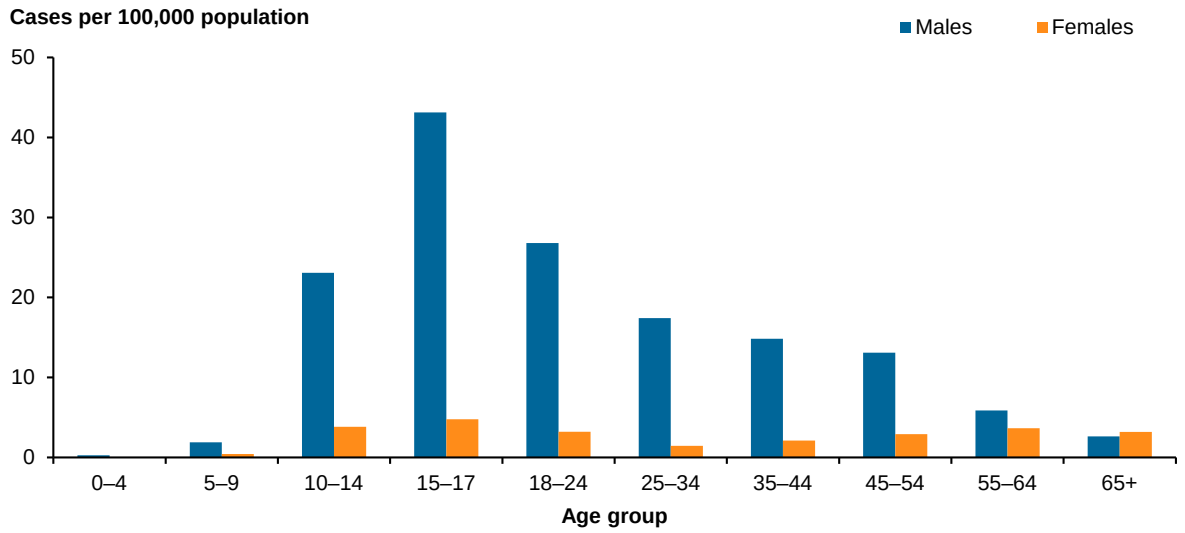
Shoulder fracture

Box 4.2: Shoulder fracture

Functional recovery after a fractured clavicle—the type of fracture most frequently observed in this report—is a slow process. Although most of the improvement occurs in the first 3 months, healing can continue for up to 1 year. One study found that 42% of patients continued to have a variety of symptoms after 6 months: pain, weakness, paraesthesia and non-union (Davies et al. 2009).

There were a total of 1,813 cases of shoulder fracture in 2012–13. Seven in 10 (73%) cases involved a fractured clavicle and around 2 in 10 (19%) affected the upper end of the humerus.

The all-ages age-standardised rate for shoulder fracture was 10 cases per 100,000 population. Male rates were more than 5 times those of female rates (17 vs 3 per 100,000). The highest age-specific rate for males was in the 15–17 age group (43 per 100,000) (Figure 4.3).



Note: The data underlying this chart can be found in Appendix C, tables C1.1 and C1.2.

Figure 4.3: Age-specific rates for hospitalised sport-related shoulder fracture, by age, by sex, Australia, 2012–13

Length of stay

MLOS for sport-related shoulder fracture showed a tendency to increase with age, and was highest for those aged 65 and over (Table 4.4). Sport-related shoulder injury resulted in a total of 4,982 days spent in hospital.

Table 4.4: Mean length of stay (in days) for all hospitalised sport-related shoulder fracture, by age, by sex, Australia, 2012–13

	Age group										
Sex	**0–4**	**5–9**	**10–14**	**15–17**	**18–24**	**25–34**	**35–44**	**45–54**	**55–64**	**65+**	**All ages**
Males	1.0	1.3	1.4	1.3	1.4	1.5	1.9	2.1	1.9	3.4	1.7
Females	0.0	1.0	1.2	1.5	1.3	2.3	2.2	1.7	2.9	3.1	2.2
Persons	**1.0**	**1.2**	**1.4**	**1.3**	**1.4**	**1.6**	**1.9**	**2.0**	**2.3**	**3.3**	**1.7**

In 9% of cases, the fracture was deemed to present a high threat to life, and in 5% of cases the person was transferred to another acute care hospital.

Types of sport

For males and females combined, *Cycling* and *Wheeled motor sports* accounted for over 2 in 5 hospitalisations for shoulder fracture. *Cycling* and *Wheeled motor sports* were also the sports most commonly associated with shoulder fracture among males. For females, *Equestrian activity* was the sport most frequently associated with this type of injury (Table 4.5).

In terms of participation-based rates, the highest rates for males 15 and over were for *Wheeled motor sports* (387 cases per 100,000 participants, RSE 18.8%), *Ice and snow sports* (79 per 100,000) and *Roller sports* (68 per 100,000). The highest reliable rates for females (RSE ≤25%) were for *Equestrian activity* (51 per 100,000) and *Ice and snow sports* (37 per 100,000) (tables B1.2 and B1.3).

Table 4.5: Ten sports most commonly associated with hospitalised sport-related shoulder fracture, Australia, 2012–13

		Males			Females		
Rank	**Sport**	**Rank**	**Number**	**% of cases**	**Rank**	**Number**	**% of cases**
1	Cycling	1	427	28.1	2	50	17.2
2	Wheeled motor sports	2	312	20.5	5	17	5.8
3	Australian Rules football	3	123	8.1	13	4	1.4
4	Rugby	4	121	8.0	16	3	1.0
5	Football, other and unspecified	5	110	7.2	12	5	1.7
6	Equestrian activities	9	32	2.1	1	67	23.0
7	Ice and snow sports	6	72	4.7	4	19	6.5
8	Soccer	7	57	3.7	7	10	3.4
9	Roller sports	8	56	3.7	11	7	2.4
10	Water sports	10	29	1.9	8	9	3.1
	Total		**1,339**	**88.0**		**191**	**65.6**

Note: Sports are sorted by the number of cases for males and females combined.

The 2 most common mechanisms of shoulder fracture were *Transport* (for example, bicycles, motorised vehicles or horses) (50%) and *Falls* (30%).

Treatment

Reduction of the fracture of the clavicle or shoulder was the most common medical procedure, used in 6 in 10 cases (Table 4.6).

Table 4.6: Three most common procedures for hospitalised sport-related shoulder fracture, Australia, 2012–13

Procedure	Number	%
Reduction of fracture of clavicle or shoulder	791	62.4
Generalised allied health interventions	195	15.4
Open reduction of fracture of humerus or elbow	120	9.5
Other medical procedures	161	12.7
Total	**1,267**	**100**

Note: There was no procedure code for 546 cases.

Shoulder dislocation

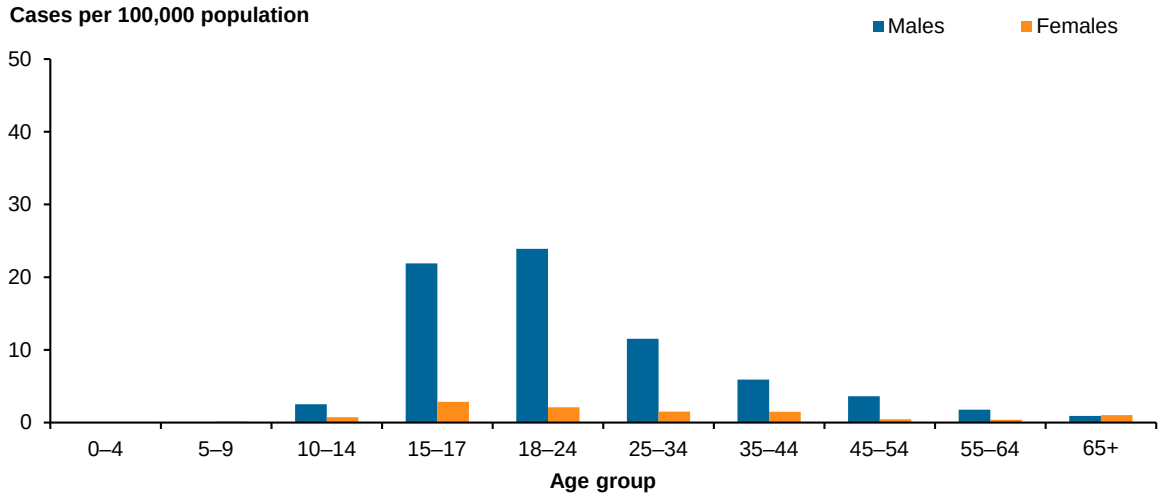
Box 4.3: Shoulder dislocation

A shoulder dislocation normally results from the traumatic removal of the head of the humerus from its socket. It is a very painful injury. A 'closed reduction'—in which the practitioner manually reinstates the head of the humerus—may be performed, or a 'surgical closed reduction'.

A common complication of shoulder dislocation is its recurrence. For example, it has been reported that recurrent instability occurs in up to one-third of patients after surgical repair of their shoulder (Zhu et al. 2015) and, in a 4-year follow-up study, subjects who had a history of a prior shoulder dislocation at baseline were over 5 times more likely to sustain a recurrent dislocation over the study period (Cameron et al. 2013). The rate of recurrence is highly age-dependent, appearing to be substantially greater for younger people (Hayes et al. 2002).

It has been estimated, using data from the New Zealand Accident Compensation Scheme (ACC), that the rate of shoulder dislocation from all causes is as high as 750 per 100,000 population at the age of 20 (Zhu et al. 2015). A United States epidemiological study of shoulder dislocations presenting to emergency departments estimates that around half of all injuries of this type were sustained during sports or recreation (Zacchilli & Owens 2010).

In 2012–13, 888 people were admitted to hospital for shoulder dislocation. Nearly 9 in 10 (87%) of these people were male. The age-standardised rate for persons was 5 cases per 100,000 population. Male age-specific rates were highest in the 15–17 and 18–24 age groups (21.9 and 23.9 per 100,000). Age-specific rates for females were low, with the highest being in the same age groups as for males (2.9 and 2.1, respectively) (Figure 4.4).



Note: The data underlying this chart can be found in Appendix C, tables C1.1 and C1.2.

Figure 4.4: Age-specific rates for hospitalised sport-related shoulder dislocation, by age, by sex, Australia, 2012–13

Length of stay

The MLOS for sport-related shoulder dislocation was comparatively low (1.2 days) and was the same for males and for females (Table 4.7).

Table 4.7: Mean length of stay for all hospitalised sport-related shoulder dislocation, by age, by sex, Australia, 2012–13

	Age group										
Sex	**0–4**	**5–9**	**10–14**	**15–17**	**18–24**	**25–34**	**35–44**	**45–54**	**55–64**	**65+**	**All ages**
Males	0.0	0.0	1.3	1.2	1.1	1.1	1.3	1.2	1.1	1.0	1.2
Females	0.0	1.0	1.0	1.0	1.0	1.1	1.1	1.3	1.0	1.9	1.2
Persons	**0.0**	**1.0**	**1.2**	**1.2**	**1.1**	**1.1**	**1.3**	**1.2**	**1.1**	**1.5**	**1.2**

The injury was life-threatening in 1% of cases, and 4% of cases were transferred to another acute care hospital.

Types of sport

Rugby was the sport most commonly associated with shoulder dislocation. For male cases, over 4 in 10 (45%) dislocations were associated with playing football of some kind. For females, the 3 sports most frequently associated with shoulder dislocation were *Netball* (9%), *Equestrian activity* (8%) and *Cycling* (8%) (Table 4.8). For males aged 15 and over, *Wheeled motor sports* had the highest crude participation-based rate (78 cases per 100,000 participants), followed by *Rugby* (64 per 100,000) and *Roller sports* (46 per 100,000). For females 15 and over, the highest reliable participation-based rate (RSE ≤ 25%) was for *Equestrian activity* (10 per 100,000) (tables B1.2 and B1.3).

Table 4.8: Ten sports most commonly associated with hospitalised sport-related shoulder dislocation, Australia, 2012–13

		Males			Females		
Rank	Sport	Rank	Number	% of cases	Rank	Number	% of cases
1	Rugby	1	129	16.8	9	4	3.3
2	Water sports	2	81	10.5	5	9	7.5
3	Cycling	4	77	10.0	3	10	8.3
4	Australian Rules football	3	81	10.5	20	1	0.8
5	Football, other and unspecified	5	66	8.6	10	4	3.3
6	Wheeled motor sports	6	57	7.4	19	1	0.8
7	Soccer	7	40	5.2	13	3	2.5
8	Touch football	8	27	3.5	6	6	5.0
9	Equestrian activities	14	15	2.0	2	10	8.3
10	Combative sports	10	22	2.9	14	2	1.7
	Total		**595**	**77.5**		**50**	**41.7**

Note: Sports are sorted by the number of cases for males and females combined.

The most frequent mechanisms of injury for shoulder dislocation were *Falls* (38%) and *Transport* (bicycles, motorised vehicles and horses) (22%).

Treatment

In 7 in 10 cases (72%), the main procedure was *Reduction of a dislocation of clavicle, scapula or shoulder* (Table 4.9).

Table 4.9: Three most common procedures for hospitalised sport-related shoulder dislocation, Australia, 2012–13

Procedure	Number	%
Reduction of dislocation of clavicle, scapula or shoulder	521	71.5
Other repair procedures on shoulder	132	18.1
Generalised allied health interventions	18	2.5
Other medical procedures	58	8.0
Total	**729**	**100**

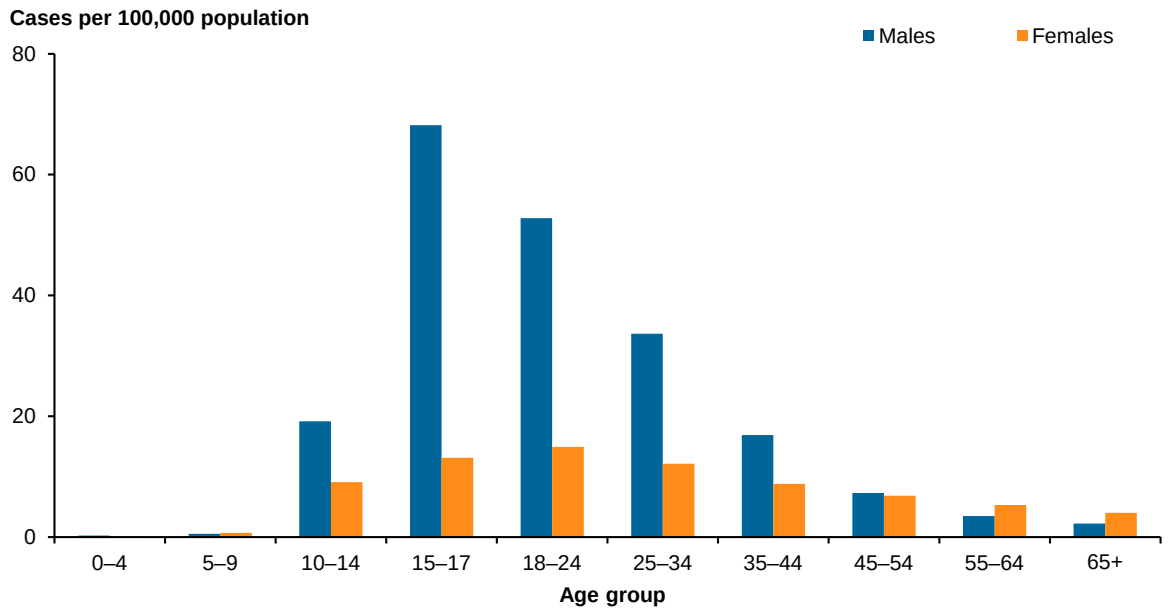
Note: There was no procedure code for 159 cases.

5 Ankle injury

Box 5.1: Ankle injury

Ankle injury is a fairly common sporting injury and can leave the affected person with long-term outcomes. Even a comparatively mild injury, such as an ankle sprain, may take a considerable period to resolve. In a study of inversion ankle injuries (sprains in which the outer ligaments of the ankle are stretched), subjects had persistent symptoms 2 years after their injury (Anandacoomarasamy & Barnsley 2005). In a 7-year follow-up of this type of injury, around one-third of people reported that they had chronic pain, swelling or recurrent sprains of the ankle. Of these, nearly three-quarters reported some form of functional impairment, most frequently an inability to perform sports at a desired level (Konradsen et al. 2002). Ankle sprains may also lead to chronic ankle instability. Valderrabano et al. report that ankle instability affects between 10% and 30% of patients after a sprain (Valderrabano et al. 2006).

Approximately 3,000 people were hospitalised as a result of sport-related ankle injury in 2012–13 (Table 1.1). Seventy per cent of these were males. The age-standardised rate for persons was 17 cases per 100,000 population. The highest age-specific rate was for males aged 15–17 (68 cases per 100,000). For females, rates were highest in the 15–17 and 18–24 age groups (13 and 15 per 100,000, respectively) (Figure 5.1).



Note: The data underlying this chart can be found in Appendix C, tables C1.1 and C1.2.

Figure 5.1: Age-specific rates for hospitalised sport-related ankle injury, by age, by sex, Australia, 2012–13

Length of stay

The overall MLOS in hospital for ankle injury at all ages was 1.5 days. The MLOS tended to rise with age (Table 5.1). Sport-related injuries to the ankle resulted in a total of 8,844 days spent in hospital (Table C1.3).

Table 5.1: Mean length of stay (in days) for all hospitalised sport-related ankle injuries, by age, by sex, Australia, 2012–13

	Age group										
Sex	**0–4**	**5–9**	**10–14**	**15–17**	**18–24**	**25–34**	**35–44**	**45–54**	**55–64**	**65+**	**All ages**
Males	1.0	1.3	1.4	1.3	1.2	1.3	1.6	1.8	1.6	2.3	1.4
Females	0.0	1.0	1.3	1.5	1.2	1.7	1.6	1.6	2.5	2.7	1.8
Persons	**1.0**	**1.3**	**1.4**	**1.3**	**1.2**	**1.3**	**1.6**	**1.7**	**1.8**	**2.5**	**1.5**

Around 300 cases of sport-related ankle injury were transferred to another acute care hospital. In 16 cases (0.5%), the injuries sustained were life-threatening.

Types of sport

For males and females combined, *Soccer* was the sport most commonly associated with cases of ankle injury (Table 5.2). However, rankings varied with sex. While *Soccer* was also the sport most frequently associated with male ankle injury hospitalisations (16%), for females, ankle injury was most commonly associated with *Roller sports* (15%).

Table 5.2: Ten sports most commonly associated with hospitalised sport-related ankle injury, Australia, 2012–13

		Males			Females		
Rank	**Sport**	**Rank**	**Number**	**% of cases**	**Rank**	**Number**	**% of cases**
1	Soccer	1	326	15.7	6	51	5.8
2	Rugby	2	272	13.1	12	15	1.7
3	Roller sports	5	155	7.5	1	130	14.8
4	Australian Rules football	3	204	9.8	22	7	0.8
5	Football, other and unspecified	4	186	9.0	16	9	1.0
6	Wheeled motor sports	6	144	6.9	15	13	1.5
7	Cycling	8	93	4.5	8	46	5.3
8	Water sports	7	102	4.9	10	23	2.6
9	Adventure and extreme sports	12	39	1.9	3	70	8.0
10	Walking and running	13	35	1.7	4	70	8.0
	Total		**1,556**	**75.1**		**434**	**49.5**

Note: Sports are sorted by the number of cases for males and females combined.

In terms of participation, the highest rate for males was for *Roller sports* (270 cases per 100,000 participants). In comparison, the participation-based rate for *Soccer* was 56 cases per 100,000). For females, the highest participation-based injury rate was for *Roller sports* (563 cases per 100,000 participants). This compared with a participation-based injury rate for *Netball* of 22 cases per 100,000 participants (tables B1.2 and B1.3).

Types of ankle injury

Box 6.1: Ankle fracture

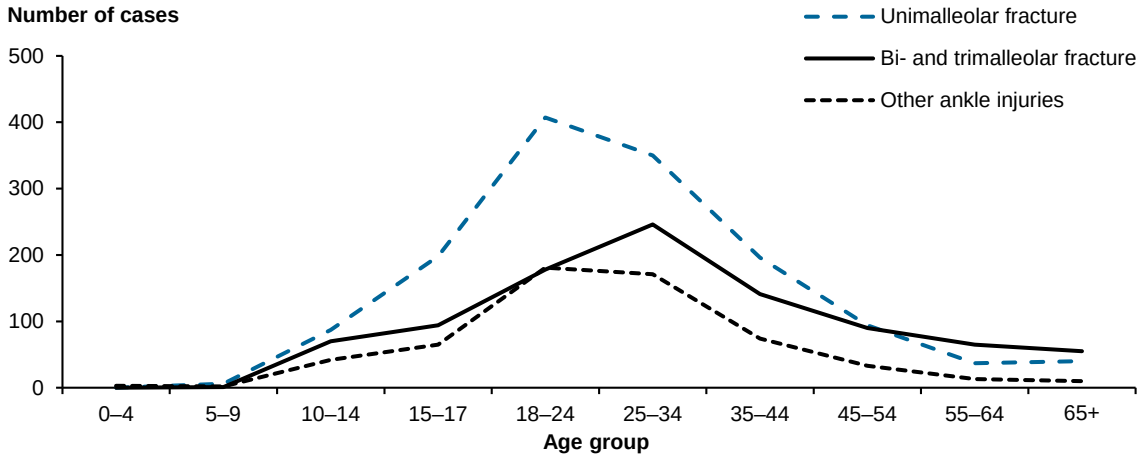
The malleoli are the 2 prominent bones on each side of the ankle. The medial malleolus is on the inner side of the ankle and the lateral malleolus on the outer side; a unimalleolar fracture affects either one of these. Bimalleolar or trimalleolar fractures are more serious types of injury. A bimalleolar fracture involves both the medial and lateral malleoli. A trimalleolar fracture involves both malleoli, as well as a fracture of the distal, or lower extremity, of the tibia, which is the inner of the 2 long bones between the ankle and the knee. The latter type of fracture can also be accompanied by damage to the ankle ligaments or a dislocation of the joint.

Unimalleolar fractures were the most frequent type of break (48%), but more serious bi- and trimalleolar fractures were also common (32%) (Table 5.3). A higher proportion of female ankle fractures were of the latter variety, compared with male ankle fractures (41% and 28%, respectively).

Table 5.3: Hospitalised sport-related ankle injury by nature of injury sustained, by sex, Australia, 2012–13

	Males		Females		Persons	
Nature of injury	**Number**	**%**	**Number**	**%**	**Number**	**%**
Unimalleolar fractures	1,063	51.3	352	40.2	1,415	48.0
Bi- and trimalleolar fractures	578	27.9	362	41.3	940	31.9
Other ankle injuries	432	20.8	162	18.5	594	20.1
Total	**2,073**	**100**	**876**	**100**	**2,949**	**100**

Unimalleolar fracture was most common between the ages of 18 and 34. Bi- and trimalleolar fractures peaked in the 25–34 age group (Figure 5.2).



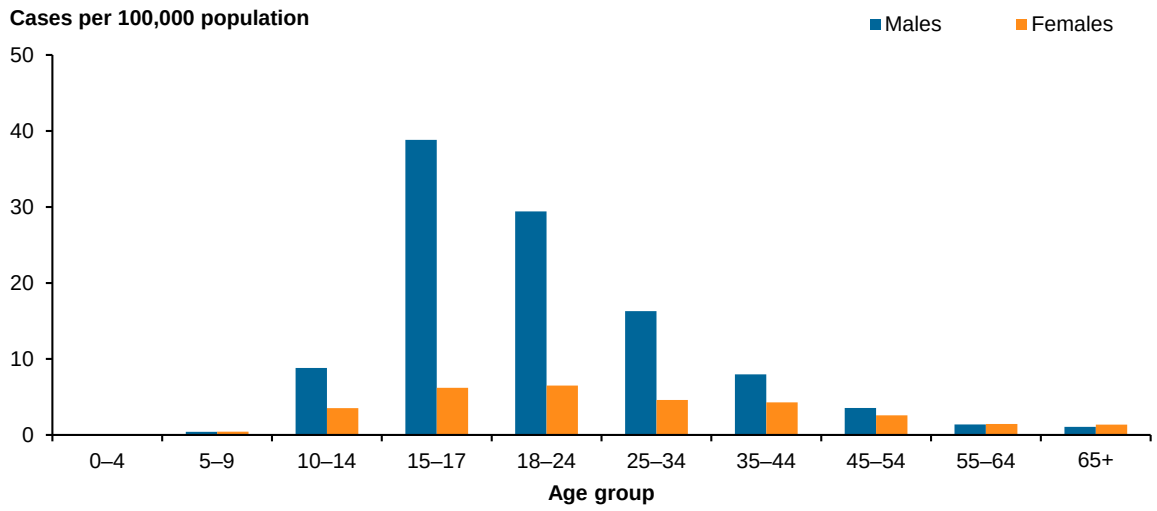
Note: The data underlying this chart can be found in Appendix C, tables C1.1 and C1.2.

Figure 5.2: All hospitalised sport-related ankle injury, by nature of injury, by age, Australia, 2012–13

Unimalleolar ankle fractures

In 2012–13, around 1,400 people were admitted to hospital as the result of sport-related unimalleolar fracture. Three-quarters were male.

Sport-related unimalleolar ankle fractures had an age-standardised rate for persons of 8 cases per 100,000 population. The rate for males (12 per 100,000) was 3 times as high as that for females (4 per 100,000). The highest age-specific rate for males was in the 15–17 age group (39) and, for females, in the 15–17 and 18–24 age groups (6 and 7, respectively) (Figure 5.3).



Note: The data underlying this chart can be found in Appendix C, tables C1.1 and C1.2.

Figure 5.3: Age-specific rates for hospitalised sport-related unimalleolar ankle fracture, by age, by sex, Australia, 2012–13

Length of stay

The all-ages MLOS for persons was 2.5 days. There was a tendency for MLOS to increase with age, and it was substantially higher for those aged 65 and over (Table 5.4). Sport-related unimalleolar fractures resulted in a total of 3,480 days spent in hospital.

Table 5.4: Mean length of stay (in days) for sport-related unimalleolar fractures, by age, by sex, Australia, 2012–13

	Age group										
Sex	**0–4**	**5–9**	**10–14**	**15–17**	**18–24**	**25–34**	**35–44**	**45–54**	**55–64**	**65+**	**All ages**
Males	0.0	1.0	1.7	2.1	2.3	2.5	2.8	2.7	2.9	4.2	2.4
Females	0.0	1.3	2.0	1.8	2.4	2.1	2.3	2.4	3.2	7.8	2.6
Persons	**0.0**	**1.2**	**1.8**	**2.0**	**2.3**	**2.4**	**2.6**	**2.6**	**3.1**	**6.4**	**2.5**

In 8% of cases of hospitalised unimalleolar fracture, this type of injury required a transfer to another acute care hospital, indicating that it was severe.

Types of sport

Overall, *Soccer* and *Rugby* were the 2 sports most frequently associated with unimalleolar fracture, accounting for over one-quarter (27%) of these injuries. The various codes of

football were associated with nearly half (48%) of unimalleolar fracture cases. *Soccer* and *Rugby* were also the sports most commonly associated with male fractures. For females, *Roller sports* were the activity most frequently associated with this type of injury (Table 5.5). Participation-based rates were highest, for both males and females aged 15 and over, for *Roller sports* (145 and 265 cases per 100,000 participants, respectively) (tables B1.2 and B1.3).

Table 5.5: Ten sports most commonly associated with hospitalised sport-related unimalleolar fractures, Australia, 2012–13

		Males			Females		
Rank	Sport	Rank	Number	% of cases	Rank	Number	% of cases
1	Soccer	1	186	17.5	7	23	6.5
2	Rugby	2	163	15.3	18	5	1.4
3	Roller sports	5	82	7.7	1	62	17.6
4	Australian Rules football	3	132	12.4	19	5	1.4
5	Football, other and unspecified	4	122	11.5	13	6	1.7
6	Water sports	7	58	5.5	9	14	4.0
7	Wheeled motor sports	6	58	5.5	17	5	1.4
8	Ice and snow sports	9	26	2.4	3	31	8.8
9	Walking and running	12	15	1.4	2	32	9.1
10	Equestrian activities	14	12	1.1	4	29	8.2
	Total		**854**	**80.3**		**212**	**60.2**

Note: Sports are sorted by the number of cases for males and females combined.

The 2 most frequent mechanisms of sport-related unimalleolar fractures were *Falls* (45%) and *Overexertion and strenuous or repetitive movements* (19%).

Treatment

The most common procedures used for this type of injury were *Open* and *Closed reductions of fracture of ankle or toe* (together accounting for 88% of procedures for ankle fracture of this kind) (Table 5.6).

Table 5.6: Three most common procedures for hospitalised sport-related unimalleolar fracture, Australia, 2012–13

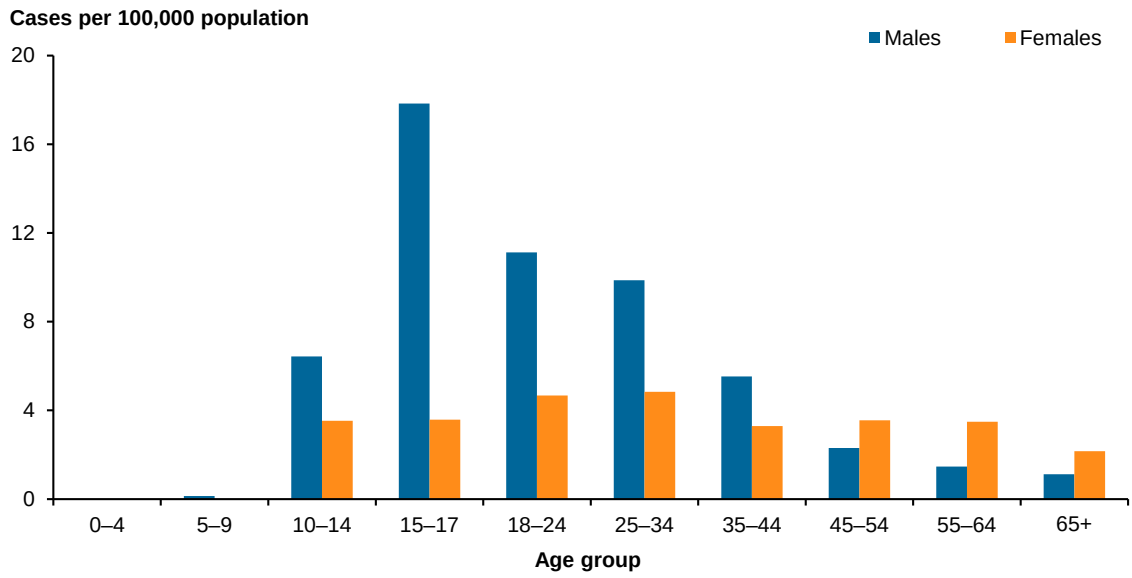
Procedure	Number	%
Open reduction of fracture of ankle or toe	976	78.5
Closed reduction of fracture of ankle or toe	113	9.1
Generalised allied health interventions	82	6.6
Other procedures	73	5.9
Total	**1,244**	**100**

Note: There was no procedure code for 171 cases.

Bi- and trimalleolar ankle fractures

There were 940 cases of bi- and trimalleolar ankle fracture in 2012–13. Nearly two-thirds (62%) were male. The all-ages age-standardised rate for bi- and trimalleolar fracture was

5 cases per 100,000 population. As for Unimalleolar fractures, the highest age-specific rate for males was in the 15–17 age group (18 per 100,000). For females, age-specific rates were fairly similar across the age bands (Figure 5.4).



Note: The data underlying this chart can be found in Appendix C, tables C1.1 and C1.2.

Figure 5.4: Age-specific rates for hospitalised sport-related bi- and trimalleolar ankle fractures, by age, by sex, Australia, 2012–13

Length of stay

The all-ages MLOS for this type of injury was almost twice that for unimalleolar fractures (4.2 days vs 2.5 days). Females had a higher overall MLOS than males (4.8 days vs 3.8 days) (Table 5.7). Sport-related bi- and trimalleolar fractures resulted in a total of 3,923 days spent in hospital by 940 persons.

Table 5.7: Mean length of stay (in days) for hospitalised sport-related bi- and trimalleolar fracture, by age, by sex, Australia, 2012–13

	Age group										
Sex	**0–4**	**5–9**	**10–14**	**15–17**	**18–24**	**25–34**	**35–44**	**45–54**	**55–64**	**65+**	**All ages**
Males	0.0	1.0	2.5	3.3	4.0	3.7	3.9	5.3	4.1	5.5	3.8
Females	0.0	0.0	2.2	3.1	2.8	4.6	4.8	6.3	7.2	4.9	4.8
Persons	**0.0**	**2.0**	**2.4**	**3.3**	**3.7**	**4.0**	**4.2**	**5.9**	**6.3**	**5.1**	**4.2**

A slightly higher proportion of cases of bi- and trimalleolar fracture cases than unimalleolar fractures required a transfer to another acute care hospital (14% vs 8%).

Types of sport

Roller sports was the activity most frequently associated with bi- and trimalleolar fractures (12%) (Table 5.8). The various codes of football did not contribute as greatly, overall, to this type of injury as was the case for unimalleolar fractures (28% vs 48%). For males, *Soccer*

and *Rugby* were the 2 sports most often related to bi- and trimalleolar fractures. For females, the most commonly associated activity was *Roller sports* (16%).

For males and females combined, bi- and trimalleolar fractures were most frequently associated with *Roller sports* and *Soccer*. For females, these injuries were most frequently related to *Roller sports* (16%). For males, however, the highest proportions of these injuries were associated with *Soccer* (14%). As for unimalleolar fractures, the highest crude participation-based rates, for both males and females 15 and over, were for *Roller sports* (87 and 260 cases per 100,000 participants, respectively) (tables B1.2 and B1.3).

Table 5.8: Ten sports most commonly associated with hospitalised sport-related bi- and trimalleolar ankle fractures, Australia, 2012–13

		Males			Females		
Rank	Sport	Rank	Number	% of cases	Rank	Number	% of cases
1	Roller sports	3	53	9.2	1	57	15.7
2	Soccer	1	83	14.4	8	13	3.6
3	Cycling	4	49	8.5	5	28	7.7
4	Rugby	2	68	11.8	11	7	1.9
5	Adventure and extreme sports	9	20	3.5	2	41	11.3
6	Wheeled motor sports	5	45	7.8	19	3	0.8
7	Walking and running	13	12	2.1	4	31	8.6
8	Equestrian activities	16	8	1.4	3	33	9.1
9	Australian Rules football	6	35	6.1	22	1	0.3
10	Water sports	8	26	4.5	12	6	1.7
	Total		**399**	**69.0**		**220**	**60.8**

Note: Sports are sorted by the number of cases for males and females combined.

In half of the cases, the mechanism of injury was *Falls*. Other common mechanisms were *Transport* (20%), *Overexertion and strenuous or repetitive movements* (15%), and *Contact with another person* (6%).

Treatment

As for unimalleolar fractures, the most common procedures used for this type of injury were *Open* and *Closed reductions of fracture of ankle or toe* (together accounting for 89% of procedures for ankle fracture of this kind) (Table 5.9).

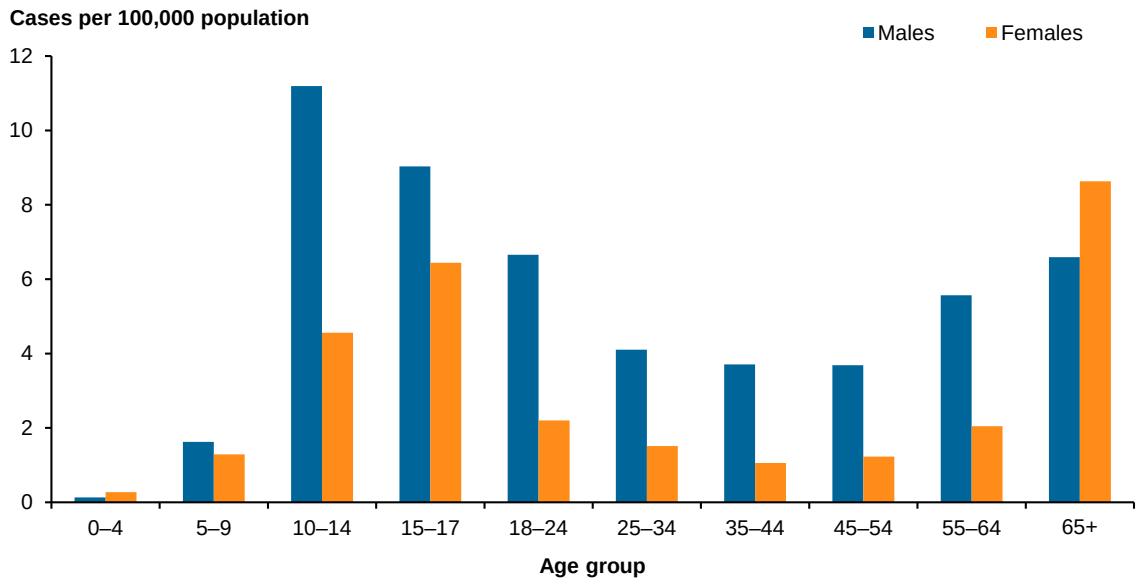
Table 5.9: Three most common procedures for hospitalised sport-related unimalleolar fracture, Australia, 2012–13

Procedure	Number	%
Open reduction of fracture of ankle or toe	623	73.2
Closed reduction of fracture of ankle or toe	135	15.9
Generalised allied health interventions	40	4.7
Other procedures	53	6.2
Total	**851**	**100**

Note: There was no procedure code for 89 cases.

6 Hip injury

In 2012–13, 898 people were hospitalised with sport-related hip injury (Table 1.1). Nearly two-thirds (63%) of these people were male. The age-standardised rate of hip injury for persons was 5 cases per 100,000 population. The highest age-specific rate for males was for children aged 10–14 (11 cases per 100,000). Females had lower age-specific rates than males for most age groups, with the highest being in the 65+ age group (9 cases per 100,000) (Figure 6.1).



Note: The data underlying this chart can be found in Appendix C, tables C1.1 and C1.2.

Figure 6.1: Age-specific rates for hospitalised sport-related hip injury, by age, by sex, Australia, 2012–13

Length of stay

The all-ages MLOS for persons was 5.2 days, which is comparatively high when compared with hospital stays due to other types of injury described in this report. In general, the MLOS rose with age (Table 6.1). Sport-related hip injury as a whole resulted in 4,632 days spent in hospital (Table C1.3).

Table 6.1: Mean length of stay (in days) for all hospitalised sport-related hip injury, by age, by sex, Australia, 2012–13

	Age group										
Sex	**0–4**	**5–9**	**10–14**	**15–17**	**18–24**	**25–34**	**35–44**	**45–54**	**55–64**	**65+**	**All ages**
Males	1.0	2.1	2.7	3.4	2.7	4.2	5.4	6.3	5.0	7.0	4.6
Females	1.5	5.0	2.6	2.4	2.2	3.5	4.0	7.0	5.6	8.9	6.1
Persons	**1.3**	**3.3**	**2.6**	**3.0**	**2.6**	**4.0**	**5.1**	**6.4**	**5.1**	**8.1**	**5.2**

Nearly one-quarter (24%) of people with sport-related hip injury were transferred to another acute care hospital. In well over half of the cases (60%), the injury sustained was life-threatening. In nearly half (46%) of the cases where the injury was deemed to be life-threatening, the nature of the injury was a fractured neck of femur. The risk of having sport-related hip injury which constituted a high threat to life generally increased with age, reaching 82% for those aged 65 and over.

Types of sport

Cycling and *Equestrian activities* were the 2 sports most commonly associated with hip injury (Table 6.2). Together they accounted for one-quarter of cases. For males, hip injury was most frequently sustained during *Cycling* (22%), followed by *Wheeled motor sports* (12%) and *Rugby* (8%). Female hip injury was most commonly associated with *Equestrian activity* (19%), followed by *Dancing* (11%).

Table 6.2: Ten sports most commonly associated with hospitalised sport-related hip injury, Australia, 2012–13

		Males			Females		
Rank	Sport	Rank	Number	% of cases	Rank	Number	% of cases
1	Cycling	1	126	22.3	5	19	5.7
2	Equestrian activities	10	17	3.0	1	63	18.9
3	Wheeled motor sports	2	67	11.9	9	9	2.7
4	Walking and running	8	20	3.5	3	30	9.0
5	Rugby	3	44	7.8	17	2	0.6
6	Roller sports	4	38	6.7	12	7	2.1
7	Dancing	16	7	1.2	2	35	10.5
8	Soccer	5	26	4.6	11	8	2.4
9	Racquet sports	13	10	1.8	4	20	6.0
10	Water sports	9	19	3.4	8	10	3.0
	Total		**374**	**66.2**		**203**	**61.0**

Note: Sports are sorted by the number of cases for males and females combined.

In terms of participation-based rates for males 15 and over, the highest were for *Wheeled motor sports* (84 cases per 100,000 participants) and *Roller sports* (58 per 100,000) (Table B1.2). For females aged 15 and over, the highest reliable participation rate (RSE ≤ 25%) was for *Equestrian activity* (51 cases per 100,000 participants) (Table B1.3).

Types of hip injury

The most common injury for both males and females was a fractured neck of femur (29% and 31%, respectively) (Table 6.3).

Box 6.2: Fractured neck of femur

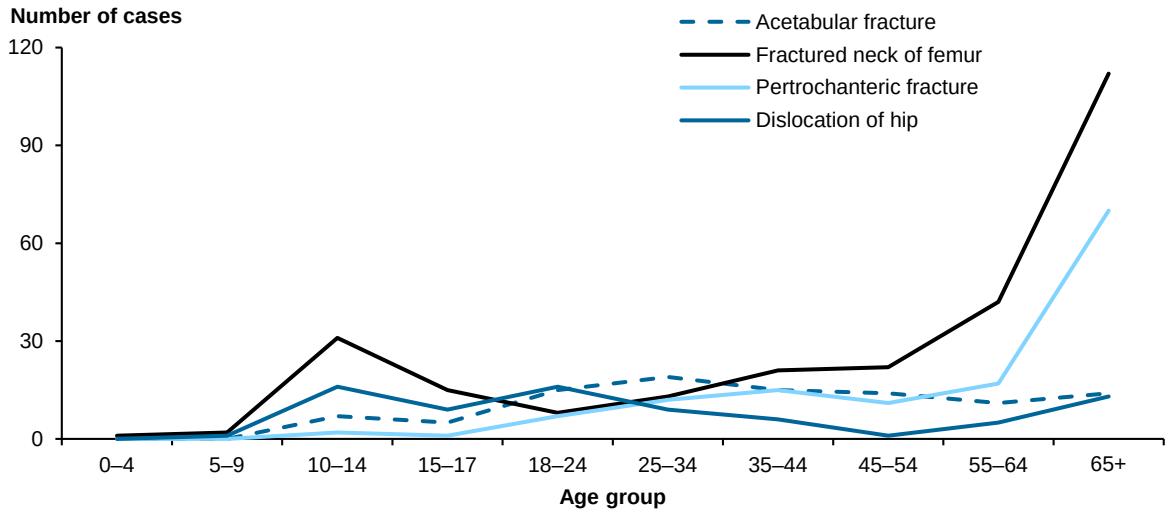
Although hip fracture is comparatively less common than other sports injury, the World Health Organization classes it as being the most detrimental type of fracture. This is particularly so for older people, for whom it can increase mortality and result in a high level of functional loss (Woolf & Pfleger 2003); examples from the literature illustrate this. A prospective study of patients over the age of 50, admitted to hospital with hip fracture, were found to have a decline in their functional abilities of around 15% to 20% directly attributable to their injury 1 year after treatment (Rosell & Parker 2003). A further prospective cohort study of people aged 60 and over who underwent surgery for repair of a hip fracture found that the mortality rate was 10% at 1 month, and 33% at 1 year. Chest infection and heart failure were the most common postoperative complications (9% and 5%, respectively). Those who experienced these complications had poor outcomes.

Postoperative heart failure resulted in mortality of 65% at 1 month and 92% at 1 year. A chest infection had a mortality rate of 43% at 1 month. The presence of comorbidities was a risk factor for complications leading to increased mortality (Roche et al. 2005). Hip fracture is a rare occurrence in children. For example, a fracture of the neck of femur comprises less than 1% of childhood fractures (Yeranosian et al. 2013). Despite this, it is not uncommon for children with a hip fracture to have severe complications. In a study, albeit small, of children ranging from 1.5 to 16 years, with a mean follow-up of around 5 years, various complications were observed. These included osteonecrosis (48%) and premature physeal closure (48%) (Kuo et al. 2011). (Osteonecrosis refers to the death of bone tissue which, in the case of a joint such as the hip, may lead to collapse of the joint surface. Premature physeal closure is closure of the growth plate which may subsequently result in a shortening of the bone, leading to permanent deformity.) Another study, of children aged 3–16, found that although there was a satisfactory outcome for 75% of children, the remaining quarter experienced serious complications, including osteonecrosis, non-union and arthritic changes (Bali et al. 2011).

Table 6.3: Hospitalised sport-related hip injury, by nature of injury sustained, by sex, Australia, 2012–13

	Males		Females		Persons	
Nature of injury	**Number**	**%**	**Number**	**%**	**Number**	**%**
Acetabular fracture	80	14.2	20	6.0	100	11.1
Fractured neck of femur	163	28.8	104	31.2	267	29.7
Pertrochanteric fracture	88	15.6	47	14.1	135	15.0
Dislocation of hip	63	11.2	13	3.9	76	8.5
Other injuries of the hip	171	30.3	149	44.7	320	35.6
Total	**565**	**100**	**333**	**100**	**898**	**100**

The frequency of fractured neck of femur and pertrochanteric fracture rose sharply from the age of 55. There was also a noteworthy peak in the number of cases of fractured neck of femur in the 10–14 age group (Figure 6.2).

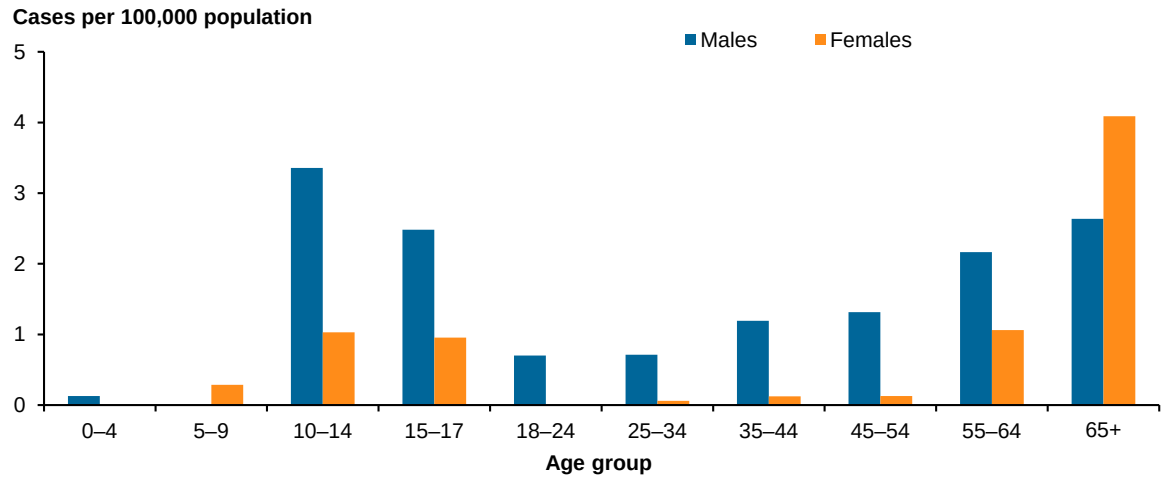


Note: The data underlying this chart can be found in Appendix C, tables C1.1 and C1.2.

Figure 6.2: All hospitalised sport-related hip injury, by nature of injury, by age, Australia, 2012–13

Fractured neck of femur

There were 267 cases of sport-related fractured neck of femur admitted to hospital in 2012–13. Three in 5 of these cases were male. The age-standardised rate for persons was comparatively low (1 case per 100,000 population). The highest rate was 4 cases per 100,000 women aged 65 and older. The next highest rate was for boys aged 10–14 (3 per 100,000) (Figure 6.3).



Note: The data underlying this chart can be found in Appendix C, tables C1.1 and C1.2.

Figure 6.3: Age-specific rates for hospitalised sport-related fractured neck of femur, by age, by sex, Australia, 2012–13

Length of stay

The overall MLOS for persons was comparatively high (6.3 days). The female all-ages MLOS of 8.1 days was higher than that for males (5.1 days) (Table 6.4). The total number of days spent in hospital for fractured neck of femur was 1,669.

Table 6.4: Mean length of stay (in days) for hospitalised sport-related fractured neck of femur, by age, by sex, Australia, 2012–13

	Age group										
Sex	**0–4**	**5–9**	**10–14**	**15–17**	**18–24**	**25–34**	**35–44**	**45–54**	**55–64**	**65+**	**All ages**
Males	1.0	0.0	4.7	2.5	3.0	3.9	4.4	4.3	4.6	8.0	5.1
Females	0.0	8.0	4.1	4.3	0.0	7.0	10.5	21.0	5.5	8.8	8.1
Persons	**1.0**	**8.0**	**4.5**	**2.9**	**3.0**	**4.2**	**5.0**	**5.8**	**4.9**	**8.5**	**6.3**

In all cases of sport-related fractured neck of femur, the injury was considered to be life-threatening. In 28% of cases, the patient was transferred to another acute care hospital.

Types of sport

For males and females combined, cases of fractured neck of femur were most frequently sustained during *Cycling* (17%) and *Walking and running* (8%). Around one-quarter (24%) of male cases were associated with *Cycling*. For females, cases were most frequently related to *Dancing* (15%) and *Walking and running* (14%) (Table 6.5).

Male crude participation-based rates for several sports surpassed that for *Cycling*, the sport most commonly associated with fractured neck of femur. The highest rates for those 15 and over were for *Roller sports* and *Wheeled motor sports* (22 and 21 cases per 100,000 participants, respectively). These rates compared with 4 per 100,000 for *Cycling* (Table B1.2).

For females 15 and over, *Dancing* had the highest participation-based rate of 7 cases per 100,000 participants. This compared with a rate of 4 per 100,000 for *Equestrian activity* (Table B1.3).

Table 6.5: Ten sports most commonly associated with hospitalised sport-related fractured neck of femur, Australia, 2012–13

		Males			Females		
Rank	**Sport**	**Rank**	**Number**	**% of cases**	**Rank**	**Number**	**% of cases**
1	Cycling	1	39	23.9	4	6	5.8
2	Walking and running	6	7	4.3	2	14	13.5
3	Dancing	16	2	1.2	1	16	15.4
4	Roller sports	3	14	8.6	7	3	2.9
5	Wheeled motor sports	2	15	9.2	13	1	1.0
6	Racquet sports	9	4	2.5	3	9	8.7
7	Rugby	4	8	4.9	15	1	1.0
8	Australian Rules football	5	8	4.9	18	1	1.0
9	Equestrian activities	11	4	2.5	5	4	3.8
10	Golf	8	6	3.7	9	2	1.9
	Total		**107**	**65.6**		**57**	**54.8**

Note: Sports are sorted by the number of cases for males and females combined.

By far the most common mechanism of injury for fractured neck of femur was *Falls* (61%).

Treatment

Fixation of fracture of pelvis or femur was the most common medical procedure used for a fractured neck of femur (51%), followed by *Arthroplasty of the hip* (27%) (Table 6.6).

Table 6.6: Five most common procedures for hospitalised sport-related fractured neck of femur, Australia, 2012–13

Procedure	Number	%
Fixation of fracture of pelvis or femur	112	50.9
Arthroplasty of hip	59	26.8
Procedures for slipped capital femoral epiphysis	19	8.6
Generalised allied health interventions	15	6.8
Other repair procedures on pelvis or hip	4	1.8
Other procedures	11	5.0
Total	**220**	**100**

Note: There was no procedure code for 47 cases.

Other hip injury

Pertrochanteric fracture

A pertrochanteric fracture is a fracture whose line lies between the greater and lesser trochanters. The trochanters are anatomical parts of the femur connecting to the hip bone.

There were 135 cases of sport-related pertrochanteric fractures admitted to hospital in 2012–13. Nearly two-thirds (65%) were males.

Sport-related pertrochanteric fractures are comparatively rare, and this is reflected in the age-standardised rate of 0.7 cases per 100,000 population.

The MLOS for pertrochanteric fractures, which rose with age, was 8.1 days. Females had a longer MLOS (11.4 days) than males (6.3 days).

Overall, in around one-quarter of all cases (26%) of pertrochanteric fracture, the injury was sustained while cycling. For males, over one-third of cases (38%) of pertrochanteric fracture were associated with *Cycling*. For females, this type of injury was most commonly related to *Walking and running* (17%) and *Dancing* (17%). The highest participation-based rate for males 15 and over was for *Roller sports* (12 cases per 100,000 participants), and for females, the highest reliable rate (RSE ≤ 25%) was for *Ice and snow sports* (4 per 100,000) (tables B1.2 and B1.3).

The chief mechanisms of this type of injury were *Falls* (53%) and *Transport* (for example, bicycles, motorised vehicles or horses) (42%).

Pertrochanteric fracture, in all 135 cases, was considered to be life-threatening. Over a third (36%) of cases were transferred to another acute care hospital.

Fixation of fracture of pelvis or femur was the most commonly used medical procedure (76%).

Acetabular fracture

Acetabular fractures involve the head of the femur being driven into the pelvis. This injury is caused by a blow to either the side or front of the knee. The acetabulum is a cavity located on the outer surface of the hip bone. The acetabulum and head of the femur form the hip joint.

Acetabular fracture is a comparatively rare injury, usually resulting from high-energy impact. There were 100 cases of hospitalisation during 2012–13 for this type of injury sustained through sport. Eight in 10 of these cases were male.

The age-standardised rate for persons for acetabular fracture was 0.5 cases per 100,000 population.

All cases of sport-related acetabular fracture were designated life-threatening. In 28% of cases, the person was transferred to another acute care hospital. The MLOS in hospital was 9.4 days.

For males, most cases of acetabular fracture were associated with *Cycling* (34%) and *Wheeled motor sports* (19%). Females most commonly sustained such fractures during *Equestrian activity* (40%) and *Cycling* (15%). For males 15 and over, the highest participation-based rates were for *Wheeled motor sports* and *Roller sports* (21 and 14 cases per 100,000 participants, respectively). The highest reliable rate for females was for *Equestrian activity* (8 per 100,000) (tables B1.2 and B1.3).

The 2 most common mechanisms of injury were *Transport* (for example, bicycle, horse, motor vehicle) (60%) and *Falls* (28%).

The most frequently used procedures for this type of injury were *Generalised allied health interventions* (51%), *Reduction of fracture of pelvis or femur* (24%), and *Reduction of dislocation of hip* 12%).

Dislocation of hip

There were 76 cases of sport-related hip dislocation in 2012–13. A large majority of these were male (83%).

The age-standardised rate for persons was 0.4 cases per 100,000 population. The highest age-specific rates were for young males aged 10–14 and 15–17 (2 cases per 100,000).

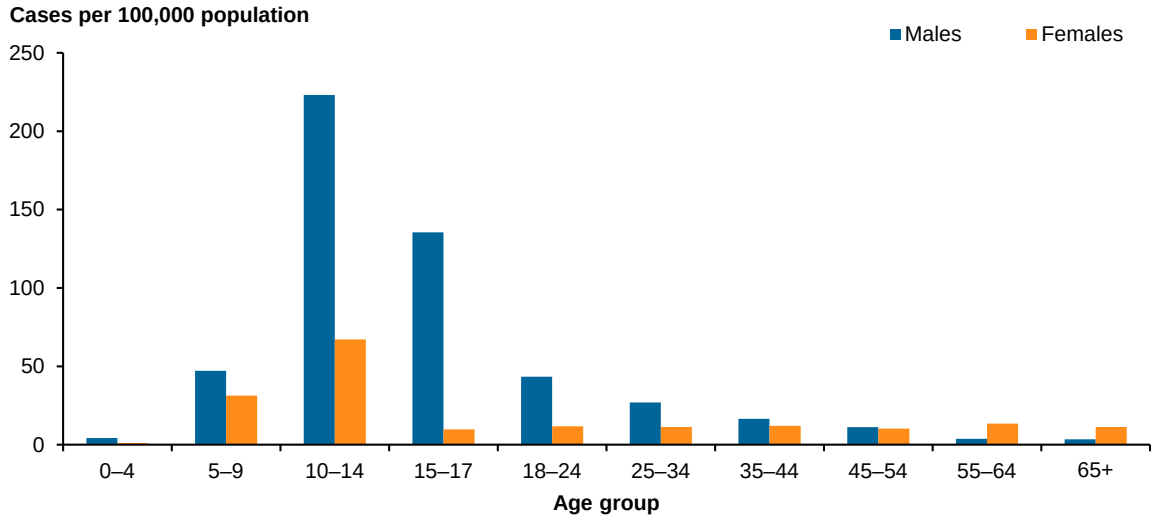
In 8% of cases of hip dislocation, the injury was considered to pose a high threat to life. 21% of people were transferred to another acute care hospital. The all-ages MLOS was 2.1 days.

The 3 sports most frequently associated with hip dislocation were *Rugby* (21%), *Wheeled motor sports* (15%) and *Water sports* (15%). The most common mechanism of injury was *Fall* (38%). Crude male participation-based rates for those aged 15 and over were highest for *Wheeled motor sports* and *Rugby* (11 and 4 cases per 100,000 participants, respectively). For females 15 and over, the highest reliable participation-based rate (RSE ≤ 5%) was for *Ice and snow sports* (2 per 100,000) (tables B1.2 and B1.3).

The most commonly used procedure was *Reduction of dislocation of hip* (70%).

7 Wrist injury

Over 5,800 (5,831) people were admitted to hospital in 2012–13 due to sport-related wrist injury (Table 1.1). Seven in 10 of these people were male. The age-standardised rate for persons for wrist injury was 34 cases per 100,000 population. The highest age-specific rates for both males and females were found in the 10–14 age group (223 and 67 cases per 100,000) (Figure 7.1).



Note: The data underlying this chart can be found in Appendix C, tables C1.1 and C1.2.

Figure 7.1: Age-specific rates for hospitalised sport-related wrist injury, by age, by sex, Australia, 2012–13

Length of stay

The overall MLOS in hospital for wrist injury at all ages was 1.8 days. The MLOS tended to rise with age (Table 7.1). Sport-related wrist injury resulted in a total of 8,262 days spent in hospital (Table C1.3).

Table 7.1: Mean length of stay (in days) for all hospitalised sport-related wrist injury, by age, by sex, Australia, 2012–13

	Age group										
Sex	**0–4**	**5–9**	**10–14**	**15–17**	**18–24**	**25–34**	**35–44**	**45–54**	**55–64**	**65+**	**All ages**
Males	1.3	1.3	1.6	1.5	1.8	1.9	2.3	2.2	2.2	3.7	1.8
Females	1.6	1.4	1.4	1.9	1.7	1.5	2.0	3.0	2.3	4.5	1.8
Persons	**1.4**	**1.4**	**1.5**	**1.5**	**1.8**	**1.8**	**2.2**	**2.5**	**2.3**	**4.3**	**1.8**

Around 300 cases of sport-related wrist injury were transferred to another acute care hospital. In 36 cases (0.6%), the injuries sustained were life-threatening.

Types of sport

For males and females combined, *Roller sports* and *Soccer* were the 2 sports most commonly associated with injuries of the wrist (Table 7.3). Together they accounted for over one-quarter (28%) of cases. For males, wrist injury was most frequently sustained during *Roller sports* (18%), followed by *Soccer* (13%) and *Cycling* (10%). For females, wrist injury was also most commonly associated with *Roller sports* (18%), followed by *Netball* (10%) and *Equestrian activities* (9%).

Table 7.2: Ten sports most commonly associated with hospitalised sport-related wrist injury, Australia, 2012–13

		Males			Females		
Rank	Sport	Rank	Number	% of cases	Rank	Number	% of cases
1	Roller sports	1	745	18.4	1	318	17.9
2	Soccer	2	510	12.6	8	85	4.8
3	Cycling	3	410	10.1	4	123	6.9
4	Australian Rules football	4	398	9.8	16	18	1.0
5	Rugby	5	331	8.2	14	20	1.1
6	Wheeled motor sports	6	330	8.1	15	19	1.1
7	Football, other and unspecified	7	292	7.2	21	9	0.5
8	Basketball	8	182	4.5	10	56	3.2
9	Equestrian activities	10	68	1.7	3	151	8.5
10	Ice and snow sports	9	105	2.6	6	107	6.0
	Total		**3,371**	**83.1**		**906**	**51.1**

Note: Sports are sorted by the number of cases for males and females combined.

In terms of participation, the highest rate for males was for *Roller sports* (598 cases per 100,000 participants). In comparison, the participation-based rate for *Racquet sports* was 5 cases per 100,000) (Table B1.2). For females, the highest participation-based injury rate was for *Roller sports* (587 cases per 100,000 participants). In comparison, the participation-based injury rate for *Netball* was 19 cases per 100,000 participants (Table B1.3).

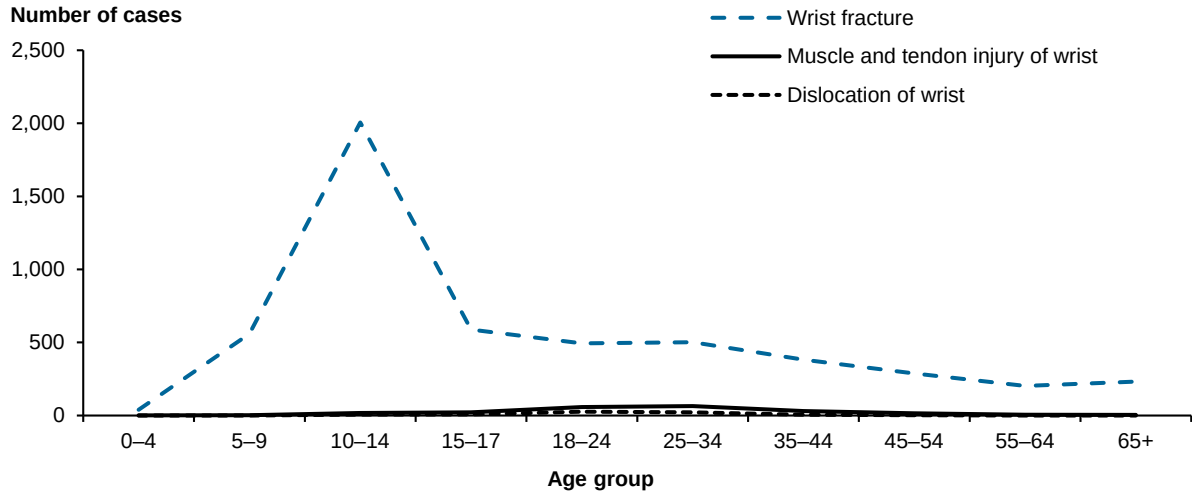
Types of wrist injury

Wrist fracture was by far the most common type of wrist injury (91%). A higher proportion of female than male wrist injuries were wrist fractures (95% vs 89%, respectively) (Table 7.3).

Table 7.3: Hospitalised sport-related wrist injury, by nature of injury sustained, by sex, Australia, 2012–13

	Males		Females		Persons	
Nature of injury	**Number**	**%**	**Number**	**%**	**Number**	**%**
Wrist fracture	3,608	88.9	1,684	95.0	5,292	90.8
Muscle and tendon injury to wrist	186	4.6	32	1.8	218	3.7
Dislocation of wrist	63	1.6	6	0.3	69	1.2
Other and unspecified injuries to the wrist	202	5.0	50	2.8	252	4.3
Total	**4,059**	**100**	**1,772**	**100**	**5,831**	**100**

Wrist fracture was more common than other types of wrist injury in every age group, with the highest rate seen in the 10–14 age group (2,006 cases) (Figure 7.2).



Note: The data underlying this chart can be found in Appendix C, tables C1.1 and C1.2.

Figure 7.2: All hospitalised sport-related wrist fracture, by nature of injury, by age, Australia, 2012–13

Wrist fracture

Box 7.1: Wrist fracture

The most common type of wrist fracture is of the distal radius. In this study, this type of injury accounted for 42% of all admitted wrist fractures. Reference to the literature regarding the outcomes of a wrist fracture illustrates the type of disability that can occur.

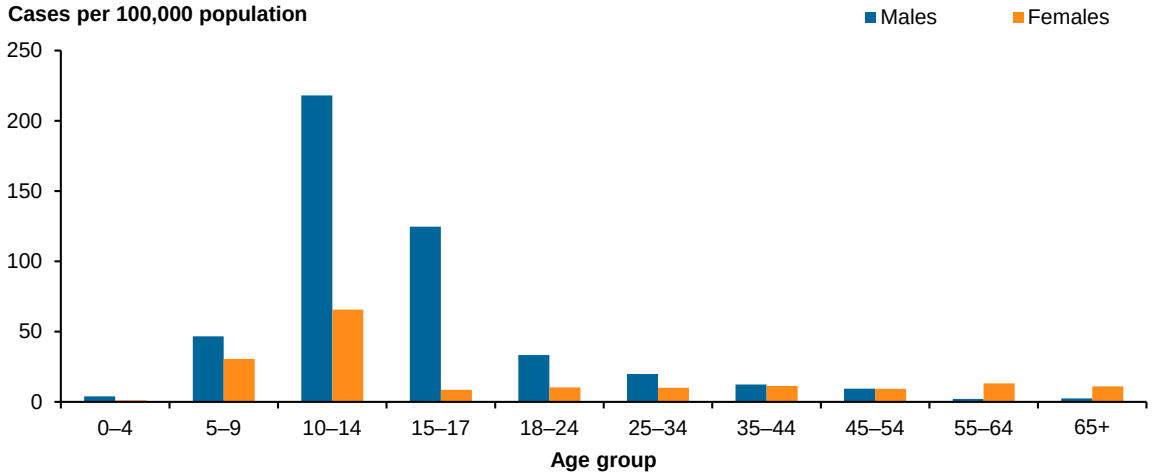
Distal radius fractures are common, accounting for around 1 in 5 of all fractures. They most commonly occur through a fall onto an outstretched hand (Khan & Shah 2014). When sustained in that way, the broken distal end of the radius usually tilts upwards, as if the wrist was in extension, and this type of wrist fracture is known as Colle's fracture. It appears that increasing age is associated with poorer functional outcomes (Cowie et al. 2015). Wrist fractures are associated with high health-care costs per patient, particularly older patients (de Putter et al. 2012).

(continued)

Box 7.1 (continued): Wrist fracture

Fractures of the wrist have the potential for long-term negative outcomes. In a prospective review of women with a Colles fracture it was found that, 3 years post-surgery, 28% reported persistent pain. For some patients, shortening of the radius had also resulted in a reduction in grip strength (Villar et al. 1987). Sustaining a fracture of the distal radius increases a person's risk of developing arthritis or wrist instability (Khan & Shah 2014). An Australian-Netherlands study has also found that, in a small proportion of cases (4%), patients with a wrist fracture developed complex regional pain syndrome (CRPS), a distressing condition that is difficult to treat (Moseley et al. 2014).

In 2012–13, 5,292 people were admitted to hospital due to sport-related wrist fracture. Wrist fracture comprised the vast majority of cases of wrist injury (91%). Around two-thirds (68%) of these cases were male. The age-standardised rate for persons was 31 cases per 100,000 population. The highest age-specific rates for both males and females were in the 10–14 age group (218 and 66 per 100,000, respectively) (Figure 7.3).



Note: The data underlying this chart can be found in Appendix C, tables C1.1 and C1.2.

Figure 7.3: Age-specific rates for hospitalised sport-related wrist fracture, by age, by sex, Australia, 2012–13

Length of stay

The overall MLOS was relatively short, at 1.4 days (Table 7.4). Longer MLOS was observed for males aged 55 and over. Sport-related wrist fractures resulted in a total of 7,382 days spent in hospital.

Table 7.4: Mean length of stay (in days) for hospitalised sport-related wrist fractures, by age, by sex, Australia, 2012–13

	Age group										
Sex	**0–4**	**5–9**	**10–14**	**15–17**	**18–24**	**25–34**	**35–44**	**45–54**	**55–64**	**65+**	**All ages**
Males	1.2	1.2	1.2	1.4	1.4	1.6	1.6	1.6	4.0	2.8	1.4
Females	1.1	1.2	1.2	1.5	1.6	1.6	1.5	1.5	1.7	2.0	1.5
Persons	**1.2**	**1.2**	**1.2**	**1.4**	**1.5**	**1.6**	**1.6**	**1.5**	**2.0**	**2.1**	**1.4**

The injury sustained was considered to be life-threatening in a very small proportion of cases (0.6%). In 5% of cases, the person was transferred to another acute care hospital.

Types of sport

Roller sports were the leading cause of wrist fracture for both males and females (20% and 19%, respectively) (Table 7.5). For males, this was followed by *Soccer* (14%) and *Cycling* (10%) and, for females, by *Netball* (10%) and *Equestrian activity* (8%). As well as being the sport most commonly associated with wrist fractures, *Roller sports* also had the highest crude participation-based rates for both males and females 15 and over (554 and 577 cases per 100,000 participants, respectively) (tables B1.2 and B1.3).

Table 7.5: Ten sports most commonly associated with hospitalised sport-related wrist fracture, Australia, 2012–13

		Males			Females		
Rank	Sport	Rank	Number	% of cases	Rank	Number	% of cases
1	Roller sports	1	717	19.9	1	313	18.6
2	Soccer	2	493	13.7	8	81	4.8
3	Cycling	3	367	10.2	4	119	7.1
4	Australian Rules football	4	352	9.8	14	18	1.1
5	Wheeled motor sports	5	303	8.4	15	17	1.0
6	Rugby	6	280	7.8	16	15	0.9
7	Football, other and unspecified	7	243	6.7	21	8	0.5
8	Basketball	8	172	4.8	10	54	3.2
9	Ice and snow sports	9	100	2.8	6	103	6.1
10	Equestrian activities	10	63	1.7	3	139	8.3
	Total		**3,090**	**85.8**		**867**	**51.6**

Note: Sports are sorted by the number of cases for males and females combined.

For 7 in 10 cases, the mechanism of injury for wrist fracture was *Falls*.

Treatment

In almost all cases of wrist fracture, the procedure used was either an *Open* or *Closed reduction of fracture radius* (96%) (Table 7.6).

Table 7.6: Three most common procedures for hospitalised sport-related wrist fracture, Australia, 2012–13

Procedure	Number	%
Closed reduction of fracture of radius	3,074	65.8
Open reduction of fracture of radius	1,401	30.0
Generalised allied health interventions	50	1.1
Other procedures	146	3.1
Total	**4,671**	**100**

Note: There was no procedure code for 621 cases.

Other injuries to the wrist

Muscle and tendon injury to the wrist

A total of 218 people were admitted to hospital in 2012–13 with a muscle or tendon injury to the wrist (Table C1.3). More than 8 in 10 (85%) of these people were male. The highest age-specific rate, of 5 cases per 100,000 population, was for males aged 15–24 (Table C1.1). The age-standardised rate for persons for this type of injury was 1.2 per 100,000.

The MLOS in hospital for this type of injury was 1.4 days.

The 3 most common mechanisms of injury were *Falls* (15%), *Transport* (12%) and *Contact with sports equipment* (12%). (Results not tabulated).

Muscle and tendon injury to the wrist was most frequently associated with *Australian Rules football* (14%), *Other and unspecified football* (13%) and *Rugby* (11%). The highest participation-based rates for persons aged 15 and over were for *Wheeled motor sports* and *Australian Rules football* (each accounting for 12 cases per 100,000 participants) (Table B1.4).

The most common medical procedure was *Repair of tendon or hand* (60%).

Dislocation of the wrist

Only 69 cases of sport-related wrist dislocation were admitted to hospital in 2012–13. In 9 in 10 cases (91%), the person was male. Rates of wrist dislocation were low. The highest age-specific rates were for males aged 15–24 (2 cases per 100,000 population, Table C1.1). The age-standardised rate for persons was 0.4 per 100,000).

The MLOS in hospital was 1.4 days.

Wrist dislocation was most commonly associated with various codes of football (65%). Specifically, cases were associated with *Rugby* (26%), *Other and unspecified football* (19%), *Soccer* (10%) and *Australian Rules football* (10%). The highest participation-based rates for persons were for *Rugby* and *Wheeled motor sports* (8 and 7 cases per 100,000 participants, respectively) (Table B1.4).

The most frequent mechanisms of injury were *Falls* (41%), and *Contact with another person* (16%). (Results not tabulated.)

The 3 most common procedures were *Reduction of dislocation of radius or ulna* (34%), *Closed reduction of dislocation of joint of hand* (18%) and *Open reduction of dislocation of joint of hand* (18%). (Results not tabulated.)

8 Injury to the spinal column and cord

At the most extreme level, injury to the spinal cord can have devastating consequences, including permanent paralysis of the upper and/or lower body limbs. More numerous are injuries in which the spinal column is injured (for example, fractured vertebrae and sprains and strains of spinal column ligaments) but the spinal cord is intact.

This chapter examines injuries to both the spinal column and the spinal cord at the level of the cervical spine and thoracic & lumbosacral spine (see Box 8.1).

Box 8.1: Classifying injuries to the spine

For the purposes of this report, all spinal injury is described as either *Spinal cord injury* or as *Other type of spine injury***.**

Cases are classified as a *Spinal cord injury* if they have 1 of the following ICD-10-AM codes as their principal diagnosis:

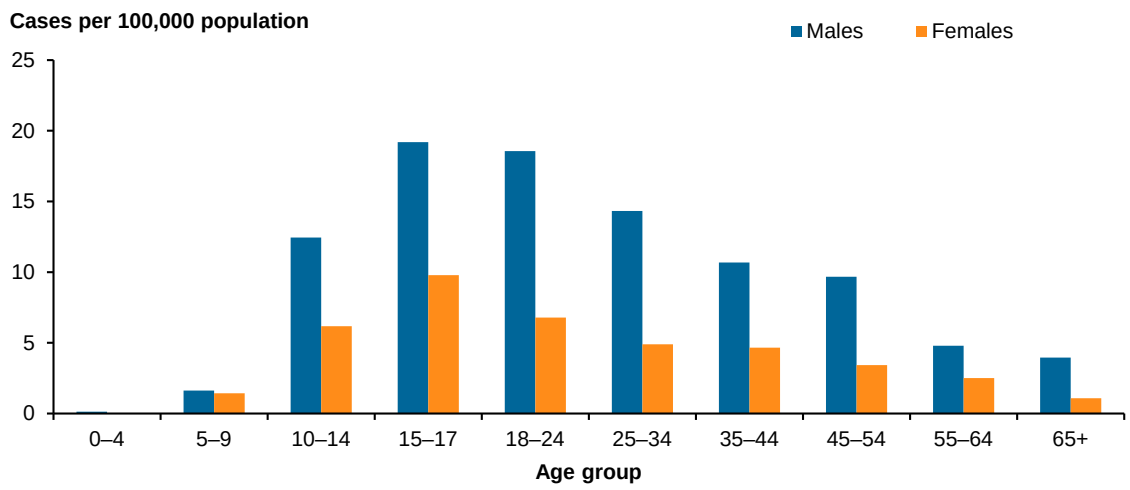
- S14.1 *Other and unspecified injuries of cervical spinal cord*
- S24.1 *Other and unspecified injuries of thoracic spinal cord*
- S34.1 *Other injury of lumbar spinal cord [conus medullaris] Complete/incomplete lumbar cord lesion.*

Other type of spine injury include:

- Fractures
- Dislocations
- Concussion and oedema of spinal cord.

Injuries to the spine are also classified according to the region of the spinal cord or column that is injured. Three regions are commonly distinguished: the cervical spine (C1–C8), the thoracic spine (T1–T12) and the lumbosacral spine (L1–L5 and S1–S5). The cervical spine is the highest part of the spinal cord and includes the neck. An injury to the cervical spinal cord will impact on the person's sensory function and ability to control movement of both the upper and lower limbs. This type of impairment is known as tetraplegia (sometimes called quadriplegia). An injury to the thoracic or lumbosacral spinal cord will impact on the person's sensory function and ability to control movement of the lower limbs, and this type of impairment is commonly known as paraplegia.

Just over 1,500 people were admitted to hospital in 2012–13 as the result of sport-related spinal injury (Table 1.1). Nearly three-quarters (72%) were male. The age-standardised rate of all sport-related spinal injury for persons was 9 cases per 100,000 population. Males had a higher age-standardised rate than did females (12 vs 5 per 100,000, respectively). The highest age-specific rates for males were for those aged 15–24 (19 cases per 100,000). For females, the highest age-specific rate was for those aged 15–17 (10 per 100,000 (Figure 8.1).



Note: The data underlying this chart can be found in Appendix C, tables C1.1 and C1.2.

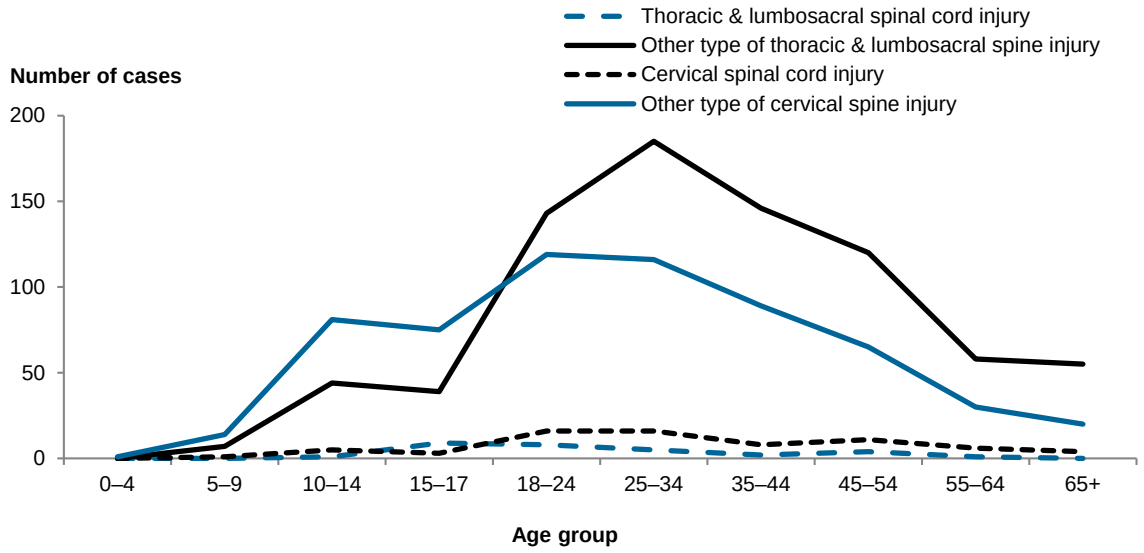
Figure 8.1: Age-specific rates for hospitalised sport-related spinal injury, by age, by sex, Australia, 2012–13

Injury to the thoracic and lumbosacral spine was more common than Injury to the cervical spine (55% and 45%, respectively). Overall, 7% of spinal injuries were to the cord. Males sustained a higher proportion of spinal cord injuries than females (8% vs 3%, respectively) (Table 8.1).

Table 8.1: Hospitalised sport-related spinal injury, by nature of injury sustained, by sex, Australia, 2012–13

	Males		Females		Persons	
Nature of injury	**Number**	**%**	**Number**	**%**	**Number**	**%**
Cervical spinal cord injury	63	5.8	7	1.6	70	4.6
Other type of cervical spine injury	478	44.3	132	30.8	610	40.5
Thoracic & lumbosacral spinal cord injury	26	2.4	4	0.9	30	2.0
Other type of thoracic & lumbosacral spine injury	512	47.5	285	66.6	797	52.9
Total	**1,079**	**100**	**428**	**100**	**1,507**	**100**

The frequency of spinal cord injury was low overall. Thoracic and lumbosacral spinal cord injury was most common between the ages of 15 and 24. Cases of Cervical spinal cord injury were most common from 18 to 34 years (Figure 8.2). Cases of other type of thoracic and lumbosacral spine injury were most frequent between the ages of 18 and 54, and reached a peak in the 25–34 age group. Other type of cervical spine injury was most common from ages 18 to 34.



Note: The data underlying this chart can be found in Appendix C, tables C1.1 and C1.2.

Figure 8.2: All hospitalised sport-related spinal injury, by nature of injury, by age, Australia, 2012–13

Length of stay

The all-ages MLOS for cases of all spinal injury was 5 days in hospital. There was, however, considerable variation in MLOS with respect to the nature of the injury sustained. Catastrophic injury to the spinal cord entails lengthy stays in hospital (Norton 2010). The all-ages MLOS for spinal cord injury was 26 days for injury involving the cervical spinal cord and 16 days where the injury involved the thoracic and lumbosacral spinal cord. In contrast, the MLOS for other type of cervical spine injury and other type of thoracic and lumbosacral spine injury were 3 and 4 days, respectively. It should be noted that the MLOS cited in this report for spinal cord injury represents the days spent in hospital during the initial acute care phase of treatment, and that such cases tend to be transferred to other medical facilities for prolonged stages of further therapy.

Sport-related spinal injury resulted in a total of 7,700 days in hospital (Table C1.3).

In over 4 in 10 cases (43%), spinal injury was considered to pose a high threat to life. One in 5 people were transferred to another acute care hospital.

Types of sport

For males, most cases of spinal injury were sustained in the course of engaging in *Water sports* (20%), followed closely by *Wheeled motor sports* (17%). *Water sports* were also commonly associated with female cases of *Spinal injury* (15%), but the sport in which female spinal injuries were most frequently sustained was *Equestrian activity*, which accounted for 35% of female cases (Table 8.2).

Table 8.2: Ten sports most commonly associated with hospitalised sport-related spinal injury, Australia, 2012–13

		Males			Females		
Rank	Sport	Rank	Number	% of cases	Rank	Number	% of cases
1	Water sports	1	219	20.3	2	66	15.4
2	Wheeled motor sports	2	188	17.4	7	12	2.8
3	Equestrian activities	6	40	3.7	1	148	34.6
4	Cycling	3	152	14.1	4	20	4.7
5	Rugby	4	128	11.9	10	7	1.6
6	Australian Rules football	5	52	4.8	19	3	0.7
7	Ice and snow sports	8	28	2.6	5	19	4.4
8	Football, other and unspecified	7	29	2.7	15	4	0.9
9	Gymnastics & trampolining	13	11	1.0	3	21	4.9
10	Soccer	9	27	2.5	14	5	1.2
	Total		**874**	**81.0**		**305**	**71.2**

Note: Sports are sorted by the number of cases for males and females combined.

In terms of participation, the highest rate for males was for *Wheeled motor sports* (258 cases per 100,000 participants). In contrast, the participation-based rate for *Water sports* was 14 per 100,000) (Table B1.2). For females, the highest reliable rates were for *Equestrian activity* and *Gymnastics and trampolining* (140 and 72 cases per 100,000 participants, respectively) (Table B1.3).

The most common mechanism of spinal injury (43%) was *Transport* (for example, bicycles, motorised vehicles or horses). This was followed by *Falls* (30%). (Results not tabulated.)

Types of injury to the spinal column or cord

Injuries to the cervical spine

During 2012–13, there were 680 cases of sport-related injury to the cervical spine admitted to hospital. Eight in 10 of these cases were male.

Types of sport

Injury to the cervical spine, as a whole, was most commonly associated with *Water sports* (26%) (Table 8.3). The 3 most common of these were *Surfing* (40%), *Swimming* (22%) and *Diving* (14%). Various codes of football were associated with nearly a third (30%) of all injury to the cervical spine.

Although the ranking differed, the top 3 sports associated with both cervical spinal cord injury and other types of cervical spine injury were *Water sports*, *Rugby* and *Cycling*. Together these accounted for 51% of cervical spinal cord injury cases and 54% of other types of cervical spine injury cases.

Table 8.3: Ten sports most commonly associated with hospitalised sport-related injury to the cervical spine, Australia, 2012–13

All cervical spinal injury		Cervical spinal cord injury			Other cervical spinal injury		
Rank	Sport	Rank	Number	% of cases	Rank	Number	% of cases
1	Water sports	1	22	31.4	1	152	24.9
2	Rugby	3	7	10.0	2	108	17.7
3	Cycling	2	7	10.0	3	70	11.5
4	Wheeled motor sports	5	6	8.6	4	59	9.7
5	Australian Rules football	6	4	5.7	5	34	5.6
6	Equestrian activities	4	6	8.6	6	31	5.1
7	Football, other and unspecified	10	2	2.9	7	24	3.9
8	Gymnastics & trampolining	—	0	0.0	8	21	3.4
9	Soccer	11	2	2.9	9	19	3.1
10	Combative sports	7	2	2.9	10	7	1.1
	Total		**58**	**82.9**		**525**	**86.1**

Injury to the thoracic and lumbosacral spine

Over 800 people (827) were hospitalised in 2012–13 as the result of sustaining sport-related injury to the thoracic and lumbosacral spine. Around two-thirds (65%) of these people were male.

Types of sport

For males and females combined, injury to the thoracic and lumbosacral spine was most often sustained during *Equestrian activity* (18%). This was followed by *Wheeled motor sports* (16%) and *Water sports* (13%). Spinal cord injury, which was fortunately rare, most frequently occurred while pursuing *Wheeled motor sports* (43%) (Table 8.4).

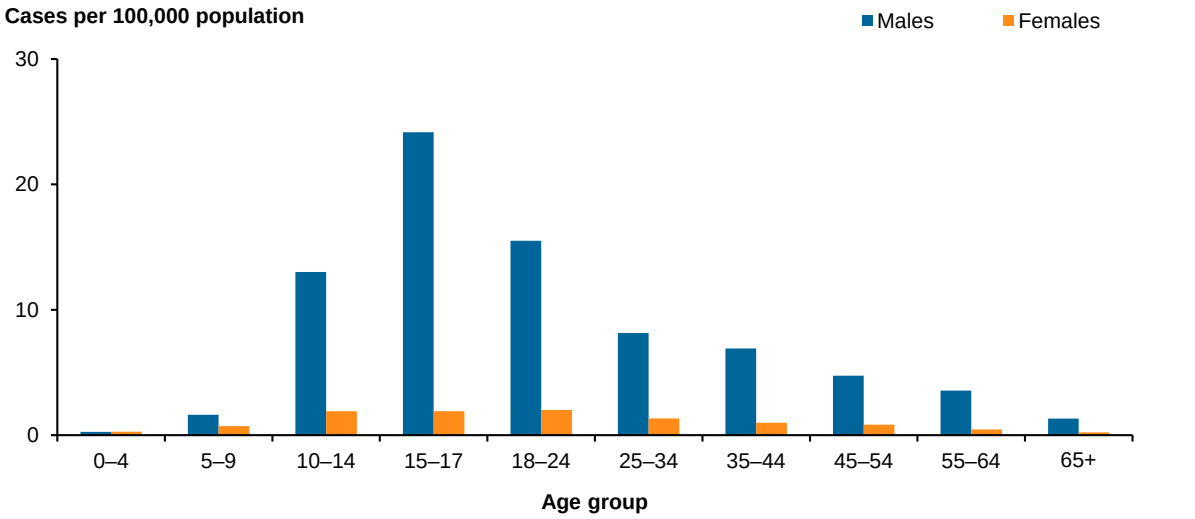
Table 8.4: Ten sports most commonly associated with hospitalised sport-related injury to the thoracic & lumbosacral spine, Australia, 2012–13

All thoracic & lumbosacral spinal injury		Thoracic & lumbosacral spinal cord injury			Other type of thoracic & lumbosacral spine injury		
Rank	Sport	Rank	Number	% of cases	Rank	Number	% of cases
1	Equestrian activities	8	1	3.3	1	150	18.8
2	Wheeled motor sports	1	13	43.3	2	122	15.3
3	Water sports	4	3	10.0	3	108	13.6
4	Cycling	2	4	13.3	4	91	11.4
5	Ice and snow sports	6	1	3.3	5	37	4.6
6	Rugby	—	0	0.0	6	20	2.5
7	Adventure and extreme sports	5	1	3.3	8	16	2.0
8	Australian Rules football	—	0	0.0	7	17	2.1
9	Walking and running	—	0	0.0	9	14	1.8
10	Racquet sports	—	0	0.0	10	12	1.5
	Total		**23**	**76.7**		**587**	**73.7**

As for injury to the cervical spine, *Transport* (for example, bicycles, motorised vehicles or horses) and *Falls* were the major mechanisms of injury in cases of injury to the thoracic and lumbosacral spine (51% and 24%, respectively). (Results not tabulated.)

9 Injury to internal organs

In 2012–13, approximately 900 people were admitted to hospital after sustaining sport-related Injury to an internal organ (Table 1.1). Nearly 9 in 10 (88%) of these people were male. The age-standardised rate for persons was 5 cases per 100,000 population. The highest age-standardised rate for males was for the 15–17 age group (24 cases per 100,000). Rates for females were comparatively low, with the highest rates being for those aged 10–24 (2 cases per 100,000) (Figure 9.1).



Note: The data underlying this chart can be found in Appendix C, tables C1.1 and C1.2.

Figure 9.1: Age-specific rates for all hospitalised sport-related injury to internal organs, by age, by sex, Australia, 2012–13

Length of stay

The overall MLOS in hospital was 4.7 days. This is higher than for many of the other types of injury described in this report (Table 9.1). Sport-related injury to any internal organ resulted in a total of 4,174 days spent in hospital (Table C1.3).

Table 9.1: Mean length of stay (in days) for all hospitalised sport-related injury to internal organs, by age, by sex, Australia, 2012–13

	Age group										
Sex	**0–4**	**5–9**	**10–14**	**15–17**	**18–24**	**25–34**	**35–44**	**45–54**	**55–64**	**65+**	**All ages**
Males	10.0	6.3	4.7	5.2	4.5	4.1	4.9	4.6	3.9	8.8	4.7
Females	7.0	3.2	4.5	3.5	4.5	5.1	3.7	5.7	4.8	5.3	4.6
Persons	**8.5**	**5.4**	**4.6**	**5.1**	**4.5**	**4.3**	**4.8**	**4.7**	**4.0**	**8.2**	**4.7**

In 116 cases (13%), the person was transferred to another acute care hospital. In around two-thirds of cases (68%), the injury sustained was deemed to present a high threat to life. There were no deaths in hospital as a result of Injury to an internal organ.

Types of sport

Overall, around one-fifth (21%) of all injuries to internal organs were associated with *Cycling*. A further 18% and 12%, respectively, were related to *Wheeled motor sports* and *Australian Rules football*. For males, *Cycling* and *Wheeled motor sports* were the 2 activities most often associated with injury to an internal organ (21% and 20%, respectively) (Table 9.2). Most females, by far, sustained injury to an internal organ while engaging in *Equestrian activity* (45%). Such injuries also commonly occurred in relation to *Cycling* (17%) (Table 9.2).

When looked at in terms of participation-based rates, males aged 15 and over engaging in *Wheeled motor sports* had the highest risk of injury to an internal organ, with a rate of 185 per 100,000 participants—a rate much higher than for *Cycling* (15 per 100,000) (Table B1.2). For females aged 15 and over, the highest reliable participation-based rate (RSE ≤ 25%) was for *Equestrian activity* (39 per 100,000 participants) (Table B1.3).

Table 9.2: Ten sports most commonly associated with hospitalised sport-related injury to internal organs, Australia, 2012–13

		Males			Females		
Rank	Sport	Rank	Number	% of cases	Rank	Number	% of cases
1	Cycling	1	163	21.0	2	19	17.1
2	Wheeled motor sports	2	155	20.0	5	6	5.4
3	Australian Rules football	3	109	14.0	—	0	0.0
4	Equestrian activities	10	23	3.0	1	50	45.0
5	Football, other and unspecified	5	53	6.8	7	3	2.7
6	Rugby	4	53	6.8	9	2	1.8
7	Water sports	6	44	5.7	3	8	7.2
8	Soccer	7	39	5.0	4	7	6.3
9	Roller sports	8	32	4.1	8	2	1.8
10	Ice and snow sports	9	27	3.5	6	4	3.6
	Total		**698**	**89.9**		**101**	**91.0**

Note: Sports are sorted by the number of cases for males and females combined.

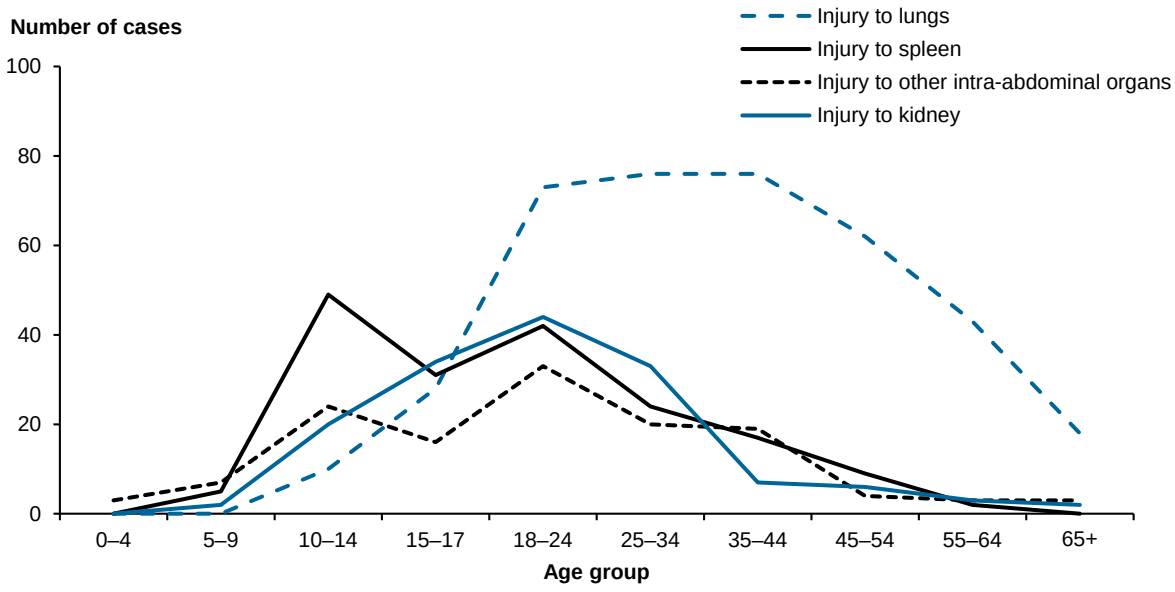
Types of internal organ injury

The most common types of injury for both males and females involved the lungs (44% and 40%, respectively) (Table 9.3). In around two-thirds of cases involving Injury to the lungs (66%), the injury was a traumatic pneumothorax.

Table 9.3: Hospitalised sport-related injury to internal organs, by nature of injury sustained, by sex, Australia, 2012–13

	Males		Females		Persons	
Nature of injury	**Number**	**%**	**Number**	**%**	**Number**	**%**
Injury to lungs	342	44.1	44	39.6	386	43.5
Injury to spleen	162	20.9	17	15.3	179	20.2
Injury to other intra-abdominal organs	103	13.3	29	26.1	132	14.9
Injury to kidney	132	17.0	19	17.1	151	17.0
Injury to other internal organs	37	4.8	2	1.8	39	4.4
Total	**776**	**100**	**111**	**100**	**887**	**100**

Injury to the lungs occurred most often between the ages of 18 and 44 (Figure 9.2). Injury to the spleen reached 2 peaks in the 10–14 and 18–24 age groups. Thereafter, this type of injury declined steadily. The occurrence of injury to the kidney rose after the age of 9 and fell dramatically after age 34.



Note: The data underlying this chart can be found in Appendix C, tables C1.1 and C1.2.

Figure 9.2: All hospitalised sport-related injury to internal organs, by nature of injury, by age, Australia, 2012–13

Injury to the lungs

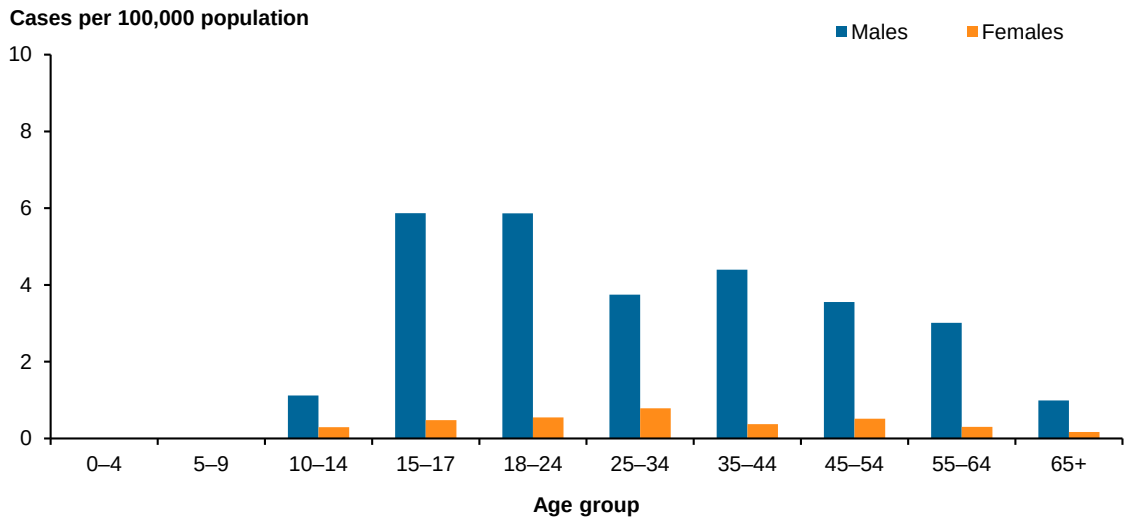
In this report, injury to the lungs includes all intrathoracic organs and structures. Injuries involving the lungs mainly comprise the following:

- a *Traumatic pneumothorax* which is an accumulation of air or gas in the pleural cavity causing the lung to collapse. It results from a blunt or penetrating chest injury. This was the most common type of lung-related injury observed
- a *Traumatic haemothorax*, which is also usually the outcome of blunt or penetrating trauma to the chest, often results from rib fractures. It manifests as a collection of blood in the pleural space

- a *Traumatic haemo-pneumothorax* is a combination of the above 2 conditions.

There were 386 cases of sport-related injuries to the lungs admitted to hospital in 2012–13. In nearly 9 out of 10 cases (89%), the injured person was male.

The age-standardised rate for persons was comparatively low, at 2 cases per 100,000 population. The highest age-specific rates were for young men in the 15–17 and 18–24 age groups (6 cases each per 100,000). Age-specific rates for females were low (less than 1 case per 100,000). There were no cases of injury to the lungs for children under the age of 10 (Figure 9.3).



Note: The data underlying this chart can be found in Appendix C, tables C1.1 and C1.2.

Figure 9.3: Age-specific rates for hospitalised sport-related injury to the lungs, by age, by sex, Australia, 2012–13

Length of stay

The all-ages MLOS for persons was 4 days. The longest MLOS was for men aged 65+ (Table 9.4). Sport-related injury to the lungs resulted in 1,555 days spent in hospital.

Table 9.4: Mean length of stay (in days) for hospitalised sport-related injury involving the lungs, by age, by sex, Australia, 2012–13

	Age group										
Sex	**0–4**	**5–9**	**10–14**	**15–17**	**18–24**	**25–34**	**35–44**	**45–54**	**55–64**	**65+**	**All ages**
Males	0.0	0.0	4.8	3.5	4.1	3.3	4.1	4.1	3.7	6.9	4.0
Females	0.0	0.0	3.0	2.0	2.8	4.5	3.7	5.4	5.3	3.3	4.1
Persons	**0.0**	**0.0**	**4.4**	**3.4**	**4.0**	**3.5**	**4.1**	**4.3**	**3.8**	**6.3**	**4.0**

In nearly three-quarters (74%) of cases of injury to the lungs, the injuries were considered to be life-threatening. One in 10 cases was transferred to another acute care hospital.

Types of sport

Overall, *Cycling* and *Wheeled motor sports* were associated with over 4 in 10 (45%) of the cases of lung injury (23% and 22%, respectively) (Table 9.5). For males, injury to the lungs

occurred most often in *Cycling* (24%), *Wheeled motor sports* (24%), and *Australian Rules football* (14%). Over half of the female cases (55%) were related to *Equestrian activities*.

In terms of participation, the highest crude rate for males 15 and over was for *Wheeled motor sports* (108 cases per 100,000 participants) (Table B1.2). For females in that age group, the highest reliable participation-based rate (RSE ≤ 25%) was for *Equestrian activity* (22 per 100,000) (Table B1.3).

Table 9.5: Ten sports most commonly associated with hospitalised sport-related lung injury, Australia, 2012–13

		Males			Females		
Rank	Sport	Rank	Number	% of cases	Rank	Number	% of cases
1	Cycling	2	81	23.7	2	8	18.2
2	Wheeled motor sports	1	81	23.7	4	2	4.5
3	Australian Rules football	3	48	14.0	—	0	0.0
4	Equestrian activities	8	11	3.2	1	24	54.5
5	Rugby	4	24	7.0	20	0	0.0
6	Water sports	5	18	5.3	3	3	6.8
7	Football, other and unspecified	6	18	5.3	8	1	2.3
8	Soccer	7	16	4.7	9	1	2.3
9	Ice and snow sports	9	8	2.3	—	0	0.0
10	Adventure and extreme sports	10	4	1.2	—	0	0.0
	Total		**309**	**90.4**		**39**	**88.6**

Note: Sports are sorted by the number of cases for males and females combined.

The 3 main mechanisms of injury to the lungs were *Transport* (for example, bicycles, motorised vehicles or horses) (55%), *Fall* (20%) and *Contact with another person* (19%). (Results not tabulated.)

Treatment

In 4 in 10 of the cases (40%) treatment consisted of *Application, insertion or removal procedures on chest wall, mediastinum or diaphragm*. For a further one-quarter (24%), *Generalised allied health interventions* were the principal procedure used. (Results not tabulated.)

Other internal organ injuries

Injury to the spleen

There were 179 cases of sport-related injury to the spleen in 2012–13. Nine in 10 of these were male.

The age-standardised rate of this type of injury was low, at 1 case per 100,000 population (males 1.9; females 0.2, tables C1.1 and C1.2). The highest age-specific rates were for males aged 10–14 and 15–17 (6.2 and 6.8 per 100,000, respectively) (Table C1.3).

The MLOS for persons in hospital was 6 days. Injury to the spleen is serious and, in 91% of cases, was deemed to present a high threat to life. Around 1 in 5 people were transferred to another acute care hospital for treatment.

For males and females combined, injury to the spleen appeared most frequently in relation to *Wheeled motor sports* (18%), *Cycling* (18%) and *Roller sports* (11%). For males, cases were also most commonly associated with *Wheeled motor sports* (20%), followed by *Cycling* (19%) and *Roller sports* (11%). For females, *Injury to the spleen* was most frequently associated with *Equestrian activity* (53%). (Results not tabulated.)

The highest participation-based rate for males aged 15 or older was for *Wheeled motor sports* (30 per 100,000 participants) (Table B1.2). The highest participation-based rate for females 15 and over was also for *Equestrian activity* (7 cases per 100,000) (Table B1.3).

Injury to the kidney

Around 150 people were admitted to hospital in 2012–13 as the result of an injury to the kidney sustained while playing sport. Nearly 9 in 10 (87%) of these people were male (Table 9.3).

This type of injury was uncommon, having age-standardised population-based rates of 1.5 cases per 100,000 males (Table C1.1) and 0.2 cases per 100,000 females (Table C1.2). The highest age-specific rate was for young men aged 15–17 (7 cases per 100,000; Table C1.1).

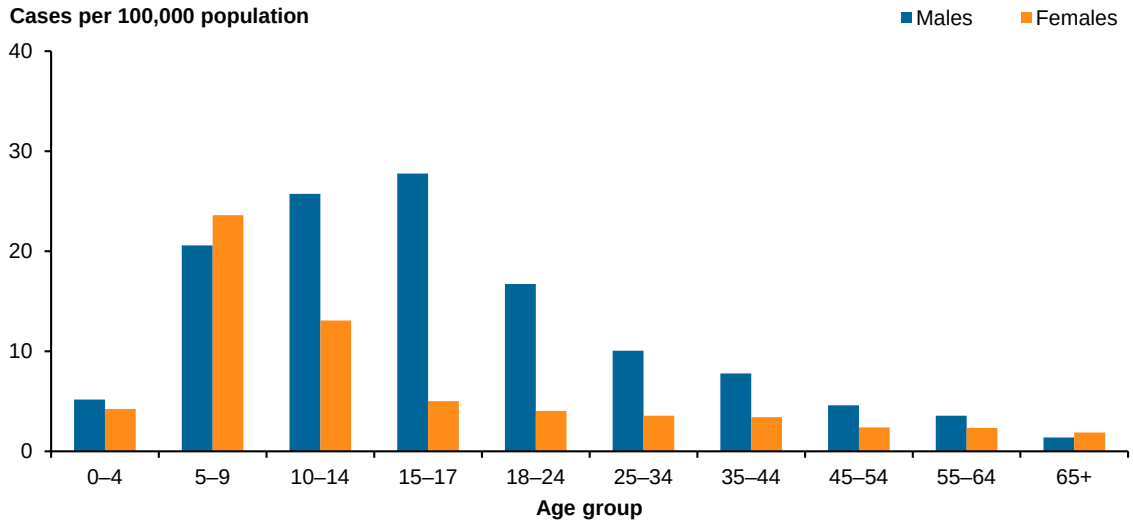
The all-ages MLOS for persons was 4.5 days (Table C1.3). A high proportion (80%) of injury to the kidney was life-threatening in nature. Relatively few of these cases were transferred to another acute care hospital (11%).

Overall, around half (49%) of the cases of kidney injury were sustained while playing the various codes of football. Male injuries to the kidney were most often associated with *Australian Rules football* (24%). The largest number of female cases (7, or 37%) were associated with *Equestrian activity*. (Results not tabulated.) The highest crude participation-based rate for males aged 15 and over was for *Wheeled motor sports* (21 cases per 100,000 participants). For females aged 15 and over, the highest reliable rate (RSE ≤ 25%) was for *Equestrian activity* (6 per 100,000) (tables B1.2 and B1.3).

The most frequent mechanism of injury was *Contact with another person* (39%), followed by *Transport* (for example, bicycles, motorised vehicles or horses) (31%) and *Falls* (25%). (Results not tabulated.)

10 Elbow injury

In 2012–13, nearly 1,700 people were admitted to hospital with sport-related elbow injury (Table 1.1). Two-thirds were male. The age-standardised rate for elbow injury was 10 cases per 100,000 population. The age-standardised rate for males was almost double that for females (13 vs 7 per 100,000; tables C1.1 and C1.2). The highest age-specific rates for males were in the 10–14 and 15–17 age groups (26 and 28 per 100,000, respectively). For females, the highest age-specific rate was for young girls aged 5–9 (Figure 10.1).



Note: The data underlying this chart can be found in Appendix C, tables C1.1 and C1.2.

Figure 10.1: Age-specific rates for hospitalised sport-related elbow injury, by age, by sex, Australia, 2012–13

Length of stay

The overall MLOS in hospital for elbow injury at all ages was 1.7 days. The MLOS tended to rise with age (Table 10.1). Sport-related injuries to the elbow resulted in a total of 2,918 days spent in hospital (Table C1.3).

Table 10.1: Mean length of stay (in days) for all hospitalised sport-related elbow injury, by age, by sex, Australia, 2012–13

	Age group										
Sex	**0–4**	**5–9**	**10–14**	**15–17**	**18–24**	**25–34**	**35–44**	**45–54**	**55–64**	**65+**	**All ages**
Males	1.3	1.3	1.5	1.4	1.6	1.8	2.3	2.0	2.0	4.1	1.7
Females	1.6	1.4	1.4	1.5	1.5	1.4	1.8	2.8	2.2	4.4	1.8
Persons	**1.4**	**1.4**	**1.5**	**1.4**	**1.6**	**1.7**	**2.2**	**2.3**	**2.1**	**4.3**	**1.7**

Around 100 cases of sport-related elbow injury were transferred to another acute care hospital.

Types of sport

For males and females combined, *Cycling* was the sport most commonly associated with cases of elbow injury (18%) (Table 10.2). However, rankings varied with sex. The second ranked sport most frequently associated with male elbow injury hospitalisations was *Roller sports* (17%). For females, the most frequently associated sports were *Gymnastics and trampolining* (14%).

Table 10.2: Ten sports most commonly associated with hospitalised sport-related elbow injury, Australia, 2012–13

		Males			Females		
Rank	**Sport**	**Rank**	**Number**	**% of cases**	**Rank**	**Number**	**% of cases**
1	Cycling	1	219	19.6	1	81	14.3
2	Roller sports	2	189	16.9	4	47	8.3
3	Gymnastics & trampolining	9	28	2.5	2	80	14.2
4	Soccer	3	83	7.4	9	16	2.8
5	Wheeled motor sports	4	80	7.1	10	14	2.5
6	Equestrian activities	14	14	1.3	3	67	11.9
7	Rugby	5	74	6.6	17	4	0.7
8	Australian Rules football	6	73	6.5	20	2	0.4
9	Football, other and unspecified	7	55	4.9	14	8	1.4
10	Basketball	8	39	3.5	11	13	2.3
	Total		**854**	**76.3**		**332**	**58.8**

Note: Sports are sorted by the number of cases for males and females combined.

In terms of participation, the highest rate for males was for *Roller sports* (238 cases per 100,000 participants). In contrast, the participation-based rate for golf was 1 case per 100,000). For females, the highest reliable rates were for *Wheeled motor sports* and *Roller sports* (214 and 90 cases per 100,000 participants, respectively) (tables B1.2 and B1.3).

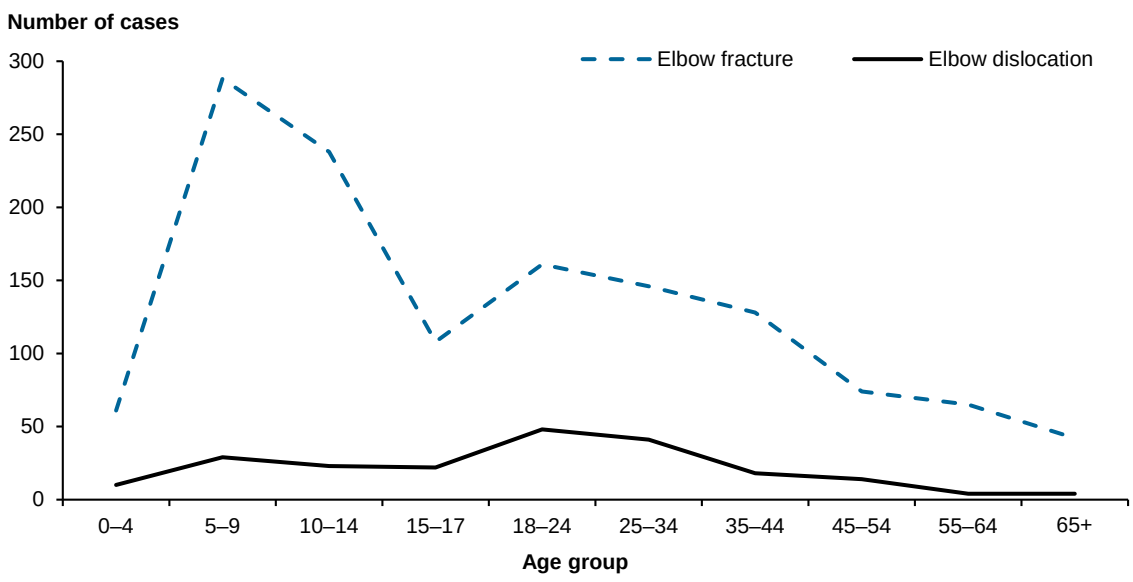
Types of elbow injury

A fracture was by far the most frequent type of elbow injury (78%) (Table 10.3). A slightly higher proportion of cases of elbow fracture occurred among females, compared with males.

Table 10.3: Hospitalised sport-related elbow injury, by nature of injury sustained, by sex, Australia, 2012–13

	Males		Females		Persons	
Nature of injury	**Number**	**%**	**Number**	**%**	**Number**	**%**
Elbow fracture	878	76.3	482	85.3	1,360	80.7
Elbow dislocation	115	12.4	49	8.7	164	9.7
Other elbow injuries	127	11.3	34	6.0	161	9.6
Total	**1,120**	**100**	**565**	**100**	**1,685**	**100**

Elbow fracture was most frequent among children aged 5–9, followed by those aged 10–14 (Figure 10.2). Elbow dislocation was slightly more common between 18 and 34, than in other age groups.



Note: The data underlying this chart can be found in Appendix C, tables C1.1 and C1.2.

Figure 10.2: All hospitalised sport-related elbow injury, by nature of injury, by age, Australia, 2012–13

Elbow fracture

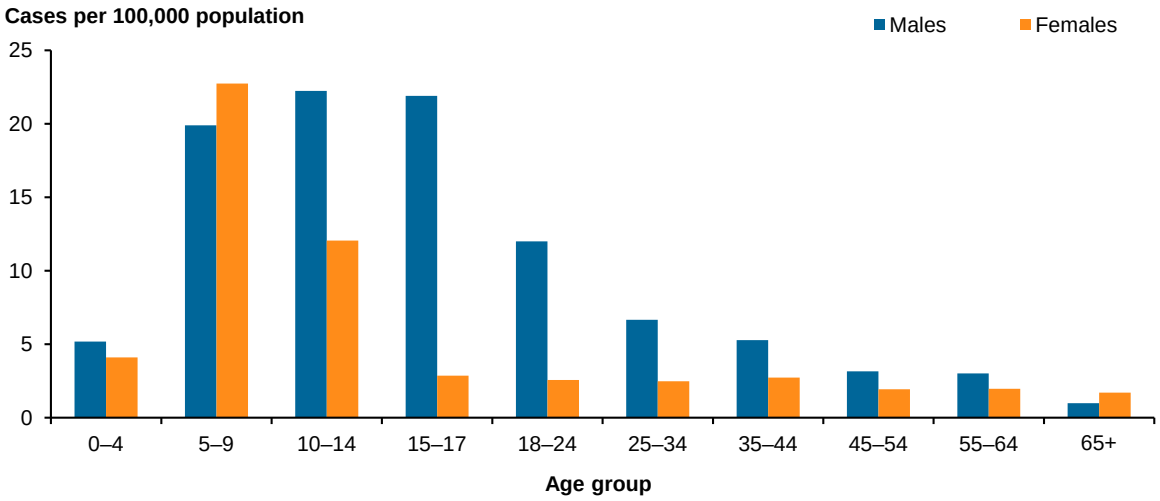
Box 10.1: Elbow fractures

Fractures of the lower end of the humerus, which are common, are difficult to treat, primarily because of the complexity of the elbow joint and because the majority have complex fracture patterns (Pollock et al. 2008; Throckmorton et al. 2007). One complication of distal humeral fractures is injury to the ulnar nerve, either as a result of the initial trauma, or due to the operative intervention (Nauth et al. 2011). Another complication of fractures in general is post-traumatic contracture or stiffness of the elbow which can result in significant disability and may require further medical intervention (King & Faber 2000; Macdermid et al. 2012).

Fractures of the upper ends of the ulna and radius are also common and can result in negative outcomes. For example, the complications associated with fractures of the radial head include stiffness, arthritis, non-union, the death of bone tissue, the abnormal formation of bone tissue outside of the skeleton, and instability of the elbow joint (Daneshvar et al. 2014).

There were over 1,300 cases of sport-related elbow fracture in 2012–13. Nearly two-thirds (65%) of these cases were male (Table 10.3). The age-standardised rate for persons for elbow fracture was 8 cases per 100,000 population. The pattern of age-specific rates was very similar to that for elbow injury as a whole, with the highest rates for males being for those aged 10–17, and for females, for young girls aged 5–9 (Figure 10.3).

Around half of the fractures in this report involved the lower end of the humerus. The other types of hospitalised elbow fracture observed in this report were fractures of the upper ends of the ulna and radius, each accounting for nearly one-quarter of cases (see Box 10.1). (Results not tabulated.)



Note: The data underlying this chart can be found in Appendix C, tables C1.1 and C1.2.

Figure 10.3: Age-specific rates for hospitalised sport-related elbow fracture, by age, by sex, Australia, 2012–13

Length of stay

The MLOS for elbow fracture tended to rise with age, and was considerably higher for those aged 65 and over (Table 10.4). A total of 2,434 days in hospital resulted from sport-related elbow fracture.

Table 10.4: Mean length of stay for hospitalised sport-related elbow fracture, by age, by sex, Australia, 2012–13

	Age group										
Sex	**0–4**	**5–9**	**10–14**	**15–17**	**18–24**	**25–34**	**35–44**	**45–54**	**55–64**	**65+**	**All ages**
Males	1.3	1.3	1.6	1.5	1.8	1.8	2.3	2.2	2.2	3.9	1.7
Females	1.6	1.4	1.4	1.9	1.7	1.5	2.0	3.1	2.3	4.7	1.9
Persons	**1.4**	**1.3**	**1.5**	**1.5**	**1.8**	**1.7**	**2.2**	**2.5**	**2.3**	**4.4**	**1.8**

Only a small proportion of these patients were transferred to another acute care hospital (7%).

Types of sport

For males and females combined, *Cycling* and *Roller sports* were the 2 activities most commonly associated with elbow fracture. For males, these 2 sports ranked highest as having been associated with this type of injury. *Gymnastics and trampolining*, and *Cycling*, were the 2 sports most commonly associated with female elbow fracture, accounting for 15% and 14% of cases, respectively (Table 10.5).

Despite the frequency of the association between *Cycling* and elbow fracture, participation-based rates for *Cycling* were comparatively low (13 and 9 cases per 100,000 participants for males and females, respectively). For males 15 and over, the highest participation-based rates were for *Roller sports* and *Wheeled motor sports* (203 and 56 cases per 100,000, respectively). For females, the highest reliable rate (RSE ≤ 25%) was for *Ice and snow sports* (24 per 100,000) (tables B1.2 and B1.3).

Table 10.5: Ten sports most commonly associated with hospitalised sport-related elbow fractures, Australia, 2012–13

		Males			Females		
Rank	**Sport**	**Rank**	**Number**	**% of cases**	**Rank**	**Number**	**% of cases**
1	Cycling	2	166	18.9	2	65	13.5
2	Roller sports	1	167	19.0	4	44	9.1
3	Gymnastics & trampolining	9	27	3.1	1	71	14.7
4	Soccer	3	69	7.9	9	12	2.5
5	Equestrian activities	12	12	1.4	3	59	12.2
6	Wheeled motor sports	5	51	5.8	8	13	2.7
7	Rugby	4	54	6.2	19	2	0.4
8	Australian Rules football	6	49	5.6	20	2	0.4
9	Football, other and unspecified	7	39	4.4	16	3	0.6
10	Walking and running	11	12	1.4	6	29	6.0
	Total		**646**	**73.6**		**300**	**62.2**

Note: Sports are sorted by the number of cases for males and females combined.

The most common mechanisms of elbow fracture were *Falls* (61%) and *Transport* (for example, bicycles, motorised vehicles or horses) (27%). (Results not tabulated.)

Treatment

Open or *Closed reductions of fractures of humerus or elbow* were the most commonly used procedures, accounting for 87% of the major interventions used (Table 10.6).

Table 10.6: Five most common procedures for hospitalised sport-related elbow fractures, Australia, 2012–13

Procedure	Number	%
Open reduction of fracture of humerus or elbow	275	24.9
Closed reduction of fracture of humerus or elbow	252	22.8
Open reduction of fracture of ulna or olecranon	196	17.8
Open reduction of fracture of radius	146	13.2
Closed reduction of fracture of radius	65	5.9
Other procedures	169	15.3
Total	**1,103**	**100**

Note: There was no procedure code for 257 cases.

Other elbow injury

Elbow dislocation

There were a total of 164 cases of sport-related elbow dislocation admitted to hospital in 2012–13. Over two-thirds (70%) of these cases were male (Table 10.3). The highest age-specific rate of 3 cases per 100,000 population was for young men 15–24 (Table C1.1). The overall age-standardised rate was low (0.9 cases per 100,000).

The overall MLOS for elbow dislocation was 1.1 days (Table C1.3). Females aged 65 and over had a longer MLOS (3.0 days). (Results not tabulated.)

More than 4 in 10 cases (42%) of elbow dislocation were associated with playing football, in particular *Australian Rules football* (12%) and *Rugby* (11%). For males, the highest proportion of cases were related to *Australian Rules football* (17%). For females, elbow dislocation was most frequently sustained during *Gymnastics and trampolining* (16%). (Results not tabulated.) The highest participation-based rates for persons 15 and over were for *Roller sports* (17 cases per 100,000 participants) and for *Australian Rules football* and *Wheeled motor sports* (each with a rate of 8 cases per 100,000) (Table B1.4).

In around two-thirds of cases (65%), the mechanism of injury was *Falls*. The medical procedure most commonly used to treat a dislocated elbow was *Closed reduction of dislocation of humerus or elbow* (76%). (Results not tabulated.)

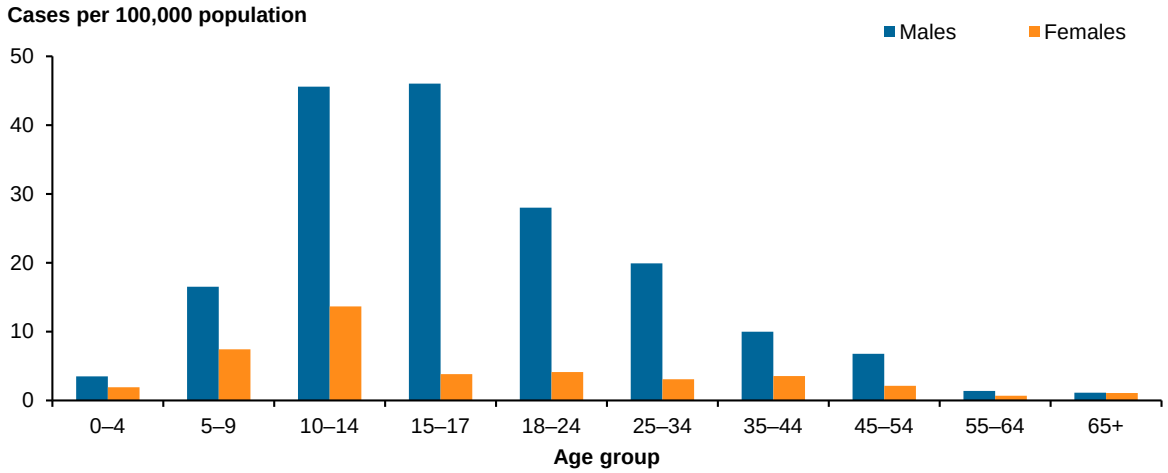
11 Long-bone fractures

Box 11.1: Long-bone fractures

Long-bone fractures are common, and complications (particularly non-union of the fracture) are relatively frequent (Giannoudis & Atkins 2007). In around 10% to 15% of long-bone fractures, there is a delay in bone healing or a non-union of the fracture. When this occurs, it may require further operations and may involve a prolonged period of pain or result in disability (Pountos et al. 2013). Long-bone non-union often results in a considerable loss of limb function and stiffness of adjacent joints (Giannoudis & Atkins 2007).

Long-bone fractures impose a high economic cost on the community. For example, the National Medical Expenditure Survey in the United States has ranked them as the category of injury associated with the highest inpatient expenditure (Kanakaris & Giannoudis 2007). There are also high indirect costs. An Australian study of isolated tibial fractures followed 60 patients for 1 year. These patients had a long convalescent period, and over one-third had 1 or more complications. After 1 year, a sizeable proportion of patients, despite achieving a satisfactory union of their fracture, reported continuing pain and a persistent level of work-related disability (Ferguson et al. 2008).

Around 2,000 people were admitted to hospital in 2012–13 as the result of sport-related long-bone fracture (Table 1.1). Eight in 10 (81%) of the people were male. The age-standardised rates were 19 cases per 100,000 males (Table C1.1) and 5 cases per 100,000 females (Table C1.2). The highest age-specific rates for males were in the 10–14 and 15–17 age groups (46 cases per 100,000). For females, the highest rate was for those aged 10–14 (14 per 100,000) (Figure 11.1).



Notes

1. The data underlying this chart can be found in Appendix C, tables C1.1 and C1.2.
2. Records with the principal diagnosis *S52.21 Fracture of proximal shaft of ulna with dislocation of head of radius* (49 cases) are included in both elbow injury and long-bone fracture. For this reason, row-specific case numbers sum to more than the total number of cases.

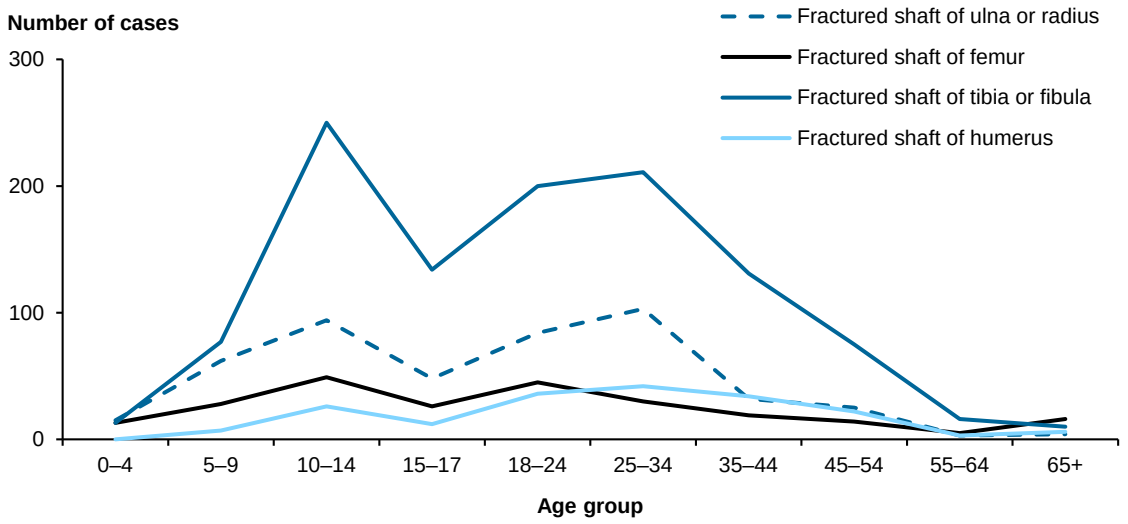
Figure 11.1: Age-specific rates for hospitalised sport-related long-bone injury, by age, by sex, Australia, 2012–13

Fractures of the tibia or fibula were the most common type of sport-related long-bone fracture for both males and females (58% and 46%, respectively) (Table 11.1).

Table 11.1: Hospitalised sport-related long-bone injury, by nature of injury sustained, by sex, Australia, 2012–13

	Males		Females		Persons	
Nature of injury	**Number**	**%**	**Number**	**%**	**Number**	**%**
Fractured shaft of ulna or radius	364	22.3	106	27.2	470	23.3
Fractured shaft of femur	198	12.1	47	12.1	245	12.1
Fractured shaft of tibia or fibula	938	57.5	179	46.0	1,117	55.3
Fractured shaft of humerus	131	8.0	57	14.7	188	9.3
Total	**1,631**	**100**	**389**	**100**	**2,020**	**100**

Fractures of the shaft of the tibia or fibula reached a peak in the 10–14 age group and, to a lesser extent, in the 18–24 and 25–34 groups. A fractured shaft of the ulna or radius was most common for those aged 10–14 and 25–34 (Figure 11.2).



Note: The data underlying this chart can be found in Appendix C, tables C1.1 and C1.2.

Figure 11.2: All hospitalised sport-related long-bone injury, by nature of injury, by age, Australia, 2012–13

Length of stay

The overall MLOS in hospital after sustaining any type of long-bone fracture was 3.2 days. In general, the MLOS tended to increase with age. The longest MLOS was for a fractured shaft of femur (5.8 days across all ages) (Table 11.2). Long-bone fracture, as a whole, resulted in 6,551 days spent in hospital (Table C1.3).

Table 11.2: Mean length of stay (in days) for hospitalised sport-related long-bone fracture, by nature of fracture, by sex, Australia, 2012–13

	Age group										
Nature of fracture	**0–4**	**5–9**	**10–14**	**15–17**	**18–24**	**25–34**	**35–44**	**45–54**	**55–64**	**65+**	**All ages**
Fractured shaft of ulna or radius	1.2	1.4	1.3	1.4	1.9	1.6	1.6	1.8	2.0	2.3	1.5
Fractured shaft of femur	3.4	9.8	5.6	3.6	5.4	5.1	3.3	6.7	10.2	8.1	5.8
Fractured shaft of tibia or fibula	1.6	1.9	2.5	2.9	4.0	3.6	4.9	4.9	9.1	5.8	3.6
Fractured shaft of humerus	0.0	2.0	1.8	1.5	1.8	2.0	3.2	2.4	3.7	7.2	2.3
All long-bone fractures	**2.0**	**3.0**	**2.5**	**2.6**	**3.5**	**3.0**	**4.0**	**4.1**	**7.9**	**6.6**	**3.2**

For long-bone fracture as a whole, 5% were considered to be life-threatening. The proportion meeting the definition was higher for a fracture of the shaft of the femur (18%).

In 13% of cases of long-bone fracture, the person was transferred to another acute care hospital. The proportion of transfers was higher for a fractured shaft of femur (22%).

Types of sport

Overall, *Soccer* was the sport most often associated with long-bone fracture (15%). This was also the case for males (17%), for whom nearly half (46%) of all long-bone fracture cases occurred while playing the various codes of football. Female fractures followed a different pattern: for these, the sport most frequently associated with long-bone fracture was *Equestrian activity* (19%) (Table 11.3).

Table 11.3: Ten sports most commonly associated with hospitalised sport-related long-bone fracture, Australia, 2012–13

		Males			Females		
Rank	**Sport**	**Rank**	**Number**	**% of cases**	**Rank**	**Number**	**% of cases**
1	Soccer	1	278	17.0	4	26	6.7
2	Wheeled motor sports	2	232	14.2	11	11	2.8
3	Rugby	3	212	13.0	17	4	1.0
4	Roller sports	4	153	9.4	2	49	12.6
5	Australian Rules football	5	146	9.0	18	2	0.5
6	Cycling	6	110	6.7	7	17	4.4
7	Ice and snow sports	8	67	4.1	3	46	11.8
8	Equestrian activities	11	32	2.0	1	72	18.5
9	Football, other and unspecified	7	101	6.2	23	0	0.0
10	Water sports	9	49	3.0	6	18	4.6
	Total		**1,380**	**84.6**		**245**	**63.0**

Note: Sports are sorted by the number of cases for males and females combined.

When looked at in terms of participation, the highest rate overall for those aged 15 and over was for *Wheeled motor sports* (191 cases per 100,000 participants). For males, *Wheeled motor sports, Roller sports* and *Rugby* had the highest rates (250, 135 and 79 cases per 100,000 participants, respectively) (Table B1.2). For females aged 15 and over, the highest reliable participation-based rates (RSE ≤ 25%) were for *Ice and snow sports* and *Equestrian activity* (71 and 44 per 100,000, respectively) (Table B1.3).

The 3 most common mechanisms of sport-related long-bone fracture were *Falls* (45%), *Transport* (25%) and *Contact with another person* (15%).

Treatment

Open and *Closed reductions of fracture of shaft of tibia or fibula* were equally common procedures for sport-related long-bone fracture (Table 11.4).

Table 11.4: Ten most common procedures for hospitalised sport-related long-bone fracture, Australia, 2012–13

Medical procedure	Number	%
Closed reduction of fracture of shaft of tibia or fibula	314	18.3
Open reduction of fracture of shaft of tibia or fibula	312	18.2
Reduction of fracture of pelvis or femur	175	10.2
Open reduction of fracture of radius	165	9.6
Generalised allied health interventions	121	7.1
Closed reduction of fracture of radius	116	6.8
Open reduction of fracture of ankle or toe	74	4.3
Open reduction of fracture of humerus or elbow	73	4.3
Closed reduction of fracture of ankle or toe	59	3.4
Open reduction of fracture of ulna or olecranon	53	3.1
Other procedures	250	14.6
Total	**1,712**	**100**

Note: There was no procedure code for 308 cases.

12 Cost of hospital care for sports injury

Cost estimation method and data source

This chapter presents average estimated costs of hospital care associated with sport-related injuries in 2012–13, based on the National Hospital Cost Data Collection Cost Report Round 17 (2012–13) and the Australian Refined Diagnosis Related Groups (AR-DRGs) assigned to the hospitalisations (IHPA 2015).

The AR-DRG is a classification system used to group episodes of patient care according to 1 of 23 *Major diagnostic categories* (MDCs) and to calculate expected hospital costs associated with diagnoses, procedures and the complexity of the illness or injury within these MDCs. For example, in Round 17 (2012–13), 240,799 separations were reported for *MDC 01: Diseases and disorders of the nervous system*, with a total estimated cost of more than $1.5 billion (IHPA 2015). The average length of stay was 4.0 days and the average estimated cost was close to $6,500. In this same round, 138,085 separations were reported for *MDC 21: Injuries, poisoning and toxic effects of drugs* at a total cost of approximately $689 million. The average estimated cost for this category being $4,987 and the average length of stay was 2.8 days.

Several hundred AR-DRGs are defined, mainly in terms of 'diagnoses' (coded according to ICD-10-AM) and 'interventions', which are coded according to the Australian Classification of Health Interventions. Estimates are produced of the cost of providing care for the type of case distinguished by each AR-DRG.

In the main, these cost estimates have been produced for care provided in public hospitals and not for private hospital care, and are limited to costs directly incurred as an admitted patient receives acute care. Estimates do not include other costs directly attributable to the treatment of the injury, such as ambulance transfers, outpatient or rehabilitation care, or the indirect costs associated with the injury, such as work absenteeism due to disability or premature death.

Estimated total admitted-patient costs are not directly comparable between public and private hospitals. The average cost for a private hospital separation was not reported for 2012–13, and is therefore excluded from the costs analysis. See 'Appendix A: Data issues' for more information on the method used for estimating average acute care costs in this report.

Overview of findings

The sections that follow present cost estimates for the types of sport-related injury that are the subject of chapters 2 to 11 in this report. The values presented estimate the total direct cost of acute care in public hospitals for sport-related cases in 2012–13.

The proportion of sport-related acute care cases that were admitted to public hospitals (rather than private hospitals) differed considerably between broad types of injury. For example, 40% of sport-related knee injuries were treated in a public hospital (Table 12.1), compared with 96% of sport-related injuries of the spinal column and cord (Table 12.7). There was also considerable variation in the proportion treated at a public hospital within the broad types of injury. For example, 25% of the sport-related cruciate ligament injury cases in this report were admitted to a public hospital for acute care, compared with 84% of sport-related cases of knee fracture (Table 12.1).

Findings in this chapter have been presented in a way that shows the total number of acute care sport-related injury cases of each type, and the number and proportion of each type that were treated at a public hospital. Estimates of total direct costs are provided for the public hospital cases of each type. This approach makes plain the large variation between the types sport-related injury cases in the proportion treated at a public hospital, and limits cost estimates to the cases to which the available cost weights apply.

When interpreting the cost estimates, it should also be kept in mind that not all sport-related injuries are identifiable in the NHMD collection, for reasons given in 'Chapter 1: Use of hospital data to measure sports injury'.

Average costs for common sport-related injuries

Knee injury

The average cost per case for sport-related knee injury treated in a public hospital in 2012–13 was approximately $6,800 (Table 12.1). Knee fractures had the highest average cost per case, followed by cruciate ligament injuries ($7,931 and $7,755, respectively).

It should be noted that less than half (40%) of sport-related knee injury cases were treated in a public hospital, so the full cost of acute care for sport-related knee injury in Australian hospitals is much higher than the $15 million reported here as the direct cost of the care provided in public hospitals.

Table 12.1: Estimated costs of hospitalised acute care sport-related knee injury, Australia, 2012–13

	Public hospitals			All hospitals	
Type of knee injury	Acute care cases	Average cost per case	Total cost of acute care	Total acute cases	% cases in public hospitals
Knee dislocation	134	$4,033	$540,360	181	74.0
Meniscal tear	251	$4,412	$1,107,460	866	29.0
Knee fracture	716	$7,931	$5,678,600	853	83.9
Cruciate ligament injury	768	$7,755	$5,956,207	3,125	24.6
Other knee injuries	367	$5,274	$1,935,647	529	69.4
All knee injuries	**2,236**	**$6,806**	**$15,218,274**	**5,554**	**40.3**

Head injury

Overall, head injury had greatest total acute care costs of all the types of sport-related injury cases admitted during 2012–13.

The sub-group other intracranial injury, which includes all intracranial injury types except concussion, had the highest average cost per case of all the sport-related head injury types treated in a public hospital during 2012–13, at close to $29,000 (Table 12.2).

Concussion, the most frequent type of hospitalised head injury due to sport, had the lowest average cost per case, at approximately $2,200. Due to the high number of concussion cases, the total estimated cost for this specific type of head injury amounted to more than $4.6 million.

The great majority (92%) of sport-related head injury cases were treated in a public hospital. As a limited exception to this, approximately 1 in 5 cases of facial fracture were treated in private hospitals.

Table 12.2: Estimated costs of hospitalised acute care sport-related head injury, Australia, 2012–13

	Public hospitals			All hospitals	
Type of head injury	Acute care cases	Average cost per case	Total cost of acute care	Total acute cases	% cases in public hospitals
Concussion	2,116	$2,195	$4,644,980	2,147	98.6
Other intracranial injury	476	$28,873	$13,743,395	495	96.2
Eye injury	114	$4,352	$496,116	116	98.3
Skull fracture	142	$9,787	$1,389,723	149	95.3
Facial fracture, incl. nose	1,653	$5,653	$9,345,021	2,055	80.4
Other and unspecified head injuries	2,413	$2,926	$7,060,102	2,555	94.4
All head injuries	**6,914**	**$5,305**	**$36,679,337**	**7,517**	**92.0**

Shoulder injury

Average acute care costs for sport-related shoulder injury ranged from $3,793 per case for shoulder dislocation to $5,775 for shoulder fracture (Table 12.3). More than three-quarters of cases of shoulder fracture (78%) and shoulder dislocation (81%) were treated in public hospital, but the majority of other types of shoulder injuries were treated in a private hospital (56%).

Table 12.3: Estimated costs of hospitalised acute care sport-related shoulder injury, Australia, 2012–13

	Public hospitals			All hospitals	
Type of shoulder injury	Acute care cases	Average cost per case	Total cost of acute care	Total acute cases	% cases in public hospitals
Shoulder fracture	1,410	$5,775	$8,142,858	1,809	77.9
Shoulder dislocation	714	$3,793	$2,707,917	887	80.5
Other shoulder injuries	276	$3,935	$1,086,069	629	43.9
All shoulder injuries	**2,400**	**$4,974**	**$11,936,844**	**3,325**	**72.2**

Ankle injury

The total cost of acute care for a unimalleolar fracture in public hospitals in 2012–13 was close to $11 million (Table 12.4). Of all the sport-related injuries involving bone fractures, ankle injuries were among the most costly per case.

Table 12.4: Estimated costs of hospitalised acute care sport-related ankle injury, Australia, 2012–13

	Public hospitals			All hospitals	
Type of ankle injury	Acute care cases	Average cost per case	Total cost of acute care	Total acute cases	% cases in public hospitals
Unimalleolar fracture	1,218	$8,785	$10,699,542	1,413	86.2
Bi- and trimalleolar fracture	835	$9,712	$8,109,682	940	88.8
Other ankle injuries	425	$6,272	$2,665,687	594	71.5
All ankle injuries	**2,478**	**$8,666**	**$21,474,911**	**2,947**	**84.1**

Hip injury

Fractured neck of femur had the highest average acute care costs for sport-related hip injury, at $16,214 per case, and accounted for 42% of the overall total sport-related hip injury costs in public hospitals (Table 12.5). Hip dislocation had the lowest average cost, at less than $3,800 per case.

Overall, 89% of sport-related hip injury cases were treated in public hospitals.

Table 12.5: Estimated costs of hospitalised acute care sport-related hip injury, Australia, 2012–13

	Public hospitals			All hospitals	
Type of hip injury	Acute care cases	Average cost per case	Total cost of acute care	Total acute cases	% cases in public hospitals
Acetabular fracture	94	$15,045	$1,414,210	100	94.0
Fractured neck of femur	221	$16,214	$3,583,388	263	84.0
Pertrochanteric fracture	116	$14,903	$1,728,720	133	87.2
Dislocation of hip	74	$3,768	$278,866	76	97.4
Other injuries of the hip	287	$5,153	$1,478,838	320	89.7
All hip injuries	**792**	**$10,712**	**$8,484,022**	**892**	**88.8**

Wrist injury

The total cost of acute care in public hospitals was second-highest for wrist injury .

Muscle and tendon injuries to the wrist had the highest average cost per case, at $4,813, but accounted for less than 5% of the total cost of acute care for sport-related wrist injury cases treated in public hospitals (Table 12.6). Wrist fracture had the second-highest average cost per case, at $4,667, and accounted for 93% of the total acute care costs for wrist injury, at an estimated $22.3 million.

Table 12.6: Estimated costs of hospitalised acute care sport-related wrist injury, Australia, 2012–13

	Public hospitals			All hospitals	
Type of wrist injury	Acute care cases	Average cost per case	Total cost of acute care	Total acute cases	% cases in public hospitals
Wrist fracture	4,777	$4,667	$22,293,859	5,291	90.3
Muscle and tendon injury to wrist	159	$4,813	$765,190	218	72.9
Dislocation of wrist	58	$4,327	$250,956	69	84.1
Other & unspecified. injuries to wrist	192	$3,950	$758,434	252	76.2
All wrist injuries	**5,186**	**$4,641**	**$24,068,439**	**5,830**	**89.0**

Spinal column and cord injury

Sport-related injuries resulting in a spinal cord injury at cervical level had an average cost of $67,523 per case, the highest of any type of case reported here (Table 12.7). A spinal cord injury at the thoracic-lumbosacral level was about $30,000 less expensive per case to treat, but was still the second most expensive type of sport-related injury reported here. All cases of Spinal cord injury included in this report received acute care in a public hospital. Other types of spinal injury, not involving injury to the spinal cord, had an average cost ranging between $8,000 and $9,000 per case.

Table 12.7: Estimated costs of hospitalised acute care sport-related spinal column and cord injury, Australia, 2012–13

	Public hospitals			All hospitals	
Type of spinal injury	Acute care cases	Average cost per case	Total cost of acute care	Total acute cases	% cases in public hospitals
Cervical spinal cord injury	70	$67,523	$4,726,618	70	100
Other cervical spinal injury	593	$8,753	$5,190,740	610	97.2
Thoracic-lumbosacral spinal cord injury	28	$37,797	$1,058,327	28	100
Other thoracic-lumbosacral spinal injury	745	$8,145	$6,068,025	796	93.6
All spinal injuries	**1,436**	**$11,869**	**$17,043,710**	**1,504**	**95.5**

Internal organ injury

The average costs of acute care for sport-related Internal organ injury ranged from approximately $6,000 to $14,000, depending on the main type of organ injured (Table 12.8). Nearly all (95%) of sport-related cases of Internal organ injury received acute care in a public hospitality, at an estimated total cost of just over $8.9 million.

Table 12.8: Estimated costs of hospitalised acute care sport-related internal organ injury, Australia, 2012–13

	Public hospitals			All hospitals	
Type of internal organ injury	Acute care cases	Average cost per case	Total cost of acute care	Total acute cases	% cases in public hospitals
Injury to lungs	369	$10,402	$3,838,407	386	95.6
Injury to spleen	174	$12,152	$2,114,499	179	97.2
Injury to other intra-abdominal organs	129	$13,935	$1,797,660	132	97.7
Injury to kidney	136	$7,429	$1,010,289	151	90.1
Injury to other internal organs	33	$6,059	$199,950	39	84.6
All internal organ injuries	**841**	**$10,655**	**$8,960,805**	**887**	**94.8**

Elbow injury

Elbow fracture was the most common type of elbow injury sustained while playing sport in 2012–13. At an average cost of $7,950 per case, these accounted for 88% of the total acute care costs for Elbow injury (Table 12.9). Around 10% of acute care for sport-related Elbow injury was received in a private hospital.

Table 12.9: Estimated costs of hospitalised acute care sport-related elbow injury, Australia, 2012–13

	Public hospitals			All hospitals	
Type of elbow injury	Acute care cases	Average cost per case	Total cost of acute care	Total acute cases	% cases in public hospitals
Elbow fracture	1,175	$7,590	$8,917,769	1,311	89.6
Elbow dislocation	158	$3,147	$497,302	164	96.3
Other elbow injuries	128	$5,556	$711,142	161	79.5
All elbow injuries	**1,461**	**$6,931**	**$10,126,213**	**1,636**	**89.3**

Long-bone injury

The highest average acute care cost for fracture to a long-bone was $17,386 for fractured shaft of the femur (Table 12.10). Fracture to the lower leg, the tibia or fibula, were the next most expensive to treat, on average, at $8,377 per case. Nearly all (98%) of cases of sport-related fractured shaft of femur injury received acute care in a public hospital. The estimated total cost for acute care due to sport-related long-bone injury was almost $16.5 million.

Table 12.10: Estimated costs of hospitalised acute care sport-related long-bone injury, Australia, 2012–13

	Public hospitals			All hospitals	
Type of long-bone injury	Acute care cases	Average cost per case	Total cost of acute care	Total acute cases	% cases in public hospitals
Fractured shaft of ulna or radius	412	$5,945	$2,449,529	469	87.8
Fractured shaft of femur	240	$17,387	$4,172,856	245	98.0
Fractured shaft of tibia or fibula	1,025	$8,378	$8,587,011	1,117	91.8
Fractured shaft of humerus	165	$7,653	$1,262,677	188	87.8
All long-bone injuries	**1,842**	**$8,943**	**$16,472,073**	**2,019**	**91.2**

Average costs by age

The average cost of acute care in a public hospital for sport-related knee injury was relatively stable across all age groups, with less than $2,500 difference between the lowest average cost ($5,041 for those aged 65 or older), and the highest cost ($7,353 for those aged 25–34) (Figure 12.1). A similar pattern was observed for sport-related shoulder injury and ankle injury. The average cost for sport-related elbow injury was highest for the youngest and oldest age groups, at $8,003 for ages 5–9 and $8,816 for those aged 65 and over. The average costs for acute care in a public hospital for sport-related long-bone and hip injury tended to increase with age. The average cost of sport-related long-bone injury was more than $10,000 higher for those aged 5–9 ($5,728 per case) than for those aged 65 and over, ($17,013 per case). Due to the small number of sport-related injuries for children under the age of 5, the average costs of these cases are not included here.

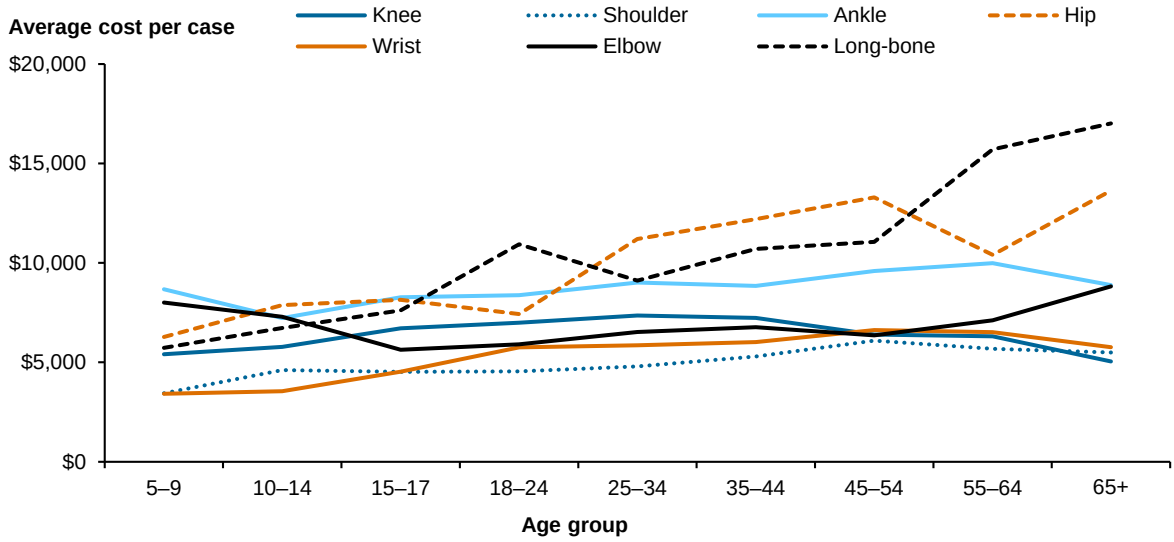


Figure 12.1: Estimated average cost of public hospital acute care for sport-related bone injury cases, by age group, Australia, 2012–13

The average cost for sport-related injuries involving the head, spine or internal organs generally rose with increasing age (Figure 12.2). The one striking exception to this was a dip in the average cost of sport-related internal organ injury for the 55–64 age group. This dip in

average cost could be an artefact of the smaller sample size for sport-related internal organ injury overall compared to sport-related head or spinal injury, and specifically for those cases aged 55–64. For instance, of these three types of sport-related injuries, internal organ injury had the smallest number of public hospital acute care cases, 841 cases compared with 1,436 cases of spinal injury and 6,914 head injury cases. While cost estimations for internal organ injury for persons aged 55–64 were based on 48 cases, compared with 88 spinal and 159 head injury cases. Additional analysis also found no internal organ injury cases among persons aged 55–64 requiring a tracheotomy, non-invasive ventilation, or major chest procedures. These types of interventions were the most costly of all sport-related internal organ injuries and could cost between $15,842 for major chest procedures without any complications or comorbidities, to $94,418 for tracheotomy and ventilation for less than 95 hours with or without catastrophic injury and/or complications and/or comorbidities.

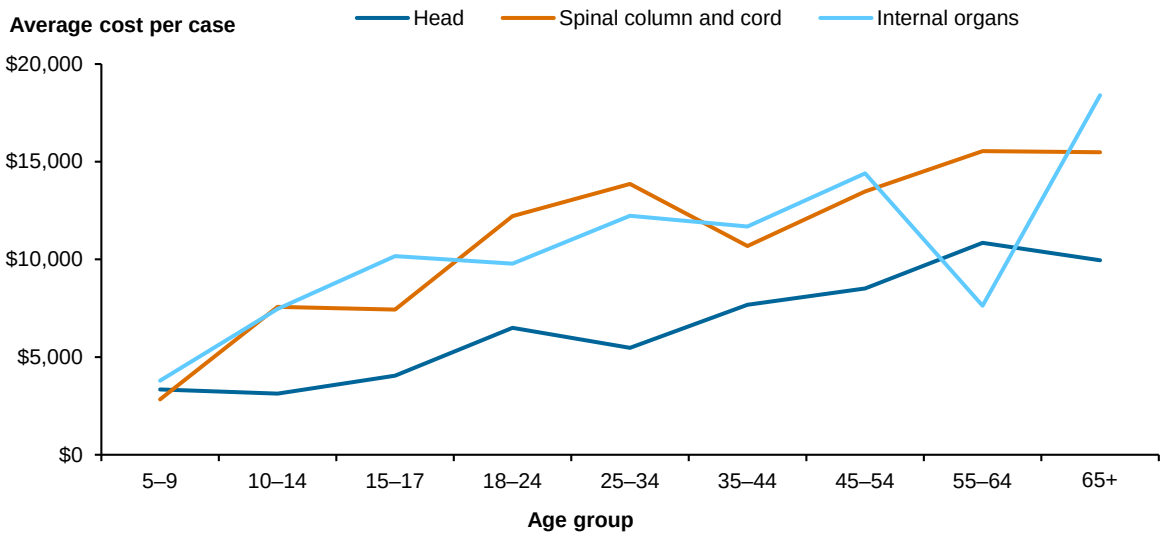


Figure 12.2: Estimated average cost of public hospital acute care for other types of sport-related injury cases, by age group, Australia, 2012–13

Appendix A: Data issues

Data sources

The data on hospital separations in this report are from the Australian Institute of Health and Welfare (AIHW) National Hospital Morbidity Database (NHMD). Comprehensive information on the quality of the data for 2012–13 is available in *Australian hospital statistics 2012–13* (AIHW 2013) and the data quality statement below. Essentially all injury cases admitted to hospitals in Australia are included in the NHMD.

In 2011–12, diagnoses and external cause injury and poisoning were recorded using the 7th edition of the *International Statistical Classification of Diseases and Related Health Problems, Tenth revision, Australia modification* (ICD-10-AM) (NCCH 2010).

The data used to calculate participation-based rates are from the confidentialised unit record file for the 2011–12 Participation in Sport and Physical Recreation Survey, which forms part of the ABS 2011–12 Multipurpose Household Survey. The data were supplied by the ABS.

Definitions

The 'principal diagnosis' is the diagnosis established, after study, to be chiefly responsible for occasioning the patient's episode of admitted patient care (AIHW 2012a).

An 'external cause' is defined as the environmental event, circumstance or condition that was the cause of injury or poisoning. Whenever a patient has a principal or additional diagnosis of an injury or poisoning, an external cause code should be recorded.

ICD-10-AM includes a range of codes to indicate the type of activity being engaged in at the time of injury (U50–U73). The block of activity codes U50–U71 encompasses sports. U72 is used to identify *Leisure activity, not elsewhere classified,* and U73 is used to identify other types of activities, including working for income in various industries, and unpaid work.

Selecting sports cases

Case data for this report are a subset of records from the NHMD, compiled by the AIHW. Records in the NHMD were included if they refer to an episode of care in an acute care hospital in Australia that ended during the year to 30 June 2013, and contain an ICD-10-AM *Activity at the time of injury* code in the range U50–U71 (sport and leisure) anywhere in the record (46,671 records).

Grouped ICD-10-AM sports activity codes used in this report are listed in Table A1.1. The table provides detail on the correspondence between the PSPRA Survey and ICD groups analysed in this report. The correspondence between the ICD groups and the survey groups is imperfect. The limited documentation available for both sources, in particular the stated inclusions and exclusions, were used in order to align the types of sport in each category.

Table A1.1: ICD-10-AM codes used to select cases for inclusion in the report

	ICD-10-AM		ABS Survey on participation in sport and physical recreation, 2011–12	
Type of sport	**ICD-10-AM codes**	**Comments**	**Survey sports categories**	**Comments**
Hospitalised sports injury overview	Range U50–U71			
Football				
Rugby	U50.01 Rugby Union U50.02 Rugby League U50.03 Rugby, unspecified		Rugby League Rugby Union	
Australian Rules	U50.00 Australian Rules football		Australian Rules football	
Soccer	U50.04 Soccer		Soccer (outdoor) Soccer (indoor)	
Touch football	U50.05 Touch football			No discrete category for touch football in the ABS CURF*. Participation-based rates could not be calculated.
Combative sports	U61.0 Aikido U61.3 Martial arts U61.1 Boxing		Martial arts Boxing	Includes aikido, chi kung, judo, jujitsu, karate, kendo, kick-boxing, ninjitsu, taekwondo, tai chi, and martial arts (other).
Netball and basketball				
Netball	U50.3 Netball		Netball (indoor and outdoor)	
Basketball	U50.1 Basketball		Basketball (indoor and outdoor)	
Wheeled motor sports	U65 Wheeled motor sports		Motor sports	Includes car racing, motorbike racing, speedway, drag racing, go-karting and motor sports (other).

(continued)

Table A1.1 (continued): ICD-10-AM codes used to select cases for inclusion in the report

	ICD-10-AM		ABS Survey on participation in sport and physical recreation, 2011–12	
Type of sport	**ICD-10-AM codes**	**Comments**	**Survey sports categories**	**Comments**
Ice and snow sports	U55 Ice and snow sports U51.20 Ice hockey	U55 includes skiing, snow mobiling, ice skating, snowboarding, tobogganing, curling, ice hockey, Other specified ice or snow sport and unspecified ice or snow sport.	Ice/snow sports	Includes bobsledding, broomball, ice hockey, ice skating, snowboarding, skeleton, snow skiing and ice sport (other).
Water sports	U52 Team water sports U53 Boating sports U54.0 Diving U54.2 Scuba diving U54.3 Snorkelling U54.4 Surfing and boogie boarding U54.5 Non-team swimming U54.6 Water-skiing U54.7 Wind surfing U54.8 Other specified individual water sport U54.9 Unspecified individual water sport	U54.1 Fishing is not included in this category.	Canoeing/kayaking Sailing Scuba diving/snorkelling Surf sports Swimming/diving Water-skiing/powerboating	Additional types of water sport were reported in the survey, but the data for them were not provided in the CURF (ABS 2013). These categories were rowing, surf lifesaving, water polo, water volleyball/canoe polo/rafting/other water sports and wind surfing.
Roller sports	U66.1 Inline skating and rollerblading U66.2 Roller-skating U66.3 Skate boarding U66.4 Scooter riding U66.8 Other specified wheeled non-motored sport U66.9 Unspecified wheeled non-motored sport		Skateboarding/inline hockey/roller sports	Includes inline hockey, rollerblading, roller-skating, skateboarding and roller sport (other).

(continued)

Table A1.1 (continued): ICD-10-AM codes used to select cases for inclusion in the report

	ICD-10-AM		ABS Survey on participation in sport and physical recreation, 2011–12	
Type of sport	**ICD-10-AM codes**	**Comments**	**Survey sports categories**	**Comments**
Equestrian activities	U63 Equestrian activities	Includes dressage; show jumping; steeplechase and cross-country eventing; endurance riding; polo and polocrosse; horse racing; hurdle racing; rodeo; trail or general horseback riding; trotting and harness. 'Equestrian activities' also includes a range of other less-common activities such as buggy racing and tent pegging.	Horse riding/equestrian activities/polo.	Includes dressage, polo cross and show jumping. Excludes rodeo and horseracing.
Other sports				
Fishing	U54.1 Fishing	Includes rock fishing; other specified fishing such as ice fishing and spear fishing; and unspecified fishing.	Fishing	Includes angling.
Dancing	U58.0 Dancing		Dancing/ballet	Includes ballroom dancing, belly dancing, boot scooting, calisthenics, sport, folk dancing, Latin dancing, line dancing, salsa, swing dancing and dancing (other).
Walking and running	U56.1 Jogging and running U56.2 Walking	Excludes walking and running activities as part of 'U56.3 Track and field'.	Jogging/running Walking for exercise	Includes running (for exercise). Excludes bush walking.
Cycling	U66.0 Cycling	Includes BMX; mountain; road; track and velodrome; other specified cycling; and cycling, unspecified.	Cycling/BMXing	Includes bike riding and mountain bike riding. Excludes exercise bike cycling and spin cycling. Survey data and documentation do not state if track and velodrome are included.
Adventure and extreme sports	U64 Adventure sports	Includes abseiling and rappelling; hiking (bush walking, tramping); mountaineering; orienteering and rogaining; river rafting; white-water rafting; rock climbing; bungy jumping; other specified adventure sport; and unspecified adventure sport.	Bush walking Cross-country running Orienteering and rogaining Rock climbing/abseiling/caving	Orienteering and rogaining not included in the CURF*.

(continued)

Table A1.1 (continued): ICD-10-AM codes used to select cases for inclusion in the report

	ICD-10-AM		ABS Survey on participation in sport and physical recreation, 2011–12	
Type of sport	**ICD-10-AM codes**	**Comments**	**Survey sports categories**	**Comments**
Gymnastics & trampolining	U57 Gymnastics	Includes balance beam; floor gymnastics; high bar; parallel bars; rings; side horse and pommel horse; trampoline and mini-trampoline; vault; other specified gymnastics; gymnastics, unspecified; other specified acrobatic sport; and unspecified acrobatic sport.	Gymnastics	Includes acrobatics, trampolining and cheerleading.
Hockey	U51.22 Field hockey U51.23 Floor hockey U51.28 Other specified hockey U51.29 Hockey, unspecified	'U51.20 Ice hockey' and 'U51.21 Street and ball hockey' (outdoor hockey played on inline or roller skates) are not included.	Hockey (indoor and outdoor)	Excludes inline hockey.
Cricket	U51.1 Cricket		Cricket (indoor) Cricket (outdoor)	
Racquet sports	U59 Racquet sports	Includes badminton; racquetball; squash; table tennis and ping pong; tennis; other specified racquet sport; and unspecified racquet sport.	Badminton Table tennis Tennis (indoor and outdoor) Squash/racquetball	
Golf	U60.5 Golf		Golf	Excludes mini-golf.

* Confidentialised Unit Record File from the ABS.

Nature of injury codes

Table A1.2 shows the *Principal diagnosis* ICD-10-AM code values that were used when assigning cases to chapters 2 to 11 in the report.

Table A1.2: ICD-10-AM codes used to select cases for inclusion in report chapters

Nature of injury	Principal diagnosis codes
Knee injury	S80.0, S81.0, S82.0–1, S82.41, S83.0–7, S87.0, S88.0
Head injury	S00–S09
Shoulder injury	S41.0, S41.80, S42.0–2, S42.7, S43.0, S46.0
Ankle injury	S82.5–6, S828.1–2, S828.8, S90.0, S90.7, S91.0, S91.7, S92.1, S93.0, S93.4, S98.0
Hip injury	S32.4, S70.0, S70.7–8, S71.0, S71.7–8, S72.0–2, S73.0–1, S74.0–1, S74.9, S75.0–1, S75.7–9, S76.0, S76.7, S77.0, S77.2, S78.0, S78.9, S79
Wrist injury	S52.5–6, S60.2, S60.7–9, S61.7–8, S62.1, S63.0, S63.5, S64.0–2, S64.7–9, S65.0–1, S65.7–9, S66, S67.8, S68.3–4, S68.8–9, S69.7–9
Injury to the spinal column and cord[(a)]	S12, S13, S14.0–7, S220–1, S23.0–1, S23.3, S24–0–7. S32.0–2, S32.7, S32.82, S33.0–3, S33.5–7, S34.0–2, S34.4–7
Injury of internal organs	S26, S27.0–8, S36.0–5, S36.7–9, S37.0, S37.2–3, S37.8, S39.6
Elbow injury[(b)]	S42.4, S50.0, S51.0, S52.0–1, S52.21, S53.0–4, S57.0, S58.0
Long-bone fracture[(b)]	S42.3, S52.2–3, S72.3, S82.2, S82.42

(a) According to ICD-10-AM coding rules, S14.7, S24.7, and S34.7 should not appear as a *Principal diagnosis*. A search was made for cases with S14.7, S24.7 or S34.7 as the *Principal diagnosis* and scrutinised *Additional diagnoses* to assess whether cases met the criteria for being a spinal cord injury. One case was included as a spinal cord injury on this basis.

(b) Records with the Principal diagnosis S52.21 *Fracture of proximal shaft of ulna with dislocation of head of radius* (49 cases) are included in both elbow injury and long-bone fracture (49 cases).

Table A1.3 shows the principal diagnosis ICD-10-AM code values that were used when specifying sub-types of cases for which data are provided in the report.

Table A1.3: ICD-10-AM codes used to select cases for inclusion in injury subgroups

Nature of injury	Principal diagnosis codes
Knee injury	
Knee dislocation	S83.0–1
Meniscal tear	S83.2
Knee fracture	S82.0–1, S82.41
Cruciate ligament injury	S83.50–S83.54
Head injury	
Concussion	S06.0
Other intracranial injury	S06.1–6, S06.8–S06.9
Eye injury	S05
Skull fracture	S02.0–1
Facial fracture, including nose	S02.2–4, S02.6

(continued)

Table A1.3 (continued): ICD-10-AM codes used to select cases for inclusion in injury subgroups

Nature of injury	Principal diagnosis codes
Shoulder injury	
Shoulder fracture	S42.0–2, S42.7–9
Shoulder dislocation	S43.00–3
Ankle injury	
Unimalleolar ankle fracture	S82.5–6
Bi- and trimalleolar ankle fracture	S82.81–82
Hip injury	
Acetabular fracture	S32.4
Fractured neck of femur	S72.0
Pertrochanteric fracture	S72.1
Dislocation of hip	S73.0
Wrist injury	
Wrist fracture	S52.5–6, S62.1
Muscle & tendon injury to wrist	S66
Dislocation of wrist	S63.0
Injury of cervical spinal column and cord	
Cervical spinal cord injury	S14.1, S14.7
Other type of cervical spinal injury	S12, S13, S14.0, S14.2–6
Injury of thoracic and lumbosacral spinal column and cord	
Thoracic and lumbosacral spinal cord injury	S24.1, S24.7, S34.1
Other type of thoracic and lumbosacral spinal injury	S22.0–1, S23.0–1, S23.3, S24.0, S24.2–7, S32.00–05, S32.1–2, S32.7, S32.82, S33.0–3, S33.5–7, S34.0, S34.2, S34.4–7
Injury of internal organs	
Injury involving the lungs	S27.0–3
Injury to the spleen	S36.0
Injury of liver and gallbladder	S36.1
Injury of kidneys	S37.0
Elbow injury	
Elbow fracture	S42.4, S52.0–1, S52.21
Elbow dislocation	S53.0–1
Long-bone fracture	
Fractured shaft of ulna and radius	S52.2–.3
Fractured shaft of femur	S72.3
Fractured shaft of tibia and fibula	S82.2, S82.42
Fractured shaft of humerus	S42.3

Estimating cases

Each record in the NHMD refers to a single episode of care in a hospital. Some injuries result in more than 1 episode in hospital and, hence, more than 1 NHMD record. This can occur in 2 main ways:

- a person is admitted to 1 hospital, then transferred to another or has a change in care type (for example, acute to rehabilitation) within the same hospital
- a person has an episode of care in hospital, is discharged home (or to another place of residence) and is then admitted for further treatment for the same injury, to the same hospital or another one.

The NHMD does not include information designed to enable the set of records belonging to an injury case to be recognised as such. Hence, there is potential for some injury cases to be counted more than once, when a single injury case results in 2 or more NHMD records being generated, all of which satisfy the selection criteria being used.

Information in the NHMD enables this problem to be reduced, though not eliminated. The approach used for this report makes use of the 'mode of admission' variable, which indicates whether the current episode began with inward transfer from another acute care hospital. Episodes of this type (inward transfers) are likely to have been preceded by another episode that also met the case selection criteria for injury cases, so are omitted from estimated case counts.

This procedure should largely correct for over-estimation of cases due to transfers, but will not correct for over-estimation due to re-admissions.

Length of stay

'Mean length of stay' (MLOS) is calculated by dividing the total number of patient days for injury separations by the estimated number of injury cases. This method ensures that the bed-days for inward transfer records are not omitted when calculating length of stay.

Note that length of stay as presented in this report does not include some patient days potentially attributable to injury. In particular, it does not include days for most aspects of injury rehabilitation, which were difficult to assign correctly without information enabling the identification of all admitted episodes associated with an injury case.

Rates

All age-specific population-based rates in this report were calculated using, as the denominator, the final estimate of the Estimated Resident Population (ERP) as at 31 December 2012.

Participation-based rates were calculated using data from the 2011–12 PSPRA Survey as the denominator. Comparisons were made between the types of sport identifiable in the survey and the types identifiable in the NHMD activity codes (Table A1.1). The categories shown in Table A1.1 were used when calculating participation-based rates, with 2 exceptions (*Water sports* and *Equestrian activities*), which were made to allow for specific differences in scope.

Water sports was limited to the following activity categories, to better align the scope of NHMD cases with inclusion terms used in PSPRA documentation:

- U53.0 Canoeing

- U53.2 Kayaking
- U53.6 Yachting and sailing
- U54.2 Scuba diving
- U54.3 Snorkelling
- U54.4 Surfing and boogie boarding
- U54.5 Swimming
- U54.6 Water-skiing.

Equestrian activities: NHMD records with an activity code 'U63.3 Horse racing events' or 'U63.4 Rodeo' were excluded, in line with exclusion terms stated in PSPRA documentation.

Age-standardisation

Direct standardisation was used to age-standardise rates using the Australian population in 2001 as the standard (ABS 2003).

High threat to life

Injuries can be classified according to the likelihood that a patient with that injury will die in hospital. The method used refers to cases with a predicted mortality risk of about 6% or higher as having a high threat to life (HTTL) or being life-threatening (Stephenson et al. 2003). Injuries of this severity are likely to have a large impact on the patient, often with persisting problems and ongoing need for health-care services.

ABS Participation in Sport and Physical Recreation survey

Participation-based rates were calculated using denominator data derived from the 2011–12 PSPRA Survey published by the ABS. Data from the survey were analysed using the ABS (Australian Bureau of Statistics) Remote Data Analysis Laboratory. The ABS ceased the use of the PSPRA Survey after 2011–12. In the interests of providing participation-based rates in this report, data from the 2011–12 survey were used as the denominator for calculating these rates.

The PSPRA 2011–12 responses were collected as part of the ABS 2011–12 Multipurpose Household Survey (MPHS). The MPHS is run each financial year from July to June throughout Australia, as a supplement to the ABS monthly Labour Force Survey. For the 2011–12 PSPRA Survey, 1 person was randomly selected in 17,036 private dwellings. Of these, 80% fully responded to the questions on participation in sport and physical recreation. Data were collected using computer-assisted telephone interviewing.

Subjects of the PSPRA included persons 15 years and over, hence, all the rates of hospitalisation per 100,000 participants shown in the graphs and tables are for persons 15 years and over.

A data quality declaration can be found under 'Explanatory notes' at the ABS website <http://www.abs.gov.au/ausstats/abs@.nsf/mf/4177.0>.

Calculation of costs

Analysis of cost estimates for this report is based on the National Hospital Cost Data Collection Cost Report Round 17 (2012–13) and the Australian Refined Diagnosis Related Groups (AR-DRG) (IHPA 2015). The values used in the report were taken from Appendix C of the Round 17 report as provided in the spreadsheet file.

AR-DRG is a classification system developed to provide a clinically meaningful way of relating the number and types of patients treated in a hospital (that is, the casemix) to the resources required by the hospital. Each AR-DRG represents a class of patients with similar clinical conditions requiring similar hospital resources. The AR-DRG system is partly hierarchical, with 23 *Major Diagnostic Categories* (MDCs), which are divided into *Surgical, Medical* and *Other* partitions, and then into 708 individual AR-DRGs (in AR-DRG 6.0x).

The Round 17 (2012–13) report provides costs weight and estimated average cost for admitted acute patient costed data according to each AR-DRG version 6.0x from 357 public hospitals nationally. Usually, the average cost across all DRGs is chosen as the reference value and given a weight of 1. In Round 17 (2012–13), the reference cost for an acute care stay in a public hospital was $5,052.

Costs presented in this report were calculated by applying 2012–13 public sector estimated national cost weights based on AR-DRG version 6.0x to the episodes of hospital care meeting the definition of sport-related injury used in this report. The reported estimates are total direct costs for public hospital cases. Estimates were not made for private hospital cases, because private sector cost data were not published for the study period.

Categories reported in this report (for example, cruciate ligament injury, ICD-10-AM S83.5) generally included records that has been assigned a number of different AR-DRG 6.0x codes. Considering this example, over 87% of the 778 included records had AR-DRG code I29Z, *Knee reconstruction or revision,* but 8 other AR-DRG codes were present in small numbers. Each of the records in a reported set was assigned a cost on the basis of its AN-DRG code. The total cost for a reported set of records is the sum of those values.

In keeping with the method for estimating average length of stay per injury case (see above), the average cost per case of injury has been estimated by dividing the total cost of acute care separations by the total number of estimated cases for each reported type of sport-related injury. For example, the average cost of a cruciate ligament injury case has been calculated here by dividing the total direct cost ($5,956,207) for the 778 cruciate ligament injury acute care public hospital separations by the number estimated acute care cases of cruciate ligament injury treated in a public hospital in 2012–13, which was 768.

Errors, inconsistencies and uncertainties

Due to rounding, the sum of the percentages in tables may not equal 100 per cent.

NHMD data are generally abstracted from records, entered and coded in hospitals, passed to state and territory health departments, then to the AIHW, before being provided to the National Injury Surveillance Unit. Processing occurs at each of these steps. Errors and inconsistencies can arise due to the large number of people and processes involved in providing the data. Some variations occur in reporting and coding, although coding standards, national minimum data sets and other mechanisms have reduced this.

Data quality statement: National Hospital Morbidity Database 2012–13

This section provides a summary of key issues relevant to interpretation of the NHMD for 2012–13.

The full AIHW Data Quality Statement for the NHMD is accessible at <http://meteor.aihw.gov.au/content/index.phtml/itemId/568730>.

Summary of key issues

- The NHMD is a comprehensive dataset that has records for all separations of admitted patients from essentially all public and private hospitals in Australia.
- A record is included for each separation—not for each patient—so patients who separated more than once in the year have more than 1 record in the NHMD.
- For 2012–13, almost all public hospitals provided data for the NHMD. (The exception was a mothercraft hospital in the Australian Capital Territory.) The great majority of private hospitals also provided data, the exceptions being the private free-standing day hospital facilities in the Australian Capital Territory, the single private free-standing day hospital in the Northern Territory, and a private free-standing day hospital in Victoria.
- Hospitals may be re-categorised as *Public* or *Private* between or within years.
- There is apparent variation between states and territories in the use of statistical discharges and associated assignment of care types. For example, for public hospitals, the proportion of separations ending with a statistical discharge varied from 0.9% to 3.9% across states and territories.
- There was variation between states and territories in the reporting of separations for *Newborns* (without qualified days).
- Data on state of hospitalisation should be interpreted with caution because of cross-border flows of patients. This is particularly the case for the Australian Capital Territory: in 2012–13, about 20% of separations for Australian Capital Territory hospitals were for patients who resided in New South Wales.
- Variations in admission practices and policies lead to variation among providers in the number of admissions for some conditions.
- Caution should be used in comparing diagnosis, procedure and external cause data over time, as the classifications and coding standards for those data can change over time. In particular, between 2009–10 and 2010–11, there were significant changes in the coding of diagnoses for diabetes and obstetrics and for imaging procedures. There were also significant changes made to coding practices for diabetes and related conditions for the 2012–13 year, resulting in increased counts for these conditions.
- The Indigenous status data in the NHMD for all states and territories are considered of sufficient quality for statistical reporting for 2010–11, 2011–12 and 2012–13. In 2011–12, an estimated 88% of Indigenous patients were correctly identified in public hospitals. The overall quality of the data provided for Indigenous status is considered to be in need of some improvement, and varied between states and territories.

Appendix B: Participation-based rates

Table B1.1: Denominator data for calculation of participation-based rates, aged 15 and older[(a)]

	Males			Females			Persons		
Type of sport	Participants	RSE %	Obs	Participants	RSE %	Obs	Participants	RSE %	Obs
Australian Rules football	222,641	9.6	152	18,891	25.9	14	241,532	9.2	166
Basketball	245,579	11.0	141	109,250	11.7	76	354,829	9.1	217
Combative sports	205,142	14.4	127	153,118	11.7	119	358,260	9.3	246
Cricket	339,421	11.1	209	20,284	33.9	14	359,705	11.0	223
Cycling	871,872	4.9	664	490,601	4.9	411	1,362,472	3.4	1,075
Dancing	30,127	22.1	28	229,058	10.2	160	259,185	9.4	188
Equestrian activity[(b)]	43,099	26.8	27	105,698	17.0	69	148,797	15.3	96
Fishing	213,064	9.5	177	20,252	25.6	21	247,163	9.2	198
Golf	731,794	6.0	524	128,710	10.9	114	860,504	5.2	638
Gymnastics and trampolining	20,862	27.3	13	29,052	37.2	18	49,914	26.9*	31
Hockey	38,374	27.0	24	74,199	18.9	42	112,573	17.0	66
Ice and snow sports	90,491	19.3	47	48,162	24.4	33	138,653	17.6	80
Netball	41,555	27.8	23	406,493	5.4	270	448,048	6.0	293
Racquet sports	654,865	6.9	420	418,844	7.0	302	1,073,709	5.4	722
Roller sports	49,672	22.9	29	21,138	28.7	16	70,811	17.9	45
Rugby	188,676	13.1	80	14,226	45.2	7	202,902	11.6	87
Soccer	535,279	5.8	299	148,015	15.0	88	683,293	5.4	387
Walking and running	2,239,320	3.0	1,680	3,352,563	1.9	2,823	5,591,883	1.7	4,503
Water sports[(b)]	1,140,625	5.3	759	841,314	5.0	705	1,981,939	4.1	1,464
Wheeled motor sports	72,847	18.8	47	3,738	71.3	2	76,585	18.0	49

(a) Denominator data were not available for the calculation of rates for adventure and extreme sports, and touch football.

(b) The participation-based rates for *Water sports* and *Equestrian activities* represent an underestimate because they were calculated using a restricted subset of cases. (See 'Appendix A: Data issues: 'Rates', for further information).

* Caution should be exercised, because the denominator has an RSE >25 and ≤50.

Table B1.2: Five highest crude participation-based rates[(a)] by nature of injury, males aged 15 and older, Australia, 2012–13

Nature of injury	Types of sport	No. of participants	Cases	Rate	Obs	RSE %
All knee injury	Wheeled motor sports	72,847	175	240.2	47	18.8
	Rugby	188,676	330	174.9	80	13.1
	Australian Rules football	222,641	306	137.4	152	9.6
	Ice and snow sports	90,491	118	130.4	47	19.3
	Soccer	535,279	687	128.3	299	5.8
Cruciate ligament injury	Rugby	188,676	187	99.1	80	13.1
	Australian Rules football	222,641	201	90.3	152	9.6
	Soccer	535,279	437	81.6	299	5.8
	Ice and snow sports	90,491	64	70.7	47	19.3
	Basketball	245,579	153	62.3	141	11. 0
Knee fracture	Wheeled motor sports	72,847	99	135.9	47	18.8
	Roller sports	49,672	26	52.3	29	22.9
	Ice and snow sports	90,491	29	32.0	47	19.3
	Rugby	188,676	54	28.6	80	13.1
	Gymnastics and trampolining	20,862	4	19.2	13	27.3*
Knee dislocation	Rugby	188,676	13	6.9	80	13.1
	Dancing	30,127	2	6.6	28	22.1
	Australian Rules football	222,641	11	4.9	152	9.6
	Gymnastics and trampolining	20,862	1	4.8	13	27.3*
	Soccer	535,279	25	4.7	299	5.8
	Rugby	188,676	13	6.9	80	13.1
Meniscal tear	Rugby	188,676	46	2.4	80	13.1
	Australian Rules football	222,641	47	2.1	152	9.6
	Hockey	38,374	8	2.1	24	27
	Soccer	535,279	108	2.0	299	5.8
	Ice and snow sports	90,491	18	2.0	47	19.3
All head injury	Roller sports	49,672	195	392.6	29	22.9
	Rugby	188,676	682	361.5	80	13.1
	Wheeled motor sports	72,847	249	341.8	47	18.8
	Australian Rules football	222,641	645	289.7	152	9.6
	Hockey	38,374	64	166.8	24	27
Concussion	Wheeled motor sports	72,847	103	141.4	47	18.8
	Roller sports	49,672	66	132.9	29	22.9
	Rugby	188,676	186	98.6	80	13.1
	Australian Rules football	222,641	214	96.1	152	9.6
	Equestrian activities	43,099	22	51.0	27	26.8*

(continued)

Table B1.2 (continued): Five highest crude participation-based rates[(a)] by nature of injury, males aged 15 and older, Australia, 2012–13

Nature of injury	Types of sport	No. of participants	Cases	Rate	Obs	RSE %
Other intracranial injury	Roller sports	49,672	53	106.7	29	22.9
	Wheeled motor sports	72,847	49	67.3	47	18.8
	Equestrian activities	43,099	14	32.5	27	26.8*
	Ice and snow sports	90,491	11	12.2	47	19.3
	Rugby	188,676	21	11.1	80	13.1
Facial fracture	Rugby	188,676	314	166.4	80	13.1
	Australian Rules football	222,641	288	129.4	152	9.6
	Hockey	38,374	34	88.6	24	27.0
	Roller sports	49,672	16	32.2	29	22.9
	Basketball	245,579	77	31.4	141	11.0
All shoulder injury	Wheeled motor sports	72,847	380	521.6	47	18.8
	Roller sports	49,672	65	130.9	29	22.9
	Rugby	188,676	245	129.9	80	13.1
	Ice and snow sports	90,491	112	123.8	47	19.3
	Australian Rules football	222,641	215	96.6	152	9.6
Shoulder fracture	Wheeled motor sports	72,847	282	387.1	47	18.8
	Ice and snow sports	90,491	71	78.5	47	19.3
	Roller sports	49,672	34	68.4	29	22.9
	Australian Rules football	222,641	103	46.3	152	9.6
	Cycling	871,872	401	46.0	664	4.9
Shoulder dislocation	Wheeled motor sports	72,847	57	78.2	47	18.8
	Rugby	188,676	120	63.6	80	13.1
	Roller sports	49,672	23	46.3	29	22.9
	Australian Rules football	222,641	80	35.9	152	9.6
	Ice and snow sports	90,491	18	19.9	47	19.3
All ankle injury	Roller sports	49,672	134	269.8	45	17.9
	Wheeled motor sports	72,847	134	183.9	49	18.0
	Rugby	188,676	250	132.5	87	11.6
	Australian Rules football	222,641	192	86.2	166	9.2
	Dancing	30,127	19	63.1	188	9.4
Unimalleolar ankle fracture	Roller sports	49,672	72	144.9	45	17.9
	Rugby	188,676	150	79.5	87	11.6
	Wheeled motor sports	72,847	54	74.1	49	18.0
	Australian Rules football	222,641	129	57.9	166	9.2
	Soccer	535,279	170	31.8	387	5.4

(continued)

Table B1.2 (continued): Five highest crude participation-based rates[(a)] by nature of injury, males aged 15 and older, Australia, 2012–13

Nature of injury	Types of sport	No. of participants	Cases	Rate	Obs	RSE %
Bi- and trimalleolar ankle fracture	Roller sports	49,672	43	86.6	45	17.9
	Wheeled motor sports	72,847	43	59.0	49	18
	Rugby	188,676	61	32.3	87	11.6
	Dancing	30,127	6	19.9	188	9.4
	Ice and snow sports	90,491	18	19.9	80	17.6
All hip injury	Wheeled motor sports	72,847	61	83.7	47	18.8
	Roller sports	49,672	29	58.4	29	22.9
	Equestrian activities	43,099	16	37.1	27	26.8*
	Dancing	30,127	6	20.0	28	22.1
	Cycling	871,872	123	14.1	664	4.9
Fractured neck of femur	Roller sports	49,672	11	22.1	29	22.9
	Wheeled motor sports	72,847	14	19.2	47	18.8
	Equestrian activities	43,099	4	9.3	27	26.8*
	Dancing	30,127	2	6.6	28	22.1
	Ice and snow sports	90,491	4	4.4	47	19.3
Pertrochanteric fracture	Roller sports	49,672	6	12.1	29	22.9
	Equestrian activities	43,099	5	11.6	27	26.8*
	Wheeled motor sports	72,847	7	9.6	47	18.8
	Cycling	871,872	33	3.8	664	4.9
	Dancing	30,127	1	3.3	28	22.1
Acetabular fracture	Wheeled motor sports	72,847	15	20.6	47	18.8
	Roller sports	49,672	**7**	14.1	29	22.9
	Ice and snow sports	90,491	3	3.3	47	19.3
	Rugby	188,676	6	3.2	80	13.1
	Cycling	871,872	27	3.1	664	4.9
Hip dislocation	Wheeled motor sports	72,847	8	11.0	47	18.8
	Rugby	188,676	8	4.2	80	13.1
	Equestrian activities	43,099	1	2.3	27	26.8*
	Australian Rules football	222,641	5	2.2	152	9.6
	Ice and snow sports	90,491	2	2.2	47	19.3
All wrist injury	Roller sports	49,672	297	597.9	29	22.9
	Wheeled motor sports	72,847	248	340.4	47	18.8
	Ice and snow sports	90,491	81	89.5	47	19.3
	Australian Rules football	222,641	189	84.9	152	9.6
	Equestrian activities	43,099	35	81.2	27	26.8*

(continued)

Table B1.2 (continued): Five highest crude participation-based rates[(a)] by nature of injury, males aged 15 and older, Australia, 2012–13

Nature of injury	Types of sport	No. of participants	Cases	Rate	Obs	RSE %
Wrist fracture	Roller sports	49,672	275	553.6	29	22.9
	Wheeled motor sports	72,847	222	304.7	47	18.8
	Ice and snow sports	90,491	78	86.2	47	19.3
	Equestrian activities	43,099	34	78.9	27	26.8*
	Australian Rules football	222,641	147	66.0	152	9.6
Muscle and tendon injury to wrist	Australian Rules football	222,641	28	12.6	152	9.6
	Roller sports	49,672	6	12.1	29	22.9
	Wheeled motor sports	72,847	8	11.0	47	18.8
	Dancing	30,127	3	10.0	28	22.1
	Fishing	213,064	19	8.9	177	9.5
Wrist dislocation	Rugby	188,676	17	9.0	80	13.1
	Wheeled motor sports	72,847	5	6.9	47	18.8
	Roller sports	49,672	2	4.0	29	22.9
	Australian Rules football	222,641	7	3.1	152	9.6
	Ice and snow sports	90,491	2	2.2	47	19.3
All injury to spinal column and cord	Wheeled motor sports	72,847	188	258.1	47	18.8
	Equestrian activities	43,099	30	69.6	27	26.8*
	Rugby	188,676	128	67.8	80	13.1
	Gymnastics and trampolining	20,862	11	52.7	13	27.3*
	Ice and snow sports	90,491	28	30.9	47	19.3
All injury to cervical spinal column and cord	Wheeled motor sports	72,847	61	83.7	47	18.8
	Rugby	188,676	110	58.3	80	13.1
	Gymnastics and trampolining	20,862	7	33.6	13	27.3*
	Australian Rules football	222,641	35	15.7	152	9.6
	Equestrian activities	43,099	6	13.9	27	26.8*
All injury to thoracic and lumbosacral spinal column and cord	Wheeled motor sports	72,847	127	174.3	47	18.8
	Equestrian activities	43,099	24	55.7	27	26.8*
	Ice and snow sports	90,491	22	24.3	47	19.3
	Gymnastics and trampolining	20,862	4	19.2	13	27.3*
	Roller sports	49,672	6	12.1	29	22.9

(continued)

Table B1.2 (continued): Five highest crude participation-based rates[(a)] by nature of injury, males aged 15 and older, Australia, 2012–13

Nature of injury	Types of sport	No. of participants	Cases	Rate	Obs	RSE %
All internal organ injury	Wheeled motor sports	72,847	135	185.3	47	18.8
	Australian Rules football	222,641	103	46.3	152	9.6
	Equestrian activities	43,099	18	41.8	27	26.8*
	Roller sports	49,672	15	30.2	29	22.9
	Ice and snow sports	90,491	26	28.7	47	19.3
Injury to the lungs	Wheeled motor sports	72,847	79	108.4	47	18.8
	Australian Rules football	222,641	48	21.6	152	9.6
	Equestrian activities	43,099	9	20.9	27	26.8*
	Rugby	188,676	22	11.7	80	13.1
	Cycling	871,872	81	9.3	664	4.9
Injury to the spleen	Wheeled motor sports	72,847	22	30.2	47	18.8
	Roller sports	49,672	6	12.1	29	22.9
	Equestrian activities	43,099	5	11.6	27	26.8*
	Ice and snow sports	90,491	10	11.1	47	19.3
	Australian Rules football	222,641	11	4.9	152	9.6
Injury to the kidneys	Wheeled motor sports	72,847	15	20.6	47	18.8
	Australian Rules football	222,641	29	13.0	152	9.6
	Ice and snow sports	90,491	7	7.7	47	19.3
	Roller sports	49,672	3	6.0	29	22.9
	Rugby	188,676	7	3.7	80	13.1
All elbow injury	Roller sports	49,672	118	237.6	29	22.9
	Wheeled motor sports	72,847	64	87.9	47	18.8
	Rugby	188,676	46	24.4	80	13.1
	Australian Rules football	222,641	52	23.4	152	9.6
	Ice and snow sports	90,491	21	23.2	47	19.3
Elbow fracture	Roller sports	49,672	98	197.3	29	22.9
	Wheeled motor sports	72,847	40	54.9	47	18.8
	Ice and snow sports	90,491	18	19.9	47	19.3
	Equestrian activities	43,099	8	18.6	27	26.8*
	Dancing	30,127	5	16.6	28	22.1
Elbow dislocation	Roller sports	49,672	13	26.2	29	22.9
	Wheeled motor sports	72,847	7	9.6	47	18.8
	Australian Rules football	222,641	19	8.5	152	9.6
	Rugby	188,676	13	6.9	80	13.1
	Dancing	30,127	1	3.3	28	22.1

(continued)

Table B1.2 (continued): Five highest crude participation-based rates[(a)] by nature of injury, males aged 15 and older, Australia, 2012–13

Nature of injury	Types of sport	No. of participants	Cases	Rate	Obs	RSE %
All long-bone fractures	Wheeled motor sports	72,847	182	249.8	47	18.8
	Roller sports	49,672	67	134.9	29	22.9
	Rugby	188,676	149	79.0	80	13.1
	Ice and snow sports	90,491	51	56.4	47	19.3
	Australian Rules football	222,641	113	50.8	152	9.6

(a) Rate per 100,000 participants.

* Caution should be exercised, because the denominator has an RSE >25 and ≤50.

Table B1.3: Five highest crude participation-based rates[(a)] by nature of injury, females aged 15 and older, Australia, 2012–13

Nature of injury	Types of sport	No. of participants	Cases	Rate	Obs	RSE %
All knee injury	Ice and snow sports	48,162	185	384.1	33	24.4
	Rugby	14,226	28	196.8	7	45.2*
	Netball	406,493	472	116.1	270	5.4
	Roller sports	21,138	24	113.5	16	28.7*
	Australian Rules football	18,891	21	111.2	14	25.9*
Cruciate ligament injury	Ice and snow sports	48,162	135	280.3	33	24.4
	Rugby	14,226	23	161.7	7	45.2*
	Netball	406,493	385	94.7	270	5.4
	Australian Rules football	18,891	16	84.7	14	25.9*
	Soccer	148,015	93	62.8	88	15.0
Knee fracture	Ice and snow sports	48,162	31	64.4	33	24.4
	Roller sports	21,138	9	42.6	16	28.7*
	Equestrian activities	105,698	15	14.2	69	17.0
	Australian Rules football	18,891	2	10.6	14	25.9*
	Soccer	148,015	15	10.1	88	15.0
Knee dislocation	Roller sports	21,138	2	9.5	16	28.7*
	Rugby	14,226	1	7.0	7	45.2*
	Dancing	229,058	14	6.1	160	10.2
	Australian Rules football	18,891	1	5.3	14	25.9*
	Ice and snow sports	48,162	2	4.2	33	24.4
Meniscal tear	Ice and snow sports	48,162	11	22.8	33	24.4
	Rugby	14,226	3	21.1	7	45.2*
	Basketball	109,250	13	11.9	76	11.7
	Netball	406,493	41	10.1	270	5.4
	Roller sports	21,138	2	9.5	16	28.7*
All head injury	Equestrian activities	105,698	225	212.9	69	17.0
	Roller sports	21,138	32	151.4	16	28.7*
	Rugby	14,226	18	126.5	7	45.2*
	Australian Rules football	18,891	18	95.3	14	25.9*
	Hockey	74,199	56	75.5	42	18.9
Concussion	Equestrian activities	105,698	103	97.4	69	17.0
	Australian Rules football	18,891	9	47.6	14	25.9*
	Roller sports	21,138	10	47.3	16	28.7*
	Rugby	14,226	6	42.2	7	45.2*
	Ice and snow sports	48,162	18	37.4	33	24.4

(continued)

Table B1.3 (continued): Five highest crude participation-based rates[(a)] by nature of injury, females aged 15 and older, Australia, 2012–13

Nature of injury	Types of sport	No. of participants	Cases	Rate	Obs	RSE %
Other intracranial injury	Equestrian activities	105,698	36	34.1	69	17.0
	Roller sports	21,138	7	33.1	16	28.7*
	Cycling	490,601	18	3.7	411	4.9
	Ice and snow sports	48,162	1	2.1	33	24.4*
	Soccer	148,015	3	2.0	88	15.0
Facial fractures	Rugby	14,226	7	49.2	7	45.2*
	Hockey	74,199	24	32.3	42	18.9
	Australian Rules football	18,891	4	21.2	14	25.9*
	Equestrian activities	105,698	19	18.0	69	17.0
	Cricket	20,284	3	14.8	14	33.9*
All shoulder injury	Equestrian activities	105,698	81	76.6	69	17.0
	Ice and snow sports	48,162	29	60.2	33	24.4
	Rugby	14,226	6	42.2	7	45.2
	Roller sports	21,138	8	37.8	16	28.7*
	Australian Rules football	18,891	4	21.2	14	25.9*
Shoulder fracture	Equestrian activities	105,698	54	51.1	69	17.0
	Ice and snow sports	48,162	18	37.4	33	24.4
	Roller sports	21,138	6	28.4	16	28.7*
	Australian Rules football	18,891	3	15.9	14	25.9*
	Cycling	490,601	49	10.0	411	4.9
Shoulder dislocation	Rugby	14,226	4	28.1	7	45.2*
	Equestrian activities	105,698	10	9.5	69	17.0
	Ice and snow sports	48,162	3	6.2	33	24.4
	Australian Rules football	18,891	1	5.3	14	25.9*
	Basketball	109,250	5	4.6	76	11.7
All ankle injury	Roller sports	21,138	119	563.0	16	28.7*
	Rugby	14,226	15	105.4	7	45.2*
	Ice and snow sports	48,162	36	74.7	33	24.4
	Equestrian activities	105,698	76	71.9	69	17.0
	Soccer	148,015	44	29.7	88	15.0
Unimalleolar ankle fracture	Roller sports	21,138	56	264.9	16	28.7*
	Ice and snow sports	48,162	26	54.0	33	24.4
	Rugby	14,226	5	35.1	7	45.2*
	Equestrian activities	105,698	28	26.5	69	17.0
	Australian Rules football	18,891	3	15.9	14	25.9*

(continued)

Table B1.3 (continued): Five highest crude participation-based rates[a] by nature of injury, females aged 15 and older, Australia, 2012–13

Nature of injury	Types of sport	No. of participants	Cases	Rate	Obs	RSE %
Bi- and trimalleolar ankle fracture	Roller sports	21,138	55	260.2	16	28.7*
	Rugby	14,226	7	49.2	7	45.2*
	Equestrian activities	105,698	30	28.4	69	17.0
	Ice and snow sports	48,162	8	16.6	33	24.4
	Fishing	34,099	4	11.7	21	25.6*
All hip injury	Equestrian activities	105,698	54	51.1	69	17.0
	Roller sports	21,138	4	18.9	16	28.7*
	Ice and snow sports	48,162	8	16.6	33	24.4
	Dancing	229,058	30	13.1	160	10.2
	Cricket	20,284	2	9.9	14	33.9*
Fractured neck of femur	Dancing	229,058	15	6.5	160	10.2
	Ice and snow sports	48,162	3	6.2	33	24.4
	Australian Rules football	18,891	1	5.3	14	25.9*
	Cricket	20,284	1	4.9	14	33.9*
	Roller sports	21,138	1	4.7	16	28.7*
Pertrochanteric fracture	Cricket	20,284	1	4.9	14	33.9*
	Ice and snow sports	48,162	2	4.2	33	24.4
	Dancing	229,058	8	3.5	160	10.2
	Equestrian activities	105,698	2	1.9	69	17.0
	Racquet sports	418,844	7	1.7	302	7.0
	Cricket	20,284	1	4.9	14	33.9*
Acetabular fracture[b]	Equestrian activities	105,698	8	7.6	69	17.0
	Roller sports	21,138	1	4.7	16	28.7*
	Cycling	490,601	2	0.4	411	4.9
	Netball	406,493	1	0.2	270	5.4
Hip dislocation[b]	Rugby	14,226	1	7.0	7	45.2*
	Ice and snow sports	48,162	1	2.1	33	24.4
	Water sports	841,314	3	0.4	705	5.0
	Cycling	490,601	1	0.2	411	4.9
All wrist injury	Roller sports	21,138	124	586.6	16	28.7
	Ice and snow sports	48,162	95	197.2	33	24.4
	Rugby	14,226	13	91.4	7	45.2*
	Equestrian activities	105,698	89	84.2	69	17.0
	Australian rules football	18,891	9	47.6	14	25.9*

(continued)

Table B1.3 (continued): Five highest crude participation-based rates[a] by nature of injury, females aged 15 and older, Australia, 2012–13

Nature of injury	Types of sport	No. of participants	Cases	Rate	Obs	RSE %
Wrist fracture	Roller sports	21,138	122	577.2	16	28.7*
	Ice and snow sports	48,162	93	193.1	33	24.4
	Equestrian activities	105,698	78	73.8	69	17.0
	Rugby	14,226	8	56.2	7	45.2
	Australian rules football	18,891	9	47.6	14	25.9*
Muscle and tendon injury to wrist	Rugby	14,226	4	28.1	7	45.2*
	Ice and snow sports	48,162	2	4.2	33	24.4
	Equestrian activities	105,698	4	3.8	69	17.0
	Basketball	109,250	1	0.9	76	11.7
	Dancing	229,058	2	0.9	160	10.2
Wrist dislocation[b]	Equestrian activities	105,698	1	0.9	69	17.0
	Water sports	841,314	3	0.4	705	5.0
	Netball	406,493	1	0.2	270	5.4
All injury to spinal column and cord	Equestrian activities	105,698	148	140.0	69.0	17.0
	Gymnastics and trampolining	29,052	21	72.3	18.0	37.2*
	Rugby	14,226	7	49.2	7.0	45.2*
	Ice and snow sports	48,162	19	39.4	33.0	24.4
	Roller sports	21,138	5	23.7	16.0	28.7
All injury to cervical spinal column and cord	Gymnastics and trampolining	29,052	14	48.2	18	37.2*
	Rugby	14,226	5	35.1	7	45.2*
	Equestrian activities	105,698	26	24.6	69	17.0
	Australian rules football	18,891	3	15.9	14	25.9*
	Ice and snow sports	48,162	3	6.2	33	24.4
All injury to thoracic and lumbosacral spinal column and cord	Equestrian activities	105,698	122	115.4	69	17.0
	Ice and snow sports	48,162	16	33.2	33	24.4
	Gymnastics and trampolining	29,052	7	24.1	18	37.2*
	Roller sports	21,138	4	18.9	16	28.7*
	Rugby	14,226	2	14.1	7	45.2*

(continued)

Table B1.3 (continued): Five highest crude participation-based rates[(a)] by nature of injury, females aged 15 and older, Australia, 2012–13

Nature of injury	Types of sport	No. of participants	Cases	Rate	Obs	RSE %
All internal organ injury	Equestrian activities	105,698	41	38.8	69	17.0
	Rugby	14,226	2	14.1	7	45.2
	Roller sports	21,138	2	9.5	16	28.7*
	Ice and snow sports	48,162	2	4.2	33	24.4
	Soccer	148,015	6	4.1	88	15.0
Injury to the lungs	Equestrian activities	105,698	23	21.8	69	17.0
	Cycling	490,601	8	1.6	411	4.9
	Dancing	229,058	2	0.9	160	10.2
	Netball	406,493	1	0.2	270	5.4
	Water sports	841,314	2	0.2	705	5.0
Injury to the spleen	Roller sports	49,672	6	12.1	29	22.9
	Equestrian activities	43,099	5	11.6	27	26.8*
	Ice and snow sports	90,491	10	11.1	47	19.3
	Australian rules football	222,641	11	4.9	152	9.6
	Rugby	188,676	8	4.2	80	13.1
Injury to the kidneys	Australian rules football	222,641	29	13.0	152	9.6
	Ice and snow sports	90,491	7	7.7	47	19.3
	Roller sports	49,672	3	6.0	29	22.9
	Rugby	188,676	7	3.7	80	13.1
	Cycling	871,872	16	1.8	664	4.9
All elbow injury	Roller sports	21,138	19	89.9	16	28.7*
	Ice and snow sports	48,162	17	35.3	33	24.4
	Equestrian activities	105,698	23	21.8	69	17.0
	Gymnastics and trampolining	29,052	6	20.7	18	37.2*
	Rugby	14,226	2	14.1	7	45.2*
Elbow fracture	Roller sports	21,138	17	80.4	16	28.7*
	Ice and snow sports	48,162	15	31.1	33	24.4
	Equestrian activities	105,698	18	17.0	69	17.0
	Gymnastics and trampolining	29,052	3	10.3	18	37.2*
	Cycling	490,601	46	9.4	411	4.9
Elbow dislocation	Rugby	14,226	2	14.1	7	45.2*
	Roller sports	21,138	2	9.5	16	28.7*
	Gymnastics and trampolining	29,052	2	6.9	18	37.2*
	Basketball	109,250	3	2.7	76	11.7
	Soccer	148,015	3	2.0	88	15.0

(continued)

Table B1.3 (continued): Five highest crude participation-based rates[(a)] by nature of injury, females aged 15 and older, Australia, 2012–13

Nature of injury	Types of sport	No. of participants	Cases	Rate	Obs	RSE %
Long-bone fracture	Roller sports	21,138	21	99.3	16	28.7*
	Ice and snow sports	48,162	34	70.6	33	24.4
	Equestrian activities	105,698	46	43.5	69	17.0
	Rugby	14,226	3	21.1	7	45.2*
	Soccer	148,015	16	10.8	88	15.0

(a) Rate per 100,000 participants.

(b) There were cases for only 3 sports.

* Caution should be exercised, because the denominator has an RSE >25 and ≤50.

Table B1.4: Five highest crude participation-based rates[(a)] by nature of injury, persons aged 15 and older, Australia, 2012–13

Nature of injury	Types of sport	No. of participants	Cases	Rate	Obs	RSE %
All knee injury	Ice and snow sports	138,653	303	218.5	80	17.6
	Rugby	202,902	358	176.4	87	11.6
	Australian rules football	241,532	327	135.4	166	11.6
	Soccer	683293	817	119.6	387	5.4
	Netball	448,048	501	111.8	293	6.0
Cruciate ligament injury	Ice and snow sports	138,653	199	143.5	80	17.6
	Rugby	202,902	210	103.5	87	11.6
	Netball	448,048	406	90.6	293	6.0
	Australian rules football	241,532	217	89.8	166	9.2
	Soccer	683,293	530	77.6	387	5.4
Knee fracture	Wheeled motor sports	76,585	105	137.1	49	18.0
	Roller sports	70,811	35	49.4	45	17.9
	Ice and snow sports	138,653	60	43.3	80	17.6
	Rugby	202,902	55	27.1	87	11.6
	Australian rules football	241,532	36	14.9	166	9.2
Knee dislocation	Rugby	202,902	14	6.9	87	11.6
	Dancing	259,185	16	6.2	188	9.4
	Australian rules football	241,532	12	5.0	166	9.2
	Roller sports	70,811	3	4.2	45	17.9
	Soccer	683,293	27	4.0	387	5.4
Meniscal tear	Rugby	202,902	49	24.1	87	11.6
	Ice and snow sports	138,653	29	20.9	80	17.6
	Australian rules football	241,532	48	19.9	166	9.2
	Soccer	683,293	117	17.1	387	5.4
	Hockey	112,573	15	13.3	66	17.0
All head injury	Wheeled motor sports	76,585	266	347.3	49	18.0
	Rugby	202,902	700	345.0	87	11.6
	Roller sports	70,811	227	320.6	45	17.9
	Australian rules football	241,532	663	274.5	166	9.2
	Equestrian activities	148,797	283	190.2	96	15.3
Concussion	Wheeled motor sports	76,585	112	146.2	49	18.0
	Roller sports	70,811	76	107.3	45	17.9
	Rugby	202,902	192	94.6	87	11.6
	Australian rules football	241,532	223	92.3	166	9.2
	Equestrian activities	148,797	125	84.0	96	15.3

(continued)

Table B1.4 (continued): Five highest crude participation-based rates[(a)] by nature of injury, persons aged 15 and older, Australia, 2012–13

Nature of injury	Types of sport	No. of participants	Cases	Rate	Obs	RSE %
Other intracranial injury	Roller sports	70,811	60	84.7	45	17.9
	Wheeled motor sports	76,585	51	66.6	49	18.0
	Equestrian activities	148,797	50	33.6	96	15.3
	Rugby	202,902	21	10.3	87	11.6
	Ice and snow sports	138,653	12	8.7	80	17.6
Facial fracture	Rugby	202,902	321	158.2	87	11.6
	Australian rules football	241,532	292	120.9	166	9.2
	Hockey	112,573	58	51.5	66	17.0
	Wheeled motor sports	76,585	23	30.0	49	18.0
	Cricket	359,705	92	25.6	223	11.0
All shoulder injury	Wheeled motor sports	76,585	399	521.0	49	18.0
	Rugby	202,902	251	123.7	87	11.6
	Roller sports	70,811	73	103.1	45	17.9
	Ice and snow sports	138,653	141	101.7	80	17.6
	Australian rules football	241,532	219	90.7	166	9.2
Shoulder fracture	Wheeled motor sports	76,585	297	387.8	49	18.0
	Ice and snow sports	138,653	89	64.2	80	17.6
	Roller sports	70,811	40	56.5	45	17.9
	Equestrian activities	148,797	73	49.1	96	15.3
	Australian rules football	241,532	106	43.9	166	9.2
Shoulder dislocation	Wheeled motor sports	76,585	58	75.7	49	18.0
	Rugby	202,902	124	61.1	87	11.6
	Australian rules football	241,532	81	33.5	166	9.2
	Roller sports	70,811	23	32.5	45	17.9
	Ice and snow sports	138,653	21	15.1	80	17.6
All ankle injury	Roller sports	70,811	253	357.3	45	17.9
	Wheeled motor sports	76,585	146	190.6	49	18.0
	Rugby	202,902	265	130.6	87	11.6
	Australian rules football	241,532	197	81.6	166	9.2
	Ice and snow sports	138,653	84	60.6	80	17.6
Unimalleolar ankle fracture	Roller sports	70,811	128	180.8	45	17.9
	Rugby	202,902	155	76.4	87	11.6
	Wheeled motor sports	76,585	58	75.7	49	18.0
	Australian rules football	241,532	132	54.7	166	9.2
	Ice and snow sports	138,653	51	36.8	80	17.6

(continued

Table B1.4 (continued): Five highest crude participation-based rates[(a)] by nature of injury, persons aged 15 and older, Australia, 2012–13

Nature of injury	Types of sport	No. of participants	Cases	Rate	Obs	RSE %
Bi- and trimalleolar ankle fracture	Roller sports	70,811	98	138.4	45	17.9
	Wheeled motor sports	76,585	46	60.1	49	18.0
	Rugby	202,902	68	33.5	87	11.6
	Equestrian activities	148,797	33	22.2	96	15.3
	Ice and snow sports	138,653	26	18.8	80	17.6
All hip injury	Wheeled motor sports	76,585	68	88.8	49	18.0
	Equestrian activities	148,797	70	47.0	96	15.3
	Roller sports	70,811	33	46.6	45	17.9
	Ice and snow sports	138,653	20	14.4	80	17.6
	Dancing	259,185	36	13.9	188	9.4
Fractured neck of femur	Wheeled motor sports	76585.28	14	18.3	49	18.0
	Roller sports	70,811	12	16.9	45	17.9
	Dancing	259,185	17	6.6	188	9.4
	Ice and snow sports	138,653	7	5.0	80	17.6
	Equestrian activities	148,797	7	4.7	96	15.3
Pertrochanteric fracture	Wheeled motor sports	76,585	8	10.4	49	18.0
	Roller sports	70,811	6	8.5	45	17.9
	Equestrian activities	148,797	7	4.7	96	15.3
	Dancing	259,185	9	3.5	188	9.4
	Cycling	1,362,472	35	2.6	1,075	3.4
Acetabular fracture	Wheeled motor sports	76,585	16	20.9	49	18.0
	Roller sports	70,811	8	11.3	45	17.9
	Equestrian activities	148,797	9	6.0	96	15.3
	Rugby	202,902	6	3.0	87	11.6
	Ice and snow sports	138,653	3	2.2	80	17.6
Hip dislocation	Wheeled motor sports	76,585	9	11.8	49	18.0
	Rugby	202,902	9	4.4	87	11.6
	Ice and snow sports	138,653	3	2.2	80	17.6
	Australian rules football	241,532	5	2.1	166	9.2
	Equestrian activities	148,797	1	0.7	96	15.3
All wrist injury	Roller sports	70,811	421	594.5	45	17.9
	Wheeled motor sports	76,585	262	342.1	49	18.0
	Ice and snow sports	138,653	176	126.9	80	17.6
	Equestrian activities	148,797	124	83.3	96	15.3
	Australian rules football	241,532	198	82.0	166	9.2

(continued)

Table B1.4 (continued): Five highest crude participation-based rates[(a)] by nature of injury, persons aged 15 and older, Australia, 2012–13

Nature of injury	Types of sport	No. of participants	Cases	Rate	Obs	RSE %
Wrist fracture	Roller sports	70,811	397	560.7	45	17.9
	Wheeled motor sports	76,585	234	305.5	49	18.0
	Ice and snow sports	138,653	171	123.3	80	17.6
	Equestrian activities	148,797	112	75.3	96	15.3
	Australian rules football	241,532	156	64.6	166	9.2
Muscle and tendon injury to wrist	Wheeled motor sports	76,585	9	11.8	49	18.0
	Australian rules football	241,532	28	11.6	166	9.2
	Rugby	202,902	19	9.4	87	11.6
	Roller sports	70,811	6	8.5	45	17.9
	Fishing	247,163	19	7.7	198	9.2
Wrist dislocation	Rugby	202,902	17	8.4	87	11.6
	Wheeled motor sports	76,585	5	6.5	49	18.0
	Australian rules football	241,532	7	2.9	166	9.2
	Roller sports	70,811	2	2.8	45	17.9
	Ice and snow sports	138,653	2	1.4	80	17.6
All injury to spinal column and cord	Wheeled motor sports	76,585	200	261.1	49	18.0
	Equestrian activities	148,797	178	119.6	96	15.3
	Rugby	202,902	135	66.5	87	11.6
	Gymnastics and trampolining	49,914	32	64.1	31	26.9
	Ice and snow sports	138,653	47	33.9	80	17.6
All injury to cervical spinal column and cord	Wheeled motor sports	76,585	65	84.9	49.0	18.0
	Rugby	202,902	115	56.7	87.0	11.6
	Gymnastics and trampolining	49,914	21	42.1	31.0	26.9*
	Equestrian activities	148,797	32	21.5	96.0	15.3
	Australian rules football	241,532	38	15.7	166.0	9.2

(continued)

Table B1.4 (continued): Five highest crude participation-based rates[a] by nature of injury, persons aged 15 and older, Australia, 2012–13

Nature of injury	Types of sport	No. of participants	Cases	Rate	Obs	RSE %
All injury to thoracic and lumbosacral spinal column and cord	Wheeled motor sports	76,585	135	176.3	49	18.0
	Equestrian activities	148,797	146	98.1	96	15.3
	Ice and snow sports	138,653	38	27.4	80	17.6
	Gymnastics and trampolining	49,914	11	22.0	31	26.9*
	Roller sports	70,811	10	14.1	45	17.9
All internal organ injury	Wheeled motor sports	76,585	139	181.5	49	18.0
	Australian rules football	241,532	103	42.6	166	9.2
	Equestrian activities	148,797	59	39.7	96	15.3
	Roller sports	70,811	17	24.0	45	17.9
	Rugby	202,902	48	23.7	87	11.6
Injury to the lungs	Wheeled motor sports	76,585	81	105.8	49	18.0
	Equestrian activities	148,797	32	21.5	96	15.3
	Australian rules football	241,532	48	19.9	166	9.2
	Rugby	202,902	22	10.8	87	11.6
	Cycling	1,362,472	89	6.5	1,075	3.4
Injury to the spleen[b]	Equestrian activities	105,698	7	6.6	69	17.0
	Roller sports	21,138	1	4.7	16	28.7*
	Cycling	490,601	2	0.4	411	4.9
Injury to the kidneys[b]	Equestrian activities	105,698	6	6.6	69	17.0
	Roller sports	21,138	3	4.7	16	28.7*
	Cycling	490,601	17	0.4	411	4.9
All elbow injury	Roller sports	70,811	137	193.5	45	17.9
	Wheeled motor sports	76,585	72	94.0	49	18.0
	Ice and snow sports	138,653	38	27.4	80	17.6
	Rugby	202,902	48	23.7	87	11.6
	Australian rules football	241,532	52	21.5	166	9.2
Elbow fracture	Roller sports	70,811	118	166.6	45	17.9
	Wheeled motor sports	76,585	48	62.7	49	18.0
	Ice and snow sports	138,653	33	23.8	80	17.6
	Equestrian activities	148,797	26	17.5	96	15.3
	Rugby	202,902	30	14.8	87	11.6

(continued)

Table B1.4 (continued): Five highest crude participation-based rates[(a)] by nature of injury, persons aged 15 and older, Australia, 2012–13

Nature of injury	Types of sport	No. of participants	Cases	Rate	Obs	RSE %
Elbow dislocation	Roller sports	70,811	12	16.9	45	17.9
	Australian rules football	241,532	19	7.9	166	9.2
	Wheeled motor sports	76,585	6	7.8	49	18.0
	Rugby	202,902	14	6.9	87	11.6
	Gymnastics and trampolining	49,914	2	4.0	31	26.9*
All long-bone fractures	Wheeled motor sports	76,585	191	249.4	49	18.0
	Roller sports	70,811	88	124.3	45	17.9
	Rugby	202,902	152	74.9	87	11.6
	Ice and snow sports	138,653	85	61.3	80	17.6
	Australian rules football	241,532	115	47.6	166	9.2

(a) Rate per 100,000 participants.

* Caution should be exercised, because the denominator has an RSE >25 and ≤50.

Appendix C: Additional tables

Table C1.1: Case numbers and age-specific rates for sport-related injury hospitalisation by nature of injury and age, males, Australia, 2012–13

	0–4		5–9		10–14		15–17		18–24	
Type of injury	**Number**	**Rate**	**Number**	**Rate**	**Number**	**Rate**	**Number**	**Rate**	**Number**	**Rate**
Knee injury	3	0.4	24	3.3	250	35.1	468	105.5	1,134	100.6
Cruciate ligament injury	0	0.0	2	0.3	58	8.1	215	48.5	778	69.0
Knee fracture	2	0.3	6	0.8	83	11.7	102	23.0	83	7.4
Knee dislocation	0	0.0	0	0.0	16	2.2	33	7.4	35	3.1
Meniscal tear	0	0.0	2	0.3	32	4.5	77	17.4	152	13.3
Head injury	116	15.0	378	51.2	1,259	176.1	1,039	234.6	1,299	113.7
Concussion	9	1.2	82	11.1	503	70.4	419	94.6	356	31.2
Other intracranial injury	0	0.0	10	1.4	39	5.5	56	12.6	78	6.8
Facial fracture	1	0.1	22	3.0	213	29.8	264	59.6	564	49.4
Shoulder injury	2	0.3	16	2.2	204	28.5	335	75.6	696	60.9
Shoulder fracture	2	0.3	14	1.9	165	23.1	191	43.1	306	26.8
Shoulder dislocation	0	0.0	0	0.0	18	2.5	97	21.9	273	23.9
Ankle injury	2	0.3	4	0.5	137	19.2	302	68.2	603	52.8
Unimalleolar ankle fracture	0	0.0	3	0.4	63	8.8	172	38.8	336	29.4
Bi- and trimalleolar ankle fracture	0	0.0	1	0.1	46	6.4	79	17.8	127	11.1
Hip injury	1	0.1	12	1.6	80	11.2	40	9.0	76	6.7
Fractured neck of femur	1	0.1	0	0.0	24	3.4	11	2.5	8	0.7
Pertrochanteric fracture	0	0.0	0	0.0	2	0.3	1	0.2	7	0.6
Acetabular fracture	0	0.0	0	0.0	5	0.7	4	0.9	13	1.1
Hip dislocation	0	0.0	1	0.1	15	2.1	8	1.8	14	1.2

(continued)

Table C1.1 (continued): Case numbers and age-specific rates for sport-related injury hospitalisation, by type of injury, males, Australia, 2012–13

	0–4		5–9		10–14		15–17		18–24	
Type of injury	**Number**	**Rate**	**Number**	**Rate**	**Number**	**Rate**	**Number**	**Rate**	**Number**	**Rate**
Wrist injury	33	4.3	348	47.1	1,595	223.1	600	135.5	495	43.3
Wrist fracture	31	4.0	345	46.7	1,559	218.1	552	124.6	381	33.4
Muscle and tendon injury to wrist	1	0.1	0	0.0	15	2.1	21	4.7	53	4.6
Wrist dislocation	0	0.0	0	0.0	5	0.7	8	1.8	22	1.9
Injury to the spinal column and cord	1	0.1	12	1.6	89	12.5	85	19.2	212	18.6
Injury to the cervical spinal column & cord	1	0.1	8	1.1	65	9.1	53	12.0	109	9.5
Injury to the thoracic and lumbosacral spinal column and cord	0	0.0	4	0.5	24	3.4	32	7.2	103	9.0
Injury of internal organs	2	0.3	12	1.6	93	13.0	107	24.2	177	15.5
Injury involving the lungs	0	0.0	0	0.0	8	1.1	26	5.9	67	5.9
Injury to the spleen	0	0.0	4	0.5	44	6.2	30	6.8	37	3.2
Injury to the kidneys	0	0.0	2	0.3	17	2.4	32	7.2	40	3.5
Elbow injury	40	5.2	152	20.6	184	25.7	123	27.8	191	16.7
Elbow fracture	36	4.7	137	18.5	159	22.2	96	21.7	135	11.8
Elbow dislocation	4	0.5	15	2.0	13	1.8	15	3.4	38	3.3
Long-bone fracture	27	3.5	122	16.5	326	45.6	204	46.1	320	28.0
Fractured shaft of ulna and radius	7	0.9	36	4.9	61	8.5	46	10.4	76	6.7
Fractured shaft of femur	10	1.3	25	3.4	40	5.6	23	5.2	41	3.6
Fractured shaft of tibia and fibula	10	1.3	56	7.6	202	28.3	127	28.7	179	15.7
Fractured shaft of humerus	0	0.0	5	0.7	23	3.2	8	1.8	24	2.1

(continued)

Table C1.1 (continued): Case numbers and age-specific rates for sport-related injury hospitalisation, by type of injury, males, Australia, 2012–13

	25–34		35–44		45–54		55–64		65+		All ages	
Type of injury	**Number**	**Rate**	**Number**	**Rate**	**Number**	**Rate**	**Number**	**Rate**	**Number**	**Rate**	**Number**	**Rate***
Knee injury	1,068	65.5	528	33.5	249	16.5	61	4.8	43	3.0	3,828	42.8
Cruciate ligament injury	658	40.4	259	16.4	86	5.7	14	1.1	1	0.1	2,071	23.0
Knee fracture	150	9.2	100	6.3	54	3.6	18	1.4	10	0.7	608	6.9
Knee dislocation	23	1.4	5	0.3	3	0.2	0	0.0	1	0.1	116	1.3
Meniscal tear	145	8.6	119	7.5	79	5.2	20	1.5	15	1.0	641	7.2
Head injury	980	58.3	424	26.6	242	15.9	114	8.8	169	11.1	6,020	68.5
Concussion	161	9.6	79	5.0	47	3.1	21	1.6	22	1.5	1,699	19.6
Other intracranial injury	61	3.6	44	2.8	31	2.0	27	2.1	52	3.4	398	4.4
Facial fracture	481	28.6	145	9.1	65	4.3	13	1.0	25	1.6	1,793	20.1
Shoulder injury	589	35.0	405	25.4	330	21.7	153	11.8	80	5.3	2,810	31.4
Shoulder fracture	293	17.4	236	14.8	199	13.1	76	5.9	40	2.6	1,522	17.1
Shoulder dislocation	194	11.5	94	5.9	55	3.6	23	1.8	14	0.9	768	8.5
Ankle injury	566	33.7	269	16.9	111	7.3	45	3.5	34	2.2	2,073	23.2
Unimalleolar ankle fracture	274	16.3	127	8.0	54	3.6	18	1.4	16	1.1	1,063	11.9
Bi- and trimalleolar ankle fracture	166	9.9	88	5.5	35	2.3	19	1.5	17	1.1	578	6.5
Hip injury	69	4.1	59	3.7	56	3.7	72	5.6	100	6.6	565	6.2
Fractured neck of femur	12	0.7	19	1.2	20	1.3	28	2.2	40	2.6	163	1.8
Pertrochanteric fracture	10	0.6	13	0.8	10	0.7	15	1.2	30	2.0	88	0.9
Acetabular fracture	18	1.1	12	0.8	10	0.7	10	0.8	8	0.5	80	0.9
Hip dislocation	7	0.4	6	0.4	1	0.1	4	0.3	7	0.5	63	0.7

(continued)

Table C1.1 (continued): Case numbers and age-specific rates for sport-related injury hospitalisation, by type of injury, males, Australia, 2012–13

	25–34		35–44		45–54		55–64		65+		All ages	
Type of injury	**Number**	**Rate**	**Number**	**Rate**	**Number**	**Rate**	**Number**	**Rate**	**Number**	**Rate**	**Number**	**Rate***
Wrist injury	454	27.0	263	16.5	170	11.2	49	3.8	52	3.4	4,059	47.3
Wrist fracture	334	19.9	198	12.4	143	9.4	28	2.2	37	2.4	3,608	42.3
Muscle and tendon injury to wrist	57	3.4	25	1.6	9	0.6	3	0.2	2	0.1	186	2.1
Wrist dislocation	21	1.2	5	0.3	2	0.1	0	0.0	0	0.0	63	0.7
Injury to the spinal column and cord	241	14.3	170	10.7	147	9.7	62	4.8	60	4.0	1,079	12.1
Injury to the cervical spinal column and cord	111	6.6	82	5.2	61	4.0	29	2.2	22	1.5	541	6.1
Injury to the thoracic & lumbosacral spinal column and cord	130	7.7	88	5.5	86	5.7	33	2.6	38	2.5	538	12.1
Injury of internal organs	137	8.1	110	6.9	72	4.7	46	3.6	20	1.3	776	8.7
Injury involving the lungs	63	3.7	70	4.4	54	3.6	39	3.0	15	1.0	342	3.8
Injury to the spleen	23	1.4	16	1.0	6	0.4	2	0.2	0	0.0	162	1.9
Injury to the kidneys	27	1.6	6	0.4	4	0.3	2	0.2	2	0.1	132	1.5
Elbow injury	169	10.0	124	7.8	70	4.6	46	3.6	21	1.4	1,120	12.7
Elbow fracture	107	6.4	84	5.3	47	3.1	39	3.0	14	0.9	854	9.7
Elbow dislocation	32	1.9	11	0.7	8	0.5	2	0.2	1	0.1	139	1.6
Long-bone fracture	335	19.9	159	10.0	103	6.8	18	1.4	17	1.1	1,631	18.6
Fractured shaft of ulna and radius	94	5.6	24	1.5	18	1.2	1	0.1	1	0.1	364	4.1
Fractured shaft of femur	28	1.7	12	0.8	10	0.7	3	0.2	6	0.4	198	2.3
Fractured shaft of tibia and fibula	180	10.7	102	6.4	61	4.0	12	0.9	9	0.6	938	10.7
Fractured shaft of humerus	33	2.0	21	1.3	14	0.9	2	0.2	1	0.1	131	1.5

* Age-standardised rate.

Note: Case numbers and age-specific rates for all of the injury types and sub-types included in the report are shown in the table. For some types of injury, but not all, the sub-types in the table include all cases of the parent type of injury, and so the sum of cases of the sub-types shown is equal to the number of cases of the parent type.

Table C1.2: Case numbers and age-specific rates for sport-related injury hospitalisation, by type of injury, females, Australia, 2012–13

	0–4		5–9		10–14		15–17		18–24	
Type of injury	**Number**	**Rate**	**Number**	**Rate**	**Number**	**Rate**	**Number**	**Rate**	**Number**	**Rate**
Knee injury	8	1.1	12	1.8	121	17.9	233	55.6	376	34.9
Cruciate ligament injury	0	0.0	0	0.0	49	7.2	159	38.0	282	26.1
Knee fracture	5	0.7	5	0.7	26	3.8	12	2.9	31	2.9
Knee dislocation	0	0.0	0	0.0	14	2.1	14	3.3	18	1.6
Meniscal tear	0	0.0	0	0.0	17	2.5	30	7.2	30	2.7
Head injury	48	6.6	136	19.5	297	43.7	208	49.6	251	23.0
Concussion	5	0.7	34	4.9	101	14.8	82	19.6	87	8.0
Other intracranial injury	0	0.0	1	0.1	8	1.2	9	2.1	18	1.6
Facial fracture	0	0.0	6	0.9	38	5.6	35	8.4	57	5.2
Shoulder injury	0	0.0	4	0.6	36	5.3	41	9.8	73	6.7
Shoulder fracture	0	0.0	3	0.4	26	3.8	20	4.8	35	3.2
Shoulder dislocation	0	0.0	1	0.1	5	0.7	12	2.9	23	2.1
Ankle injury	1	0.1	5	0.7	62	9.1	55	13.1	163	14.9
Unimalleolar ankle fracture	0	0.0	3	0.4	24	3.5	26	6.2	71	6.5
Bi- and trimalleolar ankle fracture	0	0.0	0	0.0	24	3.5	15	3.6	51	4.7
Hip injury	2	0.3	9	1.3	31	4.6	27	6.4	24	2.2
Fractured neck of femur	0	0.0	2	0.3	7	1.0	4	1.0	0	0.0
Pertrochanteric fracture	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Acetabular fracture	0	0.0	0	0.0	2	0.3	1	0.2	2	0.2
Hip dislocation	0	0.0	0	0.0	1	0.1	1	0.2	2	0.2

(continued)

Table C1.2 (continued): Case numbers and age-specific rates for sport-related injury hospitalisation, by type of injury, females, Australia, 2012–13

	0–4		5–9		10–14		15–17		18–24	
Type of injury	**Number**	**Rate**	**Number**	**Rate**	**Number**	**Rate**	**Number**	**Rate**	**Number**	**Rate**
Wrist injury	8	1.1	219	31.3	457	67.2	41	9.8	128	11.7
Wrist fracture	8	1.1	214	30.6	447	65.7	36	8.6	113	10.4
Muscle and tendon injury to wrist	0	0.0	2	0.3	2	0.3	1	0.2	5	0.5
Wrist dislocation	0	0.0	0	0.0	1	0.1	0	0.0	4	0.4
Injury to the spinal column and cord	0	0.0	10	1.4	42	6.2	41	9.8	74	6.8
Injury to the cervical spinal column and cord	0	0.0	7	1.0	21	3.1	25	6.0	26	2.4
Injury to the thoracic & lumbosacral spinal column and cord	0	0.0	3	0.4	21	3.1	16	3.8	48	4.4
Injury of internal organs	2	0.3	5	0.7	13	1.9	8	1.9	22	2.0
Injury involving the lungs	0	0.0	0	0.0	2	0.3	2	0.5	6	0.5
Injury to the spleen	0	0.0	1	0.1	5	0.7	1	0.2	5	0.5
Injury to the kidneys	0	0.0	0	0.0	3	0.4	2	0.5	4	0.4
Elbow injury	31	4.2	165	23.6	89	13.1	21	5.0	44	4.0
Elbow fracture	25	3.4	151	21.6	79	11.6	12	2.9	26	2.4
Elbow dislocation	6	0.8	14	2.0	10	1.5	7	1.7	10	0.9
Long-bone fracture	14	1.9	52	7.4	93	13.7	16	3.8	45	4.1
Fractured shaft of ulna or radius	8	1.1	26	3.7	33	4.9	2	0.5	8	0.7
Fractured shaft of femur	3	0.4	3	0.4	9	1.3	3	0.7	4	0.4
Fractured shaft of tibia or fibula	3	0.4	21	3.0	48	7.1	7	1.7	21	1.9
Fractured shaft of humerus	0	0.0	2	0.3	3	0.4	4	1.0	12	1.1

(continued)

Table C1.2 (continued): Case numbers and age-specific rates for sport-related injury hospitalisation, by type of injury, females, Australia, 2012–13

	25–34		35–44		45–54		55–64		65+		All ages	
Type of injury	**Number**	**Rate**	**Number**	**Rate**	**Number**	**Rate**	**Number**	**Rate**	**Number**	**Rate**	**Number**	**Rate***
Knee injury	359	22.4	313	19.6	177	11.5	83	6.4	45	2.6	1,727	19.7
Cruciate ligament injury	252	15.7	200	12.5	98	6.4	13	1.0	1	0.1	1,054	12.2
Knee fracture	44	2.7	40	2.5	26	1.7	34	2.6	23	1.4	246	6.9
Knee dislocation	23	1.4	5	0.3	3	0.2	0	0.0	1	0.1	65	1.3
Meniscal tear	32	1.9	44	2.7	35	2.3	28	2.1	9	0.5	225	2.5
Head injury	179	10.8	141	8.7	97	6.3	65	4.9	81	4.6	1,503	17.5
Concussion	49	3.0	48	3.0	32	2.1	7	0.5	3	0.2	448	5.3
Other intracranial injury	10	0.6	13	0.8	16	1.0	11	0.8	17	1.0	103	1.1
Facial fracture	45	2.7	32	2.0	15	1.0	14	1.1	20	1.1	262	3.0
Shoulder injury	68	4.1	82	5.1	60	3.9	64	4.9	92	5.2	520	5.6
Shoulder fracture	24	1.5	34	2.1	45	2.9	48	3.6	56	3.2	291	3.1
Shoulder dislocation	25	1.5	24	1.5	7	0.5	5	0.4	18	1.0	120	1.3
Ankle injury	201	12.2	142	8.8	106	6.8	70	5.3	71	4.0	876	9.8
Unimalleolar ankle fracture	76	4.6	69	4.3	40	2.6	19	1.4	24	1.4	352	4.0
Bi- and trimalleolar ankle fracture	80	4.8	53	3.3	55	3.6	46	3.5	38	2.2	362	4.0
Hip injury	25	1.5	17	1.1	19	1.2	27	2.0	152	8.6	333	3.4
Fractured neck of femur	1	0.1	2	0.1	2	0.1	14	1.1	72	4.1	104	1.0
Pertrochanteric fracture	2	0.1	2	0.1	1	0.1	2	0.2	40	2.3	47	0.4
Acetabular fracture	1	0.1	3	0.2	4	0.3	1	0.1	6	0.3	20	0.2
Hip dislocation	2	0.1	0	0.0	0	0.0	1	0.1	6	0.3	13	0.1

(continued)

Table C1.2 (continued): Case numbers and age-specific rates for sport-related injury hospitalisation, by type of injury, females, Australia, 2012–13

	25–34		35–44		45–54		55–64		65+		All ages	
Type of injury	**Number**	**Rate**	**Number**	**Rate**	**Number**	**Rate**	**Number**	**Rate**	**Number**	**Rate**	**Number**	**Rate***
Wrist injury	188	11.4	194	12.0	159	10.3	178	13.5	200	11.4	1,722	20.2
Wrist fracture	168	10.2	184	11.4	145	9.4	174	13.2	195	11.1	1,684	19.2
Muscle and tendon injury to wrist	7	0.4	5	0.3	6	0.4	2	0.2	2	0.1	32	0.4
Wrist dislocation	1	0.1	0	0.0	0	0.0	0	0.0	0	0.0	6	0.1
Injury to the spinal column and cord	81	4.9	75	4.7	53	3.4	33	2.5	19	1.1	428	4.9
Injury to the cervical spinal column and cord	21	1.3	15	0.9	15	1.0	7	0.5	2	0.1	139	1.6
Injury to the thoracic and lumbosacral spinal column and cord	60	3.6	60	3.7	38	2.5	26	2.0	17	1.0	289	4.9
Injury of internal organs	22	1.3	16	1.0	13	0.8	6	0.5	4	0.2	111	1.3
Injury involving the lungs	13	0.8	6	0.4	8	0.5	4	0.3	3	0.2	44	0.5
Injury to the spleen	1	0.1	1	0.1	3	0.2	0	0.0	0	0.0	17	0.2
Injury to the kidneys	6	0.4	1	0.1	2	0.1	1	0.1	0	0.1	19	0.2
Elbow injury	59	33.6	55	3.4	37	2.4	31	2.4	33	1.9	565	6.6
Elbow fracture	39	2.4	44	2.7	27	1.7	26	2.0	28	1.6	457	5.4
Elbow dislocation	9	0.5	7	0.4	6	0.4	2	0.2	3	0.2	74	0.9
Long-bone fracture	51	3.1	57	3.5	33	2.1	9	0.7	19	1.1	389	4.6
Fractured shaft of ulna or radius	9	0.5	8	0.5	7	0.5	2	0.2	3	0.2	106	1.3
Fractured shaft of femur	2	0.1	7	0.4	4	0.3	2	0.2	10	0.6	47	0.5
Fractured shaft of tibia or fibula	31	1.9	29	1.8	14	0.9	4	0.3	1	0.1	179	2.1
Fractured shaft of humerus	9	0.5	13	0.8	8	0.5	1	0.1	5	0.3	57	0.6

* Age-standardised rate.

Note: Case numbers and age-specific rates for all of the injury types and sub-types included in the report are shown in the table. For some types of injury, but not all, the sub-types in the table include all cases of the parent type of injury, and so the sum of cases of the sub-types shown is equal to the number of cases of the parent type.

Table C1.3: Case numbers, mean length of stay and total bed days for sport-related injury hospitalisation, by type of injury, by sex, all ages, Australia, 2012–13

	Males			Females			Persons		
Nature of injury	**No. of cases**	**MLOS**	**Total bed days**	**No. of cases**	**MLOS**	**Total bed days**	**No. of cases**	**MLOS**	**Total bed days**
Knee injury	3,828	1.8	6,771	1,727	1.6	2,715	5,555	1.7	9,486
Cruciate ligament injury	2,071	1.2	2,412	1,054	1.1	1,198	3,125	1.2	3,610
Knee fracture	608	4.3	2,644	246	3.8	940	854	4.2	3,584
Knee dislocation	116	2.3	264	65	1.9	125	181	2.1	389
Meniscal tear	641	1.1	685	225	1.0	232	866	1.1	917
Head injury	6,020	1.9	11,422	1,503	1.9	2,808	7,523	1.9	14,230
Concussion	1,699	1.2	2,038	448	1.3	583	2,147	1.2	2,621
Other intracranial injury	398	9.3	3,713	103	8.0	824	501	9.1	4,537
Facial fracture	1,793	1.4	2,591	262	1.6	411	2,055	1.5	3,002
Eye injury	99	2.3	227	17	2.1	35	116	2.3	262
Skull fracture	127	3.6	461	22	4.1	90	149	3.7	551
Shoulder injury	2,810	1.4	4,026	520	1.8	956	3,330	1.5	4,982
Shoulder fracture	1,522	1.7	2,513	291	2.2	628	1,813	1.7	3,141
Shoulder dislocation	768	1.2	889	120	1.2	146	888	1.2	1,035
Ankle injury	2,073	2.8	5,781	876	3.5	3,063	2,949	3.0	8,844
Unimalleolar ankle fractures	1,063	2.4	2,557	352	2.6	923	1,415	2.5	3,480
Bi- and trimalleolar ankle fracture	578	3.8	2,199	362	4.8	1,724	940	4.2	3,923

(continued)

Table C1.3 (continued): Case numbers, mean length of stay and total bed days for sport-related injury hospitalisation, by type of injury, by sex, all ages, Australia, 2012–13

	Males			Females			Persons		
Nature of injury	No. of cases	MLOS	Total bed days	No. of cases	MLOS	Total bed days	No. of cases	MLOS	Total bed days
Hip injury	565	4.6	2,600	333	6.1	2,032	898	5.2	4,632
Fractured neck of femur	163	5.1	827	104	8.1	842	267	6.3	1,669
Pertrochanteric fracture	88	6.3	550	47	11.4	537	135	8.1	1,087
Acetabular fracture	80	8.9	711	20	11.4	228	100	9.4	939
Dislocation of hip	63	2.1	134	13	1.8	23	76	2.1	157
Wrist injury	4,059	1.4	5,684	1,772	1.5	2,578	5,831	1.4	8,262
Wrist fracture	3,608	1.4	4,919	1,684	1.5	2,463	5,292	1.4	7,382
Muscle and tendon injury to wrist	186	1.5	274	32	1.3	40	218	1.4	314
Wrist dislocation	63	1.4	90	6	1.3	8	69	1.4	98
Injury to the spinal column and cord	1,079	5.7	6,146	428	3.6	1,554	1,507	5.1	7,700
Injury to the cervical spinal column and cord	63	27.5	1,735	7	15.4	108	70	26.3	1,843
Injury to the thoracic and lumbosacral spinal column and cord	26	18.3	475	4	2.0	8	30	16.1	483
Injury of internal organs	776	4.7	3,664	111	4.6	510	887	4.7	4,174
Injury involving the lungs	342	4.0	1,373	44	4.1	182	386	4.0	1,555
Injury to the spleen	162	5.5	898	17	5.8	98	179	5.6	996
Injury to the kidneys	132	4.7	620	19	3.1	59	151	4.5	679
Elbow injury	1,120	1.7	1,929	565	1.8	989	1,685	1.7	2,918
Elbow fracture	878	1.8	1,545	482	1.8	889	1,360	1.8	2,434
Elbow dislocation	115	1.1	132	49	1.1	56	164	1.1	188
Long-bone fracture	1,631	3.3	5,415	389	2.9	1,136	2,020	3.2	6,551

Note: Case numbers and age-specific rates for all of the injury types and sub-types included in the report are shown in the table. For some types of injury, but not all, the sub-types in the table include all cases of the parent type of injury, and so the sum of cases of the sub-types shown is equal to the number of cases of the parent type.

Appendix D: Further information on coverage of sport-related cruciate ligament injuries

NHMD records for most episodes of hospitalisation for repair of a cruciate ligament injury provide no direct information about whether they are sport-related. This appendix reports the findings of an investigation in which published literature and an aspect of the NHMD data were used to assess the issue.

Clinical coders classify an ACL injury in 1 of 2 ways: by selecting a principal diagnosis from ICD-10-AM 'Chapter 19 Injury, poisoning and certain other consequences of external causes' or a code from 'Chapter 13 Diseases of the musculoskeletal system and connective tissue'. The ICD-10-AM manual specifies that 'current' injuries should be coded to Chapter 19, and 'old' injuries to Chapter 13. (About two-thirds of ACL cases identified in the NHMD are coded to Chapter 13.) Cases coded to ICD chapters other than *Injury* (Chapter 19) are not subject to the requirement that their external cause should be coded, and an activity code assigned. Hence, with very few exceptions, information on whether the condition occurred during sport is not provided for ACL cases coded to Chapter 13. However, an estimate of sport-related hospitalised ACL injury that does not take account of the cases coded to Chapter 13 could be incomplete.

Are there grounds to think that those records include a noteworthy number of ACL cases that are due to sport? If so, do the Chapter 13 records refer to further episodes of care for people already represented in the hospital data by records with a principal diagnosis from Chapter 19 (and so include in the case counts in this report), or do they represent additional cases of people with ACL injury who are not already included?

The best way to approach this question would be to use record-linked hospital data, in which it should be straightforward to identify the records that refer to the episodes of admitted patient care that were provided to each person. However, record-linked data were not available for this project, and the assessment reported here made use of 2 other types of information, which provide a useful but less satisfactory basis for assessing the matter. These are information on how clinical coders decide how to code cases; and information in the NHMD records on waiting time for surgery to treat ACL injuries. (Note that, in the latter case, our focus is not on counting procedures for ACL, but on using data on waiting time for procedures as a basis for comparing the likely recency of onset of ACL injury cases coded to the 2 chapters of ICD-10-AM.)

How do coders decide whether an ACL case is 'current' or 'old'? An ICD-10-AM coding standard (number 1319) recommends that, when there is no information in relation to whether the injury is 'current' or 'old', coders should attempt to clarify this with the clinician, but they should generally assume that the injury is 'old' unless it is specified as being 'acute'.

To gain further clarification, we contacted the National Centre for Classification in Health at the University of Sydney. The Classification Support Manager confirmed that cases that were admitted to hospital soon after having been injured should be regarded as 'current', and be coded to Chapter 19. Where a longer period of time had elapsed between sustaining the injury and being admitted to hospital for a knee reconstruction, cases were deemed to be 'old'. However, no strict definition exists for 'current' versus 'old' injuries.

In practice, surgery is often not done immediately after ACL injury, but is delayed until after swelling has subsided and the knee joint has resumed a normal range of motion (Granan et al. 2009a). The great majority of ACL cases in the NHMD had been admitted for surgery. Perhaps the length of time from injury to repair affects whether cases are seen as 'current' or 'old'.

We did not find a report on time to ACL repair in Australia, so we looked at reports on practice elsewhere.

There is little consensus among clinicians regarding the optimal timing for reconstruction (Kennedy et al. 2010). Hospitals in 3 Scandinavian countries (Norway, Sweden and Denmark) contribute to national registries of ACL reconstructions (Granan et al. 2009b). There is a high level of compliance in all 3 countries with the requirement to contribute data, ranging from 71% to 97% of institutions that carry out these procedures. The median time to surgery was 7, 9 and 10 months in Norway, Denmark and Sweden, respectively.
520 patients who underwent ACL reconstruction at a large urban medical centre in the US were each followed for 3 years after their diagnosis (Collins et al. 2013). It was found that 86% had their procedure within 6 months of their diagnosis, and 94% within 1 year. Because the coding of cases of cruciate ligament injury, and the availability of an activity code, hinges on their status of being either 'current' or 'old', the likelihood is that some cases will be designated 'old', or default to Chapter 13 codes, although an ACL reconstruction after an injury is sustained is performed in what would be considered, clinically, to be a normal time frame after a new injury.

To investigate this, we selected a subset of cases that had undergone a knee reconstruction. Waiting time information present in the NHMD made it possible to estimate the minimum time that had elapsed between an injury and its repair. (It should be noted that this information is restricted to elective surgery in public hospitals—which made up a minority of the elective knee reconstructions.) When we compared the duration of the waiting time for surgery for the cases with an *Injury* principal diagnosis, and those that had been coded to Chapter 13, we found considerable similarity (see Figure D.1). Some cases that had been on the waiting list for 10–11 months were assigned an *Injury* principal diagnosis: that is, they were treated as being 'current'. The results of this analysis are shown in Figure D.1.

We cannot directly measure time from injury to repair using NHMD data. Also, we have not found Australian studies on that duration. It seems likely, however, that Australian practice would be similar to that reported for the United States and Scandinavia (that is, ACL repair occurs from several weeks to about 1 year after ACL injury in most cases).

It thus seems likely that similar cases can be coded either to the 'Musculoskeletal conditions' chapter (Chapter 13) or to the 'Injury' chapter (Chapter 19), and that many cases of ACL injury coded to Chapter 13 were, in fact, due to sport.

While we have restricted ourselves to using injury cases for our report, it is possible that this underestimates the true number of hospitalised sport-related cruciate ligament injury. This is partly due to some cases being coded to Chapter 13, but also because an unknown proportion of knee reconstructions are performed as outpatient procedures. There is also the more general problem that *Activity* is not coded at all, or is coded in a way that does not reveal the sport-relatedness of many cases.

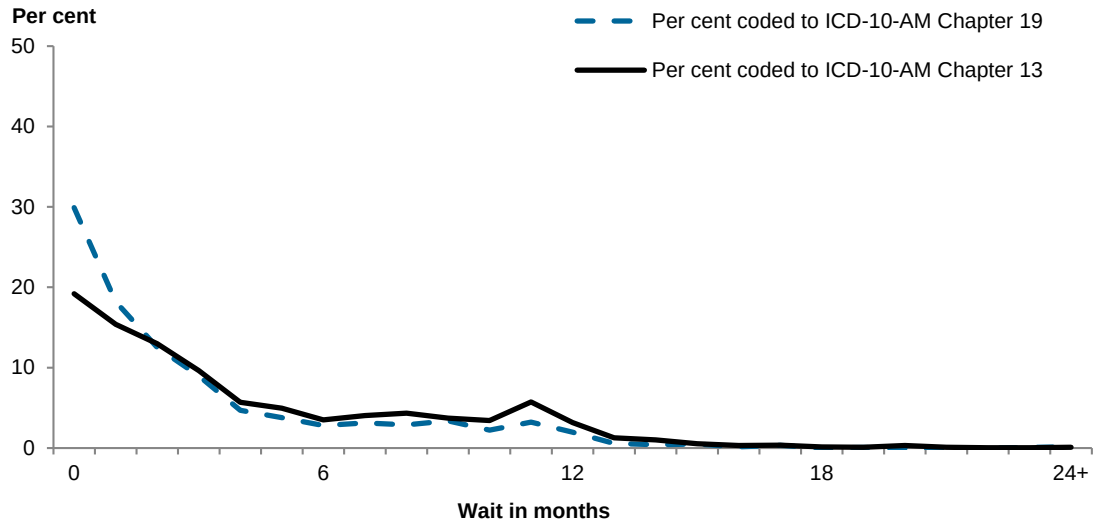


Figure D.1: Percentage of knee reconstructions coded to ICD-10-AM Chapter 13 *Diseases of the musculoskeletal system and connective tissue* vs Chapter 19 *Injury, poisoning and certain other consequences of external causes*, by the waiting time for the procedure

Some ACL cases may have been admitted soon after injury and again later, for reconstructive surgery. Cases might also be admitted for revision of a reconstruction. Record linkage could be used to measure the extent of these patterns of care.

We found an example of a study that used Injury cases as well as those coded to Chapter 13, in order to estimate the incidence of sport-related ACL injury in Australia (Janssen et al. 2012). The 2012 study arrived at an annual average estimate of ACL injury hospitalisation in excess of 7,200 cases per year, which is substantially greater than the number of cruciate ligament injury cases with an activity code for *Sport* in 2112–13 (3,125).

A difficulty for Janssen et al. (2012) was that activity codes, which are used to identify sport-related cases, are normally assigned to cases with a principal diagnosis taken from ICD-10-AM Chapter 19 (*Injury*). The authors sought to overcome this by using a pro-rata approach, assigning as 'sport-related' the same proportion of ACL cases without an activity code as was observed among the ACL cases with an activity code. The validity of this approach is, however, uncertain.

Glossary

Definitions in the Glossary contain an identification number from the Metadata Online Registry (METeOR). METeOR is Australia's central repository for health, community services and housing assistance metadata, or 'data about data'. It provides definitions for data for health and community services-related topics and specifications for related national minimum data sets (NMDS), such as the NMDS that form the basis of this report. METeOR can be viewed on the AIHW website at <www.aihw.gov.au>. For further information on the terms used in this report, refer to the definitions in the *National health data dictionary,* version 16 (AIHW 2012b).

activity when injured: The type of activity being undertaken by a person at the time of injury. METeOR identifier: 391320.

acute: Having a short and relatively severe course.

acute care: See **care type**.

acute care hospital: See **establishment type**.

admitted patient: A patient who undergoes a hospital's admission process to receive treatment and/or care. This treatment and/or care is provided over a period of time and can occur in hospital and/or in the person's home (for **hospital-in-the-home** patients). METeOR identifier: 268957.

age-standardisation: A set of techniques used to remove, as far as possible, the effects of differences in age when comparing 2 or more populations.

care type: The overall nature of a clinical service provided to an admitted patient during an episode of care (*Admitted care*), or the type of service provided by the hospital for boarders or posthumous organ procurement (*Care other than admitted care*). METeOR identifier: 491557.

Admitted patient care is categorised as:

- acute care
- rehabilitation care
- palliative care
- geriatric evaluation and management
- psychogeriatric care
- maintenance care
- newborn care
- other admitted patient care (where the principal clinical intent does not meet the criteria for any of the above).

Care other than admitted care categories include:

- posthumous organ procurement
- hospital boarder.

episode of care: The period of admitted patient care between a formal or statistical admission and a formal or statistical separation, characterised by 1 care type (see **care type** and **separation**). METeOR identifier: 491557 (Care type), METeOR identifier: 268956 (Episode of admitted patient care).

establishment type: Type of establishment (defined in terms of legislative approval, service provided and patients treated) for each separately administered establishment. METeOR identifier: 269971.

external cause: The environmental event, circumstance or condition as the cause of injury, poisoning and other adverse effect. METeOR identifier: 514295.

hospital: A health-care facility established under Commonwealth, state or territory legislation as a hospital or a free-standing day procedure unit and authorised to provide treatment and/or care to patients. METeOR identifier: 268971.

International Classification of Diseases and Related Health Conditions (ICD): The World Health Organization's internationally accepted classification of diseases and related health conditions. The tenth revision, Australian modification (ICD-10-AM), is currently in use in Australian hospitals for admitted patients.

length of stay: The length of stay of an overnight patient is calculated by subtracting the date the patient is admitted from the date of separation and deducting days the patient was on leave. A same-day patient is allocated a length of stay of 1 day. METeOR identifier: 269982.

mode of admission: The mechanism by which a person begins an episode of admitted patient care. METeOR identifier: 269976.

mode of separation: Status at separation of person (discharge/transfer/death) and place to which person is released (where applicable). METeOR identifier: 270094.

patient days: The total number of days for all patients who were admitted for an episode of care and who separated during a specified reference period. A patient who is admitted and separated on the same day is allocated 1 patient day. METeOR identifier: 270045.

principal diagnosis: The diagnosis established, after study, to be chiefly responsible for occasioning an episode of admitted patient care; an episode of residential care; or an attendance at the health-care establishment. METeOR identifier: 514273.

private hospital: A privately owned and operated institution, catering for patients who are treated by a doctor of their own choice. Patients are charged fees for accommodation and other services provided by the hospital and relevant medical and paramedical practitioners. Acute care and psychiatric hospitals are included, as are private free-standing day hospital facilities. See also **establishment type**.

public hospital: A hospital controlled by a state or territory health authority. Public hospitals offer free diagnostic services, treatment, care and accommodation to all eligible patients. See also **establishment type**.

same-day patient: An admitted patient who is admitted and separated on the same date.

separation: An episode of care for an **admitted patient**, which can be a total hospital stay (from admission to discharge, transfer or death) or a portion of a hospital stay beginning or ending in a change in type of care (for example, from acute care to rehabilitation).

Separation also means the process by which an admitted patient completes an episode of care either by being discharged, dying, transferring to another hospital or changing type of care.

separations: The total number of episodes of care for admitted patients, which can be total hospital stays (from admission to discharge, transfer or death) or portions of hospital stays beginning or ending in a change of type of care (for example, from acute to rehabilitation) that cease during a reference period. METeOR identifier: 270407.

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Related publications

AIHW: Kreisfeld R, Harrison JE, & Pointer S 2014. Australian sports injury hospitalisations 2011–12. Injury research and statistics series no. 92. Cat. no. INJCAT 168. Canberra: AIHW.

This report focuses on acute care services provided by hospitals for sports injuries treated in Australian hospitals in 2012–13. Cases of sports injury are examined in terms of the body region injured. Of the selected injury types, Head injury was the most common, accounting for 16% of all hospitalised sport-related cases. Injury to the knee accounted for 12% of hospitalised sports injury.

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