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Hospital separations due to traumatic brain injury, Australia 2004–05

Yvonne Helps, Geoff Henley and James Harrison

Flinders UNIVERSITY

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Yvonne LM Helps
Geoff Henley
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James E Harrison

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Any enquiries about or comments on this publication should be directed to:

Geoff Henley
Research Centre for Injury Studies
Flinders University of South Australia
GPO Box 2100,
Adelaide 5001, South Australia

Phone: (08) 8201 7602
email: nisu@flinders.edu.au

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Contents

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Executive summary

Traumatic Brain Injury (TBI) is characterised by a blow or other force to the head which results in damage to the brain or an alteration in brain function.

This report covers hospitalisations in Australia in 2004–05 where traumatic brain injury (TBI) was the principal diagnosis (62.5% of TBI-related cases), injury cases with TBI as an additional diagnosis (26.1% of cases), and other TBI cases (11.4%).

There were an estimated 22,710 hospitalisations involving traumatic brain injury in Australia in 2004–05. These hospitalisations resulted in over 26,000 episodes of inpatient care totalling nearly 206,000 days, and estimated direct costs of hospital care of $184 million.

Trends

Hospitalisation rates for TBI as a principal diagnosis remained stable from 1999–00 to 2004–05.

A 7% increase was seen over the same period for injury cases with TBI as an additional diagnosis.

For 'other TBI' cases there was a 33% increase in rates between 1999–00 and 2004–05, but this was off a low base, i.e. these rates were low at less than one-sixth the rates of TBI as a principal diagnosis.

Age and sex distribution

In 2004–05, for cases with TBI as a principal or additional diagnosis, rates of hospitalisation for males per 100,000 population were two and a half times those for females. For 'other TBI' cases, the rate for males was about double the female rate.

The higher rates for males applied across all age groups.

Rates of hospitalisation for TBI were highest for youth and young adults, and for seniors. For 'other TBI' cases, the highest rates occurred in people aged 75 years and over.

Causes of brain injury

The most common causes of brain injury in cases with TBI as principal diagnosis were falls (42%), transportation (29%) and assault (14%). Where TBI was an additional diagnosis, the most common causes were the same, but with transportation (42%) more common than falls (30%) and assault (16%).

More females than males sustained TBI caused by falls; and much higher numbers of males than females sustained TBI caused by assault. Transportation accounted for equal proportions of TBI among males and females.

Activity at the time of injury was recorded for about 47% of TBI cases. Among the cases where activity was recorded, sport was most commonly specified, particularly football.

Severity and survival

Concussion, and brief loss of consciousness (less than 30 minutes), occurred for many TBI patients: 60% of principal diagnosis cases; 59% of additional diagnosis cases, and 34% of 'other TBI' cases.

Only 1.2% of patients in these groups experienced a loss of consciousness of prolonged duration (more than 24 hours).

Overall, 4.3% of TBI cases resulted in death. Almost 12% of cases admitted with an intracranial injury (e.g. haemorrhage, haematoma) died in hospital compared with less than 1% of TBI cases without intracranial injury.

Abbreviations

ABS	Australian Bureau of Statistics
ABS-CDC	ABS Causes of Death Collection
ABI	Acquired Brain Injury
ALOS	Average length of stay
AIHW	Australian Institute of Health and Welfare
CDC	Centers for Disease Control
DRGs	Diagnosis Related Groups
ED	Emergency Departments
GCS	Glascow Coma Scale
ICD	International Classification of Diseases
ICD-10-AM	International Classification of Diseases, version 10, Australian modification
ICISS	ICD–based Injury Severity Score
LOC	Loss of Consciousness
LOS	Length of stay in hospital
NCIS	National Coroners Information System
NHMD	National Hospital Morbidity Database
NISU	National Injury Surveillance Unit
NOHSC	National Occupational Health and Safety Commission
PTA	Post Traumatic Amnesia
RCIS	Research Centre for Injury Studies
SRR	Survival Risk Ratio
TBI	Traumatic Brain Injury
USA	United States of America
WHO	World Health Organization

1 Introduction

Background

Traumatic Brain Injury (TBI) is a leading cause of hospitalisation, disability, and death worldwide (Laurer et al. 2000; Bruns & Hauser 2003; Hukkelhoven et al. 2003). In Australia this type of injury affects tens of thousands of people every year. In an AIHW report on hospital separations data for the 1996–97 collection period, 27,437 stays for TBI were found, at a rate of 149 hospitalisations per 100,000 population (Fortune & Wen 1999). The report found that nearly 70% of hospitalised TBI records were for males, that nearly 60% of all separations were for persons aged 15–64 (those most likely to be engaged in the workforce), and that persons aged 15–19 had the highest age-specific rate of TBI (284 per 100,000 population). This report also found that 3% of TBI patients died in hospital during the reporting period. Fortune and Wen cite the work of Kraus, who estimated that of people with newly incident cases of traumatic brain injury who are discharged from hospital alive, 16.4% will go onto experience long term disability (Kraus 1987).

The most recent report to include national Australian data on TBI reported that of the 21,800 hospital separations in 2004–05 included in their selection criteria as being for TBI, almost 12,000 cases used specialist disability services post trauma (AIHW 2007). Where the ICD-10-AM codes within the selection criteria for TBI were reported as a Principal or Additional Diagnosis code, the bulletin found that the overall rate of hospitalisation between 1999–00 and 2004–05 remained at about 107 separations per 100,000 population per year (AIHW 2007). It was noted that within the 0–14 years age group, the age-standardised rate over the same period declined from 120 to 93 separations per 100,000 population, and that the rate for people aged 45–64 years increased from 58 to 66 separations per 100,000 population, while the rate for people aged 65 years and older rose from 118 to 153 separations per 100,000 population.

Purpose

This report describes the occurrence, severity and circumstances of TBI in Australia for the data collection period 2004–05. A literature review describes TBI from an international and national perspective. The groups of injury types that result in TBI, and selection criteria for those groups in this report are similar, but not the same, as the coding definitions used by Fortune and Wen, and the most recent bulletin described above. The definition and description of the TBI injury groups in this report have the potential to more fully describe the injury experience of TBI cases than has previously been attempted, with analysis of different combinations of injury type, consideration of severity of injury, burden on the hospital system, and cost. The major External causes and mechanisms of injury are examined to provide a more in depth understanding of the nature and outcomes of TBI, and analyses are provided by sex and age groups in counts, proportions, and rates where appropriate. Severity of TBI injury is analysed by several means, and the burden and cost of injury on hospital and services is discussed.

Literature review

Brain injury and TBI

Brain injury can be one of the most devastating types of harm to humans, who rely on cognition, emotion, behaviour and memory, as well as physical abilities, in order to function and prosper (Boon & de Montfort 2002). Acquired brain injury (ABI) is most commonly associated with misuse or abuse of drugs and alcohol, stroke, tumour or haemorrhage, and a number of other diseases and disorders (Novack 1999; Brain Injury Association of Queensland Inc. 2006).

In contrast, Traumatic Brain Injury (TBI), the subject of this report, is characterised by an external assault to the head that results in damage to the brain. This might be in the form of a blow or blunt force (perhaps caused by an assault or a fall), or may be caused by rapid back and forward motion as might be experienced in rapid or sudden deceleration (as in a motor vehicle accident).

Bruns and Hauser make a distinction between head injury and TBI:

'Confusion exists regarding head injury (HI) and TBI. HI is a non-specific and antiquated term, which includes clinically evident external injuries to the face, scalp, and calvarium, such as lacerations, contusions, abrasions, and fractures, and may or may not be associated with TBI. TBI injury is more properly defined as an alteration in brain function manifest as confusion, altered level of consciousness, seizure, coma, or focal sensory or motor neurologic deficit resulting from blunt or penetrating force to the head. In mild TBI, subtle behavioural and neuropsychological changes may be the only symptom(s)' (Bruns & Hauser 2003).

Dawodu also seeks to clarify:

'Traumatic Brain Injury (TBI) is a non-degenerative, non-congenital insult to the brain from an external mechanical force, possibly leading to permanent or temporary impairments of cognitive, physical, and psychosocial functions with an associated diminished, or altered state of consciousness.

The definition of TBI has not been consistent and tends to vary according to specialties and circumstances. Often, the term brain injury is used synonymously with head injury, which may not be associated with neurological deficits. The definition also has been problematic with variations in inclusion criteria' (Dawodu 2005).

Any assault to the head that involves concussion, and a period of loss of consciousness no matter how brief, has the potential for injury to the brain. It is also possible to sustain a major insult and even open brain injury (that is, where the skull is breached and exposed to the air), such as a gunshot wound, and not suffer loss of consciousness (Novack 1999). Concussion is, however, relatively common among TBI cases, and is the result of an alteration of consciousness, which often results in a period of unconsciousness, and may cause headaches, disrupted vision, lack of co-ordination and vertigo (Centre for Neuro Skills 2006).

Definition of TBI for statistical reports

For most statistical reports involving TBI, especially those involving hospital discharge data, case inclusion is normally based on a range of ICD codes. In 1995, the Centers for Disease Control and Prevention (CDC) derived a series of diagnostic categories based on ICD-9 or ICD-9-CM to be used in their TBI surveillance studies (Thurman et al. 1995). The following diagnostic codes were included in the definition of TBI:

- 800.0–801.9 Fracture of the vault or the base of the skull
- 803.0–804.9 Other and unqualified and multiple fractures of the skull
- 850.0–854.1 Intracranial injury, including concussion, contusion, laceration, and haemorrhage

In 2002, the International Collaborative Effort (ICE) on Injury Statistics, an international activity sponsored by the CDC's National Centre for Health Statistics, developed the Barell Injury Diagnosis Matrix (Barell et al. 2002). This matrix, based on ICD-9-CM, further subdivided TBI cases into three subcategories based on the presence of various combinations of TBI-related codes. For example, Type 1 TBI cases exclude cases where a skull fracture was present without mention of an intracranial injury, but also includes cases with injuries to the optic nerves and pathways. Most previous statistical TBI reports have generally included cases based on the ICD-9 or ICD-9-CM code ranges indicated above, although some minor variations do occur. Few previous reports have been based on ICD-10 coding.

This report includes cases based on the presence of the ICD-10-AM code for intracranial injury (S06). This inclusion criterion correlates closely to the Type 1 TBI category as contained in the Barell Matrix, in that it excludes cases which sustained a skull fracture, but where no intracranial injury was reported.

Measures of severity of TBI

Concussion, and the duration of concussion, are markers of severity of trauma. Duration of periods of Post Traumatic Amnesia (PTA) may be used as a measure of severity (Novack 1999). Duration of PTA (using the Westmead PTA Scale (Shores et al. 1986)) is often used in conjunction with the Glasgow Coma Scale (GCS) in determining severity of TBI (Khan et al. 2003). Mild cases are characterized by a GCS of between 12 and 15, and may have a PTA of less than 24 hours, moderate cases are defined as having a GCS of 9–11 and a PTA of 1–7 days duration. Severe cases are defined as recording a GCS of 3–8, and PTA of 1–4 weeks duration, and very severe cases are defined as those with having a PTA of more than four weeks duration (Cripps 2007). The Westmead PTA Scale has also been used to monitor memory recovery post mild TBI (Ponsford et al. 2004). Since the hospital discharge data used for this report did not include information on PTA or GCS scales, neither of these measures were utilised to determine the severity of TBI for any of the included cases.

Primary and secondary injury

Cerebral insult due to trauma is generally defined in terms of primary (damage at the time of the injury event that is irreversible) and secondary injury (injury developing post trauma, that may result in extended damage and diminished neurological outcome), with medical management and intervention targeting secondary injury mechanisms to increase recovery outcomes (Laurer et al. 2000; Finfer & Cohen 2001; Boon & de Montfort 2002; Khan et al. 2003). It has been reported that interaction between coexisting secondary injuries that may initiate at different intervals post trauma, can result in cell death (Vink & Van Den Heuvel 2004). Research in clinical neuroscience has advanced understanding about the nature and evolution of primary injury. While preventing secondary injury remains the patient management focus, it is now more commonly recognised that primary injury may not be a single, irreversible and discrete event, but may be initiated at the time of an external insult, and develop over hours or days (Reilly 2001). If this is indeed the case, it is predicted that whilst the focus of treatment will remain preventing secondary injury, that interrupting the progress of the primary injury will become the next research and treatment challenge, most likely through advances in cellular biology (Reilly 2001).

TBI in populations

In the United States, South Africa, China, Australia and France, it has been reported that males are at higher risk of TBI than females, and that the highest risk is for assault or motor vehicle injury to adolescent and young adult males (Finfer & Cohen 2001; Bruns & Hauser 2003; Khan et al. 2003). Other studies also report that in the more economically developed countries, TBI is the largest cause of death and disability in youth and young adults (Hukkelhoven et al. 2003).

As well as a peak for TBI hospitalisations in the late teens and early adult years, a second peak has been reported in the elderly, with road accidents, falls and assaults being the top three mechanisms of injury (Finfer & Cohen 2001; Bruns & Hauser 2003; Dawodu 2005). Alcohol use has also been reported as an important factor in all causes (Finfer & Cohen 2001).

There has been little previous research into the epidemiology of TBI among Indigenous Australians. However, a recent study found that the rate of head injury due to assault among Indigenous Australians was 21 times higher than the equivalent rate for non-Indigenous Australians (Jamieson et al. 2008).

Lasting effects of TBI

Depression, mood anxieties and psychiatric disorders can result from TBI, and can impede recovery, affect relationships, and diminish quality and enjoyment of life. Depression has been reported to be a frequent consequence of TBI, with severe depression more likely for those cases where mood and anxiety disorders were present before the injury, and that major depression was associated with reductions in memory and executive functioning (Jorge et al. 2004). When compared to a non-injured control group, TBI sufferers had higher rates of psychiatric illness than those without injury, and those patients with severe TBI had higher rates of psychiatric illness than those with mild TBI, in the year following the injury event (Fann et al. 2004). The same study found that substance abuse initially decreased after TBI for those patients with a psychiatric history, perhaps as a consequence of increased health care contacts and was found to increase after the first year post trauma, while for patients with no prior psychiatric disorders, there was an increase in substance misuse post trauma that declined during the first year post trauma (Fann et al. 2004). Another study found that alcohol abuse and or dependence was more frequent among TBI patients with mood disorders emerging in the twelve months post trauma, and that the frequency of mood disorders was significantly higher in patients who relapsed into alcohol abuse or dependence (Jorge et al. 2005). The study also found that the rate of return to work post trauma was significantly lower for those who were alcohol abusers or alcohol dependent, and worse still for those who also developed mood disorders (Jorge et al. 2005). An association between TBI and resultant mental orders, susceptibility to alcoholism and likelihood of progression to criminality was found in a Finnish study (Timonen et al. 2002). The birth cohort study looked at crimes committed by members of the study aged 15 years and older, and divided the types of criminal activity into those who had been convicted twice or more for drunk driving, and those convicted of all other crimes. It found that convicted persons who had sustained their TBI prior to twelve years of age commenced criminal activity sooner than those offenders who received the TBI after that age (Timonen et al. 2002). Severity of TBI as an indicator for higher risk of criminality as well as for psychiatric disorders and alcoholism was also explored, and although a crude measure showed a positive correlation, the result was not conclusive (Timonen et al. 2002).

Continuity of treatment after acute care, and ongoing rehabilitation of TBI sufferers in Australia are often responsibilities undertaken by families, and often co-ordinated by the family's general practitioner (Khan et al. 2003).

Family life, personal relationships and earning capacity can be adversely affected, and recovery compared to previous levels of functioning vary with the type and severity of cases (Khan et al. 2003). Changes in the level of cognition, and the behaviour of the sufferer can affect personal interaction, and disrupt work and study ability to the extent that these deficits can be more debilitating than lingering physical impairments (Khan et al. 2003).

The ability to drive a vehicle can aid return to society, to work and to resumption of normal leisure and social activities. As might be expected, people with mild or less severe TBI are more likely to resume driving after the recovery period than those persons with severe injury. In an English study that surveyed 563 patients with TBI in ten rehabilitation centres within the first year after the injury, it was reported that 37% of previous drivers had resumed driving, 11% had received a legal ban on driving (mainly due to risk of epilepsy and seizures), and 5% had been advised not to resume driving by a clinician (Hawley 2001). The same study found that of those currently driving, 48% reported experiencing aggression, irritability and difficulty in controlling anger, and memory difficulties were reported by 64% of people (Hawley 2001). Concentration and attention lapses (28% of cases), dizziness (30% of cases), balance and co-ordination problems (13% of cases) and proneness to depression (22% of cases) were reported by injured persons, and carers reported personality changes in 14% of cases and lack of insight in 9% of cases (Hawley 2001).

It has been suggested (and debated) that there is an increased risk of early onset of neurological diseases in predisposed patients who suffer repetitious TBI through situations such as some types of sport, domestic violence situations and perhaps work related activities (Lancon et al. 1998; Laurer et al. 2000). Behavioural impairment in neurological function and deficits in cognition can occur up to years post trauma, and are seen to be the most persistent effects of TBI (Laurer et al. 2000).

Co-morbid conditions

Injuries other than that which caused the TBI are often associated with the TBI event. A 2004 study found that co-morbid injuries were not related to increased risk of onset of psychiatric illness, regardless of whether or not the patient had a psychiatric history (Fann et al. 2004). Other trauma associated with TBI is often referred to as poly trauma. Trauma victims may sustain injury to other parts of the body, such as blunt trauma to the chest, which may cause dysfunction to the lungs or heart, and require immediate and specialist care, further complicating the diagnosis and treatment of the TBI (National Institute of Neurological Disorders and Stroke 2007). It has also been reported that a serious and relatively common complication of TBI is a condition that inflames and degenerates stomach tissue (erosive gastritis), which can increase the risk of aspiration pneumonia through bacterial growth in the stomach (National Institute of Neurological Disorders and Stroke 2007).

Pre-existing co-morbid and chronic conditions such as arthritis, coronary disease, hypertension and diabetes in older people also negatively impact on TBI recovery and outcomes (Thompson et al. 2006).

TBI in infants and children

Shaken baby syndrome has long been debated, with contention about whether shaking on its own can generate acceleration that can injure (shaking-whiplash injury) or even kill a baby, or whether a contact injury is necessary to inflict TBI (Lancon et al. 1998; Saternus et al. 2000; Goldsmith & Plunkett 2004; Hyme 2005). A study that analysed the self reports of perpetrators of violence to babies and children found that most assaults were shakes without impact, that symptoms were immediate, and that none of the infants studied returned to normal function and behaviour post trauma (Starling et al. 2004). In the ICD-10-AM coding used in Australian hospital records, there is no code that relates directly to Shaken baby or shaken infant syndrome (Waller 2006). In the ICD-9-CM codes used in the USA, the code 995.55 *Shaken infant syndrome* is quite specific as a diagnosis. In the Australian (ICD-10-AM) classification this code maps most closely to T74.1 *Maltreatment syndrome, physical abuse. Battered: baby or child syndrome NOS, spouse syndrome NOS* which includes children and adults, and is a very non-specific code (Waller 2006).

While recovery after TBI is usually reported to be better in children, deficits in higher cognitive functioning may not be apparent until later in their development (Khan et al. 2003). A longitudinal cohort in Canada reported that the risk of subsequent head injury within 12 months of the first head injury is higher than for children who seek care for injuries not related to the head (Swaine et al. 2007).

A study of children presenting with mild traumatic head injury to two major hospitals in Melbourne, Australia investigated cognitive and behavioural outcomes one week, and three months, post presentation (Ponsford et al. 1999). The study used the Westmead PTA Scale to monitor children aged 7–15 years, and the Children's Orientation and Amnesia Test (COAT) to monitor six year olds, and other tests were used to monitor behavioural and post concussive outcomes. When compared to a control group (of children presenting to the same hospitals with non-head injuries) at one week post presentation, the injured children reported significantly higher frequencies of headaches and dizziness, and a smaller, but still significant, higher frequency of fatigue was also reported (Ponsford et al. 1999). At three months post presentation, the control and injury groups were again compared.

While most children in the injury group reported that their symptoms had resolved, 17% of the injured children still reported cognitive and behaviour problems persisting, and it was found that these children were more likely to have suffered previous head injury, and to have learning difficulties, pre-morbid stressors (such as family breakdown, being teased at school), or neurological or psychiatric problems (Ponsford et al. 1999).

A study in the United States reported similar results; a group of 8–15 year old children with mild closed head injury were monitored at one week, and at three months post presentation. When compared to non-injured siblings after three months, the injured children reported higher frequencies of headaches, dizziness, low energy levels, and difficulty in concentrating and remembering (Yeates et al. 1999). The study discussed pre-morbid stressors contributing to the outcomes of the injured children, and also found that injured children who showed increases in post-concussive symptoms resulted in deficits on some neuropsychological measures (Yeates et al. 1999).

A study of all hospitalisations for head injury in 0–15 year olds in the state of Victoria, Australia, during 2002 and 2003 reported that the Glasgow Coma Scale on presentation was a reliable predictor of outcome (Mitra et al. 2007). The study found that low GCS was associated with poorer outcomes, higher need for rehabilitation, and lower visual memory scores. A GCS of three was associated with a significantly higher Injury Severity Score (ISS), longer stay in hospital, and higher incidence of mortality (Mitra et al. 2007). Of cases reported as having died in hospital in that period, all had presented with a GCS of 3 (Mitra et al. 2007).

A North American study that investigated adverse effects on intellectual development and academic achievement in children between five and six years post trauma, found that there were significant and persistent deficits in intellectual development and in academic development and performance in children who sustained a TBI prior to six years of age (Ewing-Cobbs et al. 2006). Negative outcomes noted in the study included nearly fifty per cent of the TBI group failing a school grade, or requiring placement in specialist help groups. The study found that early years TBI sufferers had an eighteen times higher risk of unfavourable academic performance than children who had not previously suffered TBI, and had lower IQ scores than their non-TBI counterparts, which did not increase over time (Ewing-Cobbs et al. 2006). Verbal ability and fluency, working memory and problem solving capabilities are also later and long term effects of TBI that has occurred in early to middle childhood (Brookshire et al. 2000). The Ewing-Cobbs study noted that proper use of infant and child restraints had the potential to significantly reduce motor vehicle injury, and also recommended parenting programs to reinforce positive behaviours to reduce TBI and other injuries related to assault (Ewing-Cobbs et al. 2006).

An Australian prospective study of young children having incurred a TBI examined intellectual, language and memory capabilities immediately post injury, and at 12 months and 30 months post trauma (Anderson et al. 2004). The study found that there was a strong relationship between the severity of the injury and resultant function of all neuro-behavioural spheres, and further, that low socioeconomic status increased the risk of long term impairment where injuries were severe, and where pre-trauma function was lower than the cohort (Anderson et al. 2004).

TBI in older adults

Post recovery outcomes after TBI are known to be more negative in older people (Hukkelhoven et al. 2003). In a study examining injury outcome at six months post presentation, the mortality rate for patients aged less than 35 years was 21%, while the mortality rate was 72% for patients aged 65 years and older, and of those surviving patients, the proportions of unfavourable outcomes (vegetative state and severe disability) were 39% for those aged up to 35 years, and 85% for those case aged 65 years and older (Hukkelhoven et al. 2003). While traffic accidents and assault are the main mechanisms of injury in younger people, falls are the foremost mechanism of TBI in older people, followed by traffic accidents as pedestrians, drivers or passengers (Thompson et al. 2006). As with younger age groups, males are overrepresented in TBI compared to females (Thompson et al. 2006), but it has been reported that the rate ratio is lower where the mechanism of injury is a fall, as the risk for both sexes is more similar in older age (Dawodu 2005). Thompson points out that risk factors for older adults include the increase in adherence of the dura (brain covering) to the skull, and the increased likelihood of older people regularly taking aspirin or other anticoagulants, and that when combined with common mechanisms of TBI such as a fall or a traffic accident, can increase the likelihood of secondary (post trauma) injury (Thompson et al. 2006). Hospital stay is longer for older patients, increasing the cost burden of their injury, and mortality rates for older people (55years plus) suffering mild or severe TBI have been predicted to be many times higher than for younger TBI sufferers (Hukkelhoven et al. 2003; Thompson et al. 2006).

Case selection

This report is based on Australian hospital separations for the period 2004–05. The data is drawn from the Australian Institute of Health and Welfare (AIHW) National Hospital Morbidity Database (NHMD). A hospital separation is defined as:

…the process by which an episode of care for an admitted patient ceases. A separation may be formal or statistical.

(National Health Data Committee 2003)

The cases in this report were coded to the fourth edition of the ICD-10-AM (NCCH 2004) in all jurisdictions of Australia. For this report on hospitalised traumatic brain injury, the following broad selection criteria were used:

- Australian hospital separations reported as occurring during the period 1 July 2004–30 June 2005, and
- Occurrence in any diagnosis field of an S06 ICD-10-AM code.

In this report, a case is considered to be a Traumatic Brain Injury (TBI) case if it has a code in the S06 range (see Table 1.2) occurring in at least one of the fifty available diagnosis fields. The broad inclusion criterion above determines that every record considered in this report will contain at least one code in the S06 group, a proportion of which appear as the Principal Diagnosis.

From the broad selection criteria, three specific sets of records were examined. These groups were;

1. Records where the Principal Diagnosis code is S06 (Table 2.3). Since Principal Diagnosis is the condition considered to most completely explain the episode in hospital, these cases can be regarded, with some confidence, as being ones where hospitalisation has occurred because of TBI. This group is the subject of Chapter 2.
2. Records where the Principal Diagnosis code is for another injury (that is, in the range S00–S05, S07–T75, T79) provided that S06 appears as an Additional Diagnosis code (Table 3.3). Injury was the main explanation for these episodes of in-hospital care, and TBI was recorded as being present. TBI alone might not account for the admission, although an injury to the head was the Principal Diagnosis for a little over half of these cases. They are the subject of Chapter 3.
3. Other records in which S06 appears as an Additional Diagnosis code (Table 4.3). This group is smaller than the others. About forty per cent of these cases have Principal Diagnosis codes for diseases, many of which sometimes result in falling or collapse. Another fifteen per cent have fainting, collapse or otherwise unspecified convulsion as the Principal Diagnosis. Most other records in this set have codes for rehabilitation as the Principal Diagnosis, suggesting that these records refer to a later stage of care of cases that are probably also included in set 1 or set 2.

The summary table of case numbers below indicates the size of each designated TBI injury group (Table 1.1). Cases meeting these criteria are the subject of a separate chapter, as shown in the table.

Where the Mode of admission to hospital is recorded as a Transfer from another acute hospital, the record is excluded from the estimated case counts on the basis that it is not newly incident, but a further episode of care. However, the bed days associated with these inward transfer cases are included in estimates of length of hospital stay for TBI, in order to more fully represent the health care burden. The estimates of length of hospital stay do not include time spent in all rehabilitative services, other than where rehabilitative services have occurred in acute care.

Given the information to which we have access, it is not possible to identify multiple records for individual cases. Therefore, readmissions for the original injury were not able to be excluded. The exclusion of inward transfer cases from other hospitals is intended to approach a closer estimate of incident TBI cases (Table 1.1).

Full details of further selection criteria are included in the chapter for each group. A further chapter considers the burden of hospital and rehabilitation care.

Table 1.1: Groups of cases of TBI by sex, Australia 2004–05

Selection criteria	Males	Females	Persons	Per cent
Principal Diagnosis (Chapter 2:TBI as Principal Diagnosis cases)[a]	9,743	4,447	14,190	*62.5%*
Principal Diagnosis in the range S00–T75 & T79 and S06 in at least one other diagnosis field (Chapter 3:S06 as Additional Diagnosis cases)[b]	4,257	1,668	5,925	*26.1%*
Principal Diagnosis not within the range S00–T75 & T79 and S06 in at least one other diagnosis field (Chapter4:Other TBI cases)[c]	1,611	984	2,595	*11.4%*
ICD-10-AM code S06 occurring in any diagnosis field[d] (all cases of TBI injury)	**15,611**	**7,099**	**22,710**	***100%***

(a) Excludes inward transfers from other acute hospitals (m=961, f=462).
(b) Excludes inward transfers from other acute hospitals (m=506, f=200).
(c) Excludes inward transfers from other acute hospitals (m=823, f=423).

These criteria include all cases coded as involving TBI (i.e. S06). They do not include all head injuries. In particular, a substantial number of cases are coded as involving skull fracture without mention of TBI. These cases have been considered briefly in Chapter 5 (see Table 5.1).

Severity measures

Loss of consciousness

Evidence of loss of consciousness following an insult to the head is a clear indication of effect on the brain. However, whether loss of consciousness has occurred, and its duration, may not be known for all cases of head injury, as there is generally a lag between the injury event and medical attention, the injury event may not have been observed by others, the injured person may be confused and unsure of the events, and/or there may be memory loss. The Glasgow Coma Scale is widely used to predict early outcome, or survival outcome of head injury. The scale rates head injury severity on the three dimensions; ability to open and close the eyes, verbal response and motor response. A high degree of injury will result in low functionality, and a low score. Glasgow Coma Scale values were not available for this project. However, the Australian Clinical Modification of ICD-10 (ICD-10-AM) provides a category to record the presence and duration of loss of consciousness. The categories available are shown in Table 1.2, along with frequencies of use of each category in the data used for this project.

Table 1.2: ICD-10-AM categories for concussive injury by case count and per cent, Australia 2004–05

ICD-10-AM category–Concussive injury	Count	Per cent
No concussion	4,293	*18.9*
S06.00 Concussion	3,828	*16.9*
S06.01 Loss of consciousness of unspecified duration	4,866	*21.4*
S06.02 Loss of consciousness of brief duration [less than 30 minutes]	9,046	*39.8*
S06.03 Loss of consciousness of moderate duration [30 minutes to 24 hours]	405	*1.8*
S06.04 Loss of consciousness of prolonged duration [more than 24 hours], with return to pre-existing conscious level	95	*0.4*
S06.05 Loss of consciousness of prolonged duration [more than 24 hours], without return to pre-existing conscious level	177	*0.8*
Total	**22,710**	***100.0***

ICISS

The threat-to-life measure, ICD-based Injury Severity Score (ICISS), involves calculating a Survival Risk Ratio (SRR), i.e. the probability of survival, for each individual injury diagnosis code as the ratio of the number of patients with that injury code who have not died to the total number of patients diagnosed with that code. Thus, a given SRR approximates the likelihood that a patient will survive a particular injury. Each patient's ICISS score (survival probability) is then the product of the probabilities of surviving each of their injuries individually. This may be a single SRR, as in the case of a patient with a single injury, or it may be multiple SRRs, as in the case of a patient with multiple injuries. Hence, a patient's ICISS score can vary from 0 (most severe) to 1 (least severe). The ICISS values reported here do not provide a direct estimate of survival for reasons given in the Data Issues appendix. The ICISS score has not been shown to be an indicator of predicted return to previous level of functioning. A detailed explanation of the ICISS method is described in the report 'Diagnosis-based injury severity scaling' (Stephenson et al. 2003).

Length of stay in hospital

Average length of stay in hospital (ALOS) has often been used as a proxy for the severity of a particular injury type. In order to be useful in considering severity and burden on services, length of stay information in this report includes inward transfers from other acute hospitals, whereas case analysis in other sections of the report do not, in order to avoid over estimating injury incidence. In this report ALOS is one of several measures presented to allow the reader to make comparisons between natures of injury, mechanism, and differences between the sexes.

Cases resulting in death

Some severe traumatic brain injury cases result in immediate death, or death within minutes. These cases are generally not admitted to hospital, and are not included in this report. Some other TBI cases survive to be admitted to hospital, but death occurs before discharge. These cases are included in this report.

Where possible, the count or proportion of deaths in hospital is provided, but in some analyses, case numbers or proportions are too small to report due to issues of case identification and confidentiality.

Burden on hospital and rehabilitation care

Direct costs of hospitalised care can be very high for TBI injury, and can also place pressure on existing services (McGarry et al. 2002). Rehabilitation accommodation and services are likewise expensive specialist services. Appropriate and timely treatment, and rehabilitation management affect the likelihood of successful social re-integration, resumption of family and interpersonal relationships, and likelihood of return to work of those impacted by TBI.

The data source on which this report is based records acute care and rehabilitation services provided in Australian hospitals for inpatients. It does not provide data on outpatient (ambulatory) services, or services provided by nursing homes or similar facilities.

Also, some hospital inpatient services provided because of effects of TBI might not be identified as such in the separation records. This is particularly likely for certain late effects, such as those manifesting as behavioural changes.

2 TBI as Principal Diagnosis

In this report, cases where an S06 code occurs as the Principal Diagnosis are considered as being ones where hospitalisation has occurred because of TBI. Of the 22,710 cases with an S06 code occurring in any diagnosis field in the reporting period, 62.5% (n=14,190) recorded an S06 code as the Principal Diagnosis (Table 2.1).

More than 99.8% of cases with S06 as the Principal Diagnosis code also included at least one External Cause code. A small group of cases (n=15) included External cause codes, but only codes for complications of surgical and medical care. These were retained for analysis. An even smaller group of cases (n=9) lacked any External cause code, but were retained for analysis, though they were not included in analysis by type of External cause.

Records reported as being inward transfers from other acute hospitals (n=1,423) were excluded to avoid double counting injury cases, but are included in calculations for length of hospital stay to more fully describe the burden of TBI injury.

Table 2.1: Selection for TBI as Principal Diagnosis cases by sex, Australia 2004–05

Selection criteria	Males	Females	Persons
Cases with a Principal Diagnosis of S06 and			
An External Cause code in the ICD-10-AM injury range V01–Y36, Y85-Y87, Y89	9,725	4,441	14,166
An External Cause code in the ICD-10-AM Complications of surgical and medical care range Y40–Y84, Y88	..	..	15
No External Cause code was recorded	..	..	9
Total Principal Diagnosis TBI cases[(a)]	**9,743**	**4,447**	**14,190**

(a) Excludes inward transfers from other acute care hospitals (m=961, f=462).
.. Cell counts in tables that are 4 cases or fewer have been suppressed, as have percentages derived from them, to protect confidentiality.

Overview

Of the 14,190 cases in this selection, nearly 70% were males, and the rate for males was nearly two and a half times the rate for females (Table 2.2). TBI as Principal Diagnosis cases constituted 62.5% of all identified cases of TBI. Mean length of stay (hospital bed days) was higher for females (6.1 days) than for males (5 days). One case for females reported a length of stay of more than 1,000 days. This case and number of bed days was included in the bed days total and in the calculation of mean length of stay.

Table 2.2: TBI as Principal Diagnosis cases, selected indicators, Australia 2004–05

Indicators	Reported TBI as Principal Diagnosis cases			
	Males	Females	Persons	Ratio m:f
Number of TBI as Principal Diagnosis cases[(a)]	9,743	4,447	14,190	2.2
Proportion of all injury hospital separations[(b)]	*4.0%*	*2.4%*	*3.3%*	
Age standardised (direct) rate/100,000 population	98.7	41.9	70.1	2.4
Mean length of stay (bed days)	5.0	6.1[(c)]	5.4[(c)]	
Total patient days[(d)]	49,111	27,143[(c)]	76,254[(c)]	

(a) Excludes inward transfers from other acute care hospitals (m=961, f=462).
(b) Derived from (Bradley & Harrison in press).
(c) Includes 1 case where the reported length of stay was greater than 1,000 days.
(d) Includes inward transfers from other acute care hospitals for total bed days (m=961, f=462).

Principal Diagnosis

Codes in the S06 range are those that describe intracranial injury, and include concussive injury, traumatic cerebral oedema, diffuse brain injury and focal brain injury. Of the 14,190 cases where an S06 code was reported as the Principal Diagnosis, nearly 70% were concussive injuries, with almost half of those cases reporting a loss of consciousness of less than 30 minutes (Table 2.3). Very few cases reported a loss of consciousness of 24 hours or more. Similar proportions of cases of focal brain injury and diffuse brain injury were reported (less than 5% of total injuries).

Table 2.3: Distribution of Principal Diagnosis in S06 code range by sex, Australia 2004–05

	Males		Females		Persons	
S06 Intracranial injury codes	**Counts**	**Per cent**	**Counts**	**Per cent**	**Counts**	**Per cent**
S06.0 Concussive injury	6,731	*69.1*	2,938	*66.1*	9,669	*68.1*
S06.00 Concussion	*1,993*	*29.6*	*1,091*	*37.1*	*3,084*	*31.9*
S06.01 Loss of consciousness of unspecified duration	*1,315*	*19.5*	*500*	*17.0*	*1,815*	*18.8*
S06.02 Loss of consciousness of brief duration [less than 30 minutes]	*3,294*	*48.9*	*1,301*	*44.3*	*4,595*	*47.5*
S06.03 Loss of consciousness of moderate duration [30 minutes to 24 hours]	*116*	*1.7*	*45*	*1.5*	*161*	*1.7*
S06.04, S06.05 Loss of concussion of prolonged duration [more than 24 hours], with/without return to pre-existing conscious level	*13*	*0.2*	*..*	*..*	*14*	*0.2*
S06.1 Traumatic cerebral oedema	23	*0.2*	8	*0.2*	31	*0.2*
S06.2 Diffuse brain injury	429	*4.4*	165	*3.7*	594	*4.2*
S06.20 Diffuse cerebral and cerebellar brain injury, unspecified	*24*	*5.6*	*8*	*4.8*	*32*	*5.4*
S06.21 Diffuse cerebral contusions ≤ 5 mls blood	*91*	*21.2*	*21*	*12.7*	*112*	*18.9*
S06.22 Diffuse cerebellar contusions ≤ 5 mls blood	*21*	*4.9*	*5*	*3.0*	*26*	*4.4*
S06.23 Multiple intracerebral and cerebellar haematomas >5 mls blood	*243*	*56.6*	*112*	*67.9*	*355*	*59.8*
S06.28 Other diffuse cerebral and cerebellar injury Multiple lacerations of cerebrum and cerebellum	*50*	*11.7*	*19*	*11.5*	*69*	*11.6*
S06.3 Focal brain injury	461	*4.7*	191	*4.3*	652	*4.6*
S06.30 Focal cerebral and cerebellar injury, unspecified	*0*	*0.0*	*..*	*..*	*..*	*..*
S06.31 Focal cerebral contusion ≤ 5 mls blood	*311*	*67.5*	*126*	*66.0*	*437*	*67.0*
S06.32 Focal cerebellar contusion ≤ 5 mls blood	*..*	*..*	*..*	*..*	*8*	*1.2*
S06.33 Focal cerebral haematoma > 5 mls blood Intracerebral haematoma/haemorrhage	*133*	*28.9*	*54*	*28.3*	*187*	*28.7*
S06.34 Focal cerebellar haematoma > 5 mls blood Cerebellar haemorrhage	*..*	*..*	*..*	*..*	*9*	*1.4*
S06.38 Other focal cerebral and cerebellar injury Laceration of cerebrum and cerebellum	*..*	*..*	*..*	*..*	*9*	*1.4*
S06.4 Epidural haemorrhage	233	*2.4*	87	*2.0*	320	*2.3*
S06.5 Traumatic subdural haemorrhage	1,132	*11.6*	686	*15.4*	1,818	*12.8*
S06.6 Traumatic subarachnoid haemorrhage	466	*4.8*	252	*5.7*	718	*5.1*
S06.8 Other intracranial injuries	127	*1.3*	59	*1.3*	186	*1.3*
S06.9 Intracranial injury, unspecified	141	*1.4*	61	*1.3*	202	*1.4*
Total	**9,743**	***100***	**4,447**	***100***	**14,190**	***100***

Subgroup proportions are percentages relating to that diagnosis group.
.. Cell counts in tables that are 4 cases or fewer have been suppressed, as have percentages derived from them, to protect confidentiality.

Age and sex distribution

Cases with TBI as Principal Diagnosis were significantly higher (95% CIs) for males than for females in all age groups (Figure 2.1). The pattern of rates by age was similar for males and females, with rates being highest for youths to young adults, and for seniors aged 60 years or more.

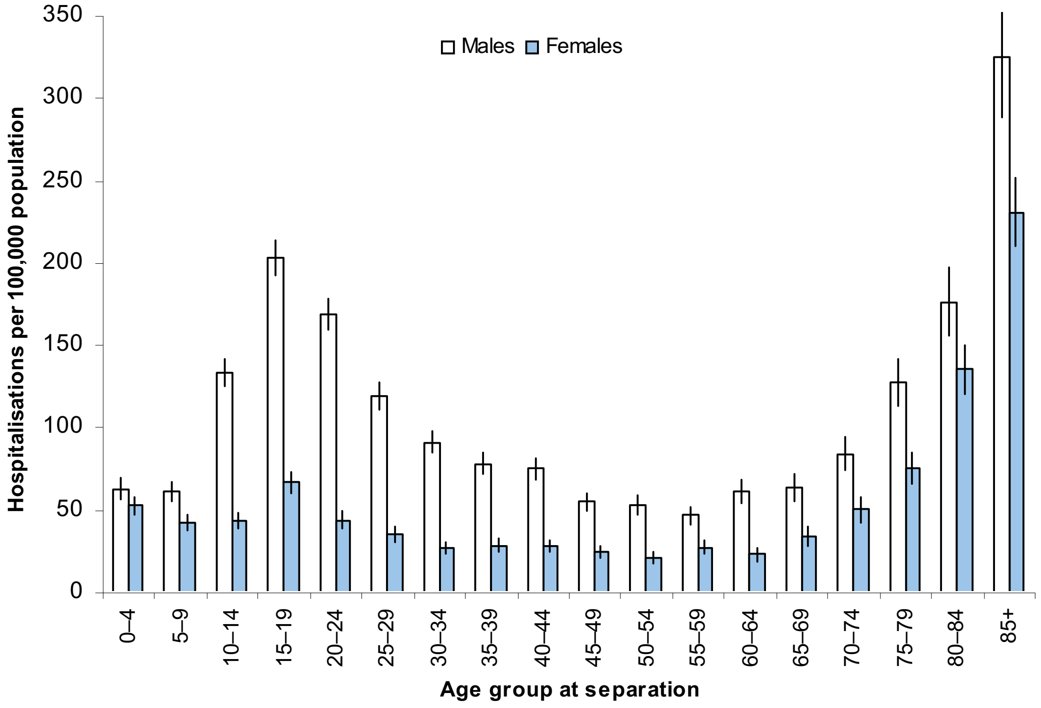


Figure 2.1 TBI as Principal Diagnosis cases by sex and age group, Australia 2004–05

Trends over time

Age-standardised rates for TBI as Principal Diagnosis cases appear to have remained static over a six year time span, with rates for males consistently higher than rates for females (Figure 2.2). A decrease in the rate for males and females is seen for 2003–04, after which rates for both groups return to slightly higher rates than for the year previous.

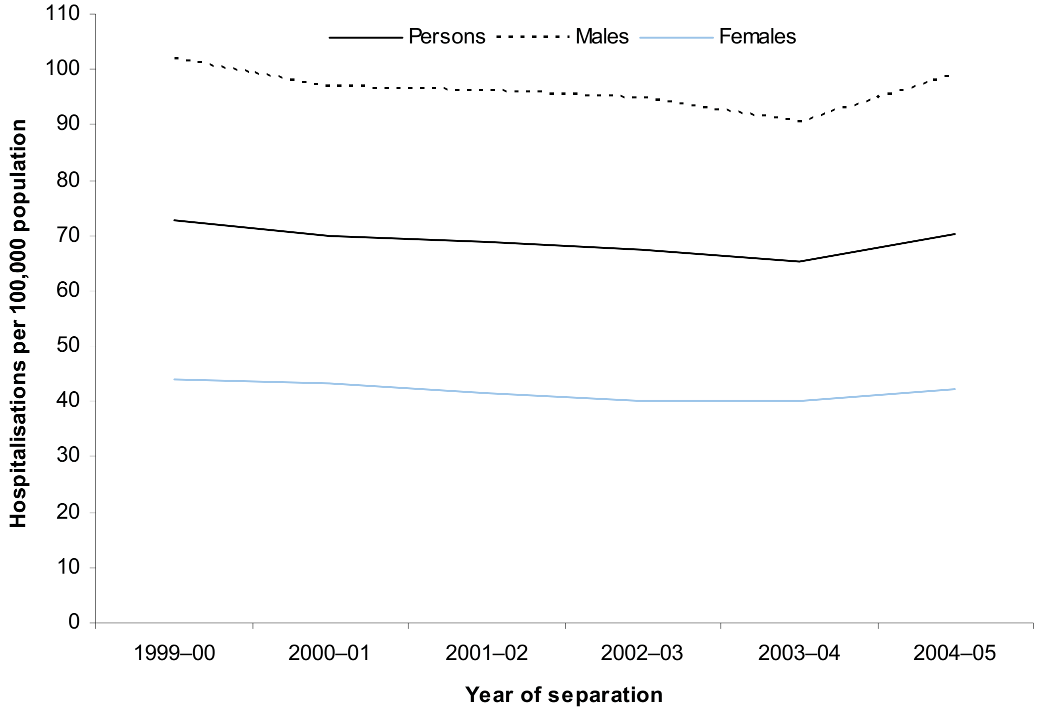


Figure 2.2: TBI as Principal Diagnosis cases, Australia 1999–00 to 2004–05: age standardised rates

External Cause of injury

Falls were the most commonly reported External Cause (42% overall), with 53% of all cases for females, and 37% for males (Table 2.4). The External Cause with the next highest proportion of cases was *Transportation* (29.4% overall), with 30% of total cases for males, and 29% for females. More than twice the proportion of cases for males (18%) compared to females (8%) was due to *Assault*. Much smaller proportions of TBI were due to *Intentional self harm* (1% for both males and females). Within the group labelled *Other unintentional injuries*, the largest identifiable External Cause was *Striking against or struck by other objects* (18% of the group total), followed by *Hit, struck, kicked, twisted, bitten or scratched by another person* (16% of the group total), and *Striking against or bumped into by another person* (15% of the group total).

Table 2.4: External Causes for TBI as Principal Diagnosis cases, Australia 2004–05

	Males		Females		Persons	
Major groups	**Count**	**Per cent**	**Count**	**Per cent**	**Count**	**Per cent**
Falls (W00–W19)	3,610	*37.1*	2,364	*53.2*	5,974	*42.1*
Transportation (V01–V99)	2,888	*29.6*	1,290	*29.0*	4,178	*29.4*
Intentional, inflicted by another (X85–Y09, Y35–Y36, Y87.1, Y89.0, Y89.1)	1,711	*17.6*	334	*7.5*	2,045	*14.4*
Other unintentional injuries (W20–W64, W75–W99, X20–X39, X50–X59, Y85, Y86, Y89.9)	1,430	*14.7*	409	*9.2*	1,839	*13.0*
Struck by projected, thrown or falling object (W20)	*162*	*11.3*	*43*	*10.5*	*205*	*11.1*
Striking against or struck by sports equipment (W21)	*105*	*7.3*	*51*	*12.5*	*156*	*8.5*
Striking against or struck by other objects (W22)	*240*	*16.8*	*99*	*24.2*	*339*	*18.4*
Hit, struck, kicked, twisted, bitten or scratched by another person (W50)	*263*	*18.4*	*30*	*7.3*	*293*	*15.9*
Striking against or bumped into by another person (W51)	*248*	*17.3*	*31*	*7.6*	*279*	*15.2*
Remainder other unintentional	*412*	*28.8*	*155*	*37.9*	*567*	*30.8*
Intentional self-harm (X60–X84, Y87.0)	50	*0.5*	23	*0.5*	73	*0.5*
Undetermined intent (Y10–Y34, Y87.2)	17	*0.2*	7	*0.2*	24	*0.2*
No External Cause reported	18	*0.2*	5	*0.1*	23	*0.2*
Complications of surgical and medical care (Y40–Y84)	10	*0.1*	5	*0.1*	15	*0.1*
Near drowning (W65–W74)	..	..	..	..	8	*0.1*
Poisoning, other substances (X45–X49)	..	..	..	..	..	..
Poisoning, pharmaceuticals (X40–X44)	..	..	..	..	..	..
Fires/burns/scalds (X00–X19)	0	*0.0*	..	..	..	..
Major groups total[(a)]	**9,743**	***100***	**4,447**	***100***	**14,190**	***100***

(a) Excludes inward transfers from other acute care hospitals (m=961, f=462).
Subgroup proportions are percentages relating to that diagnosis group.
.. Cell counts in tables that are 4 cases or fewer have been suppressed, as have percentages derived from them, to protect confidentiality.

Activity at time of injury

Activity at time of injury was specified for 48% of cases (n=6,820), with 40% of those cases being reported as *Other specified* activity (Table 2.5). The broad category of sport was reported for 16% (n=2,208) of cases, with *Football* contributing 32% (n=715) of that total. *Working for income* was reported for 4% of cases (n=581), with no specified type of work reported for nearly 60% of those cases. For the remainder of *Working for income* cases, *Agriculture, forestry and fishing* contributed 20% (n=115) of records, and *Construction* work contributed 13% (n=74).

Table 2.5: TBI as Principal Diagnosis cases by reported activity, Australia 2004–05

	Males		Females		Persons	
Activity	**Count**	**Per cent**	**Count**	**Per cent**	**Count**	**Per cent**
While engaged in sports	1,754	*18.0*	454	*10.2*	2,208	*15.6*
Football	*670*	*38.2*	*45*	*9.9*	*715*	*32.4*
Motorcycling	*191*	*10.9*	*14*	*3.1*	*205*	*9.2*
Cycling	*207*	*11.8*	*43*	*9.5*	*250*	*11.3*
Trail or general horseback riding	*24*	*1.4*	*120*	*26.4*	*144*	*6.5*
Skate boarding	*49*	*2.8*	..	..	*51*	*2.3*
Other and unspecified sports activity	*613*	*34.9*	*230*	*50.7*	*843*	*38.2*
While engaged in leisure	359	*3.7*	102	*2.3*	461	*3.3*
While working for income	497	*5.1*	84	*1.9*	581	*4.1*
Working for income—Agriculture, forestry and fishing	*101*	*20.3*	*14*	*16.7*	*115*	*19.8*
Working for income—Construction	*73*	*14.7*	..	..	*74*	*12.7*
Working for income—Transport and storage	*47*	*9.5*	..	..	*50*	*8.6*
Working for income—other and unspecified	*276*	*55.5*	*66*	*78.6*	*342*	*58.9*
While engaged in other types of work	212	*2.2*	104	*2.3*	316	*2.2*
While resting, sleeping, eating or engaging in other vital activities	255	*2.6*	244	*5.5*	499	*3.5*
Other specified activity	1,796	*18.4*	909	*20.4*	2,705	*19.1*
Unspecified activity	4,870	*50.0*	2,550	*57.3*	7,420	*52.3*
All activities	**9,743**	***100***	**4,447**	***100***	**14,190**	***100***

Subgroup proportions are percentages relating to that activity type.

.. Cell counts in tables that are 4 cases or fewer have been suppressed, as have percentages derived from them, to protect confidentiality.

Place of occurrence of injury

Of all Principal Diagnosis TBI cases, 78.6% (n=9,735) reported an identified place of occurrence for the injury event (Table 2.6). *Streets and highways* were most commonly reported (22%), with the proportion of records similar for males and females, and the majority of cases were reported as occurring on a *Roadway* (n=2,580). Almost 21% of injuries occurred in the *Home*, with nearly twice as many injuries reported for females as for males. For 9% of cases (n=1,320), the place of occurrence was a *Sports and athletics* area, with *Sporting ground (outdoor)* being reported most commonly (62% of those cases), and the proportion of males was nearly three times that of females. In *Trade and service areas* there was a small proportion of cases (6%), with the majority of those being recorded as occurring in a *Café, hotel and restaurant* setting. *Residential institutions* (3%) and *Schools* (3%) reported much lower proportions of TBI cases.

Table 2.6: TBI as Principal Diagnosis cases by place of occurrence, Australia 2004–05

	Males		Females		Persons	
Place of occurrence	**Count**	**Per cent**	**Count**	**Per cent**	**Count**	**Per cent**
Home	1,593	*16.4*	1,365	*30.7*	2,958	*20.8*
Residential institution	210	*2.2*	279	*6.3*	489	*3.4*
Aged care facilities	*170*	*81.0*	*265*	*95.0*	*435*	*89.0*
Other and unspecified residential institution	*40*	*19.0*	*14*	*5.0*	*54*	*11.0*
School	266	*2.7*	107	*2.4*	373	*2.6*
Health Service area	52	*0.5*	51	*1.1*	103	*0.7*
Other specified institution and public administrative area	37	*0.4*	17	*0.4*	54	*0.4*
Sports and athletics area	1,137	*11.7*	183	*4.1*	1,320	*9.3*
Sporting grounds (outdoor)	*756*	*66.5*	*66*	*36.1*	*822*	*62.3*
Racetrack and racecourse	*180*	*15.8*	*32*	*17.5*	*212*	*16.1*
Other and unspecified sports and athletics area	*201*	*17.7*	*85*	*46.4*	*286*	*21.7*
Street and highway	2,227	*22.9*	921	*20.7*	3,148	*22.2*
Roadway	*1,799*	*80.8*	*781*	*84.8*	*2,580*	*82.0*
Sidewalk	*323*	*14.5*	*105*	*11.4*	*428*	*13.6*
Other and unspecified street and highway	*105*	*4.7*	*35*	*3.8*	*140*	*4.4*
Trade and service area	708	*7.3*	180	*4.0*	888	*6.3*
Cafe, hotel and restaurant	*521*	*73.6*	*89*	*49.4*	*610*	*68.7*
Other and unspecified trade and service area	*187*	*26.4*	*91*	*50.6*	*278*	*31.3*
Industrial and construction area	129	*1.3*	12	*0.3*	141	*1.0*
Farm	192	*2.0*	69	*1.6*	261	*1.8*
Other specified place of occurrence	565	*5.8*	204	*4.6*	769	*5.4*
Unspecified place of occurrence	2,627	*27.0*	1,059	*23.8*	3,686	*26.0*
All places	**9,743**	***100***	**4,447**	***100***	**14,190**	***100***

Subgroup proportions are percentages relating to that activity type.

Severity of Principal Diagnosis cases

Length of stay

For all External Causes of Principal Diagnosis TBI cases, the average length of stay (ALOS) was 5.4 days (Table 2.7). This ALOS would be lower but for one female case that exceeded 1,000 bed days (for which the External Cause was reported as being *Transportation*), which has also inflated the ALOS for females compared to males. Males were more than twice as likely to be hospitalised with Principal Diagnosis TBI than females, and a total of 658 deaths in hospital (4.6% of all Principal Diagnosis cases) were reported, with males represented about 1.5 times more frequently than females.

Of the top three External Causes, reported ALOS was highest for *Transportation* cases. As noted in the preceding paragraph, one case of unusually long stay has increased the ALOS for females and for persons. Males were hospitalised due to *Transportation* injury over twice as often as females, and just over 4% of cases died before discharge from hospital, with males represented nearly twice as often as females. *Transportation* injury cases had the lowest chance of survival of the three main External Causes of injury reported here, none of which reported an ICISS score of less than 80% probability of survival.

Falls cases had an ALOS of 5.4 days, and males were hospitalised one and a half times more often than females. A higher proportion of this External Cause group died in hospital than in the other reported major External Cause groups, and total External Causes. Despite the higher proportion of deaths for *Falls*, the ICISS scores for males, females and persons were slightly better than those for *Transport* cases.

TBI hospitalisations due to *Assault* reported the same ALOS as for *Falls* cases (5.4 bed days), but the male to female ratio was higher (2.2:1). A smaller proportion of these cases resulted in death than was reported for the other selected External Causes, and for Principal Diagnosis TBI overall (1.2%). ICISS scores for *Assault* indicated survival probabilities of 87% for males, 90% for females, and 88% for persons.

Table 2.7: Length of hospital stay due to top three major External Causes and total TBI as Principal Diagnosis cases reported 2004–05, by sex, all ages

Principal Diagnosis by body region		Males	Females	Persons	
Falls (W00–W19)	Cases	3,610	2,364	5,974	m:f 1.5:1
	Bed days[(a)]	20,995	13,245	34,240	
	ALOS	5.8	5.6	5.4	
	Mean ICISS[(b)]	0.8418	0.8480	0.8443	
	Died in hospital[(c)]	226	190	416	*7%* died
Transport (V01–V99)	Cases	2,888	1,290	4,178	m:f 2.2:1
	Bed days[(a)]	15,567	10,162	25,729	
	ALOS	5.4	7.9[(d)]	6.2[(d)]	
	Mean ICISS[(b)]	0.8294	0.8405	0.8328	
	Died in hospital[(c)]	112	63	175	*4.2%* died
Assault (X85–Y09)	Cases	1,711	334	2,045	m:f 5.1:1
	Bed days[(a)]	5,690	1,258	6,948	
	ALOS	3.3	3.8	3.4	
	Mean ICISS[(b)]	0.8740	0.8977	0.8778	
	Died in hospital[(c)]	21	..	..	*1.2%* died
Total Principal Diagnosis (S06 codes)	Cases	9,743	4,447	14,190	m:f 2.2:1
	Bed days[(a)]	49,111	27,143	76,254	
	ALOS	5.0	6.1[(d)]	5.4[(d)]	
	Mean ICISS[(b)]	0.8553	0.8566	0.8557	
	Died in hospital[(c)]	390	269	659	*4.6%* died

(a) Includes inward transfers for total length of hospital stay per case.
(b) Mean ICISS based on cases.
(c) Includes inward transfers for total deaths in hospital.
(d) Includes 1 case where the reported length of stay was greater than 1,000 days
.. Cell counts in tables that are 4 cases or fewer have been suppressed to protect confidentiality.

Mean ICISS score

Of specified External Causes of TBI, mean ICISS scores were highest, and therefore the probability of survival the best, for *Assault*, *Falls* and *Transportation* cases in the 10–14 years age group (Figure 2.3). *Other* combined External Causes of injury were also highest for this age group.

In general, the probability of survival decreased with age for *Falls*, *Transportation* and *Assault*, but less so for the combined External Causes of injury designated *Other*. The worst probability of survival was for victims of *Assault* in the 70–74 year age group (mean ICISS score 0.5459).

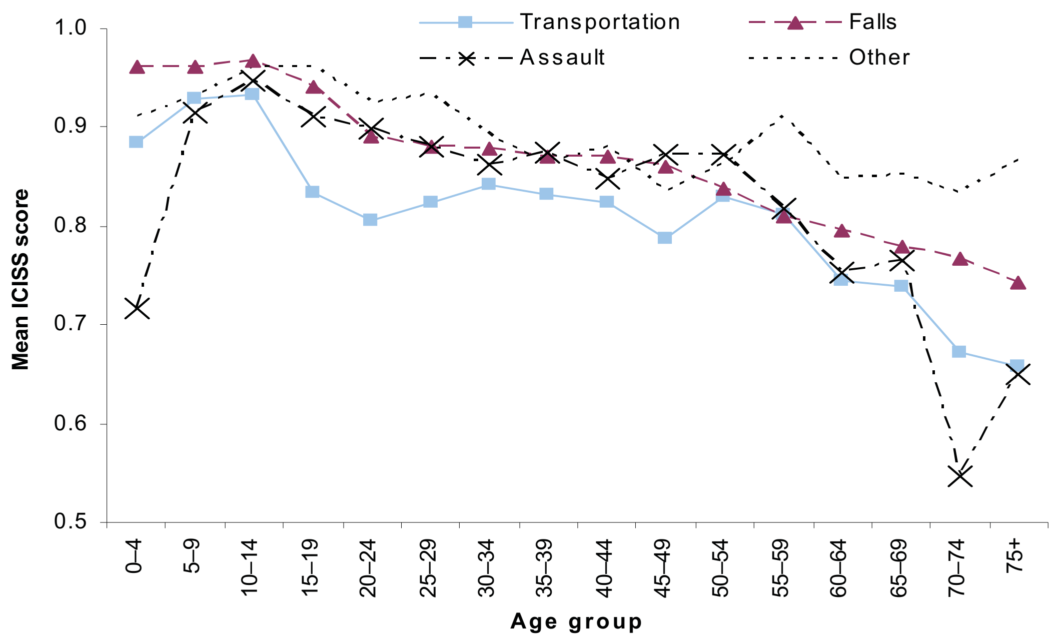


Figure 2.3: Mean ICISS for TBI as Principal Diagnosis cases by age group and External Cause group, Australia 2004–05

Loss of consciousness

For the purpose of investigating the role of loss of consciousness (LOC) in indicating the severity of the brain injury, each of the 14,190 records in the Principal Diagnosis cases selection was searched for a diagnosis of concussive injury (S06.0–S06.05) in any diagnosis field, including the Principal Diagnosis field. This takes into account 2,034 cases where a LOC occurred, but a Principal Diagnosis other than that of concussion was reported (S06.1–S06.9).

Overall, 60% (n=8,513) of patients in this group recorded either a concussion (not further specified) or a LOC of brief duration, compared to only 1.2% (n=164) patients who recorded a LOC of prolonged duration. Patients who sustained a LOC of prolonged duration with return to pre-existing conscious level had the longest mean length of stay (LOS) of 31.9 days (Table 2.8). This was more than double the value of 14.2 days for patients who sustained a LOC of prolonged duration without return to pre-existing conscious level. This difference is most likely explained by the much lower survival rate of less than 35% for the latter group, compared to almost 90% for those patients who returned to a previous conscious level.

Interestingly, TBI patients for whom no concussion was recorded had a relatively long mean LOS of 14.4 days, when compared to patients who sustained a concussion (1.4 days) and patients who sustained a LOC of a brief duration (2.5 days). This difference was also reflected in the observed survivor proportions of 88%, 99.7% and 99.2% respectively.

Table 2.8: Reported loss of consciousness (LOC) for TBI as Principal Diagnosis cases by severity measures, Australia 2004–05

ICD-10-AM category	Count	Per cent	Mean LOS	Mean ICISS	Surv prop [(a)]
No concussion	2,486	*17.5*	14.4	0.673	*0.884*
S06.00 Concussion	3,112	*21.9*	1.4	0.984	*0.997*
S06.01 LOC of unspecified duration	2,787	*19.6*	6.5	0.794	*0.933*
S06.02 LOC brief duration [less than 30 minutes]	5,401	*38.1*	2.5	0.924	*0.992*
S06.03 LOC of moderate duration [30 minutes to 24 hours]	239	*1.7*	3.9	0.707	*0.866*
S06.04 LOC of prolonged duration [more than 24 hours], with return to pre-existing conscious level	57	*0.4*	31.9	0.476	*0.860*
S06.05 LOC of prolonged duration [more than 24 hours], without return to pre-existing conscious level	107	*0.8*	14.2	0.036	*0.140*
Total	**14,189[(b)]**	***100.0***	**5.4**	**0.856**	***0.954***

(a) Observed proportion of patients who survived to discharge.
(b) Excludes 1 case (female) with length of stay of 1,000 days.

TBI as Principal Diagnosis deaths in hospital

For all ages, 4.6% (n=659) of all hospitalisations for TBI as Principal Diagnosis resulted in death, the proportions being highest for *Falls* (63%) followed by *Transportation* (27%), Other *major group* (7%) and *Assault* (4%) (Figure 2.4).

For those aged 0–14 years and whose TBI was *Assault*-related, 4% died in hospital, while for both *Transportation* and *Falls*-related cases, this figure was less than 1%.

For 15–29 year olds, 4% of those whose TBI was *Transportation*-related died in hospital, with the equivalent percentages for both *Falls* and *Assault* being less than 1%.

In the 30–44 age group, of those admitted with a *Transportation*-related TBI, 2.3% died in hospital. This percentage was slightly higher than for *Falls*-related TBI (2.0%) and *Assault*-related TBI (1.7%).

Almost 6% of those aged 45–64 years who were admitted with a *Transportation*-related TBI, died in hospital, compared to 4.7% and 1.3% for *Falls*-related and *Assault*–related TBI respectively.

Those aged 65 years and over, accounted for 62% of all TBI deaths in hospital. Of these, 19% admitted with a *Transportation*-related TBI died, compared to 16% for *Falls*-related TBI cases, and 3.3% for *Assault*-related TBI cases.

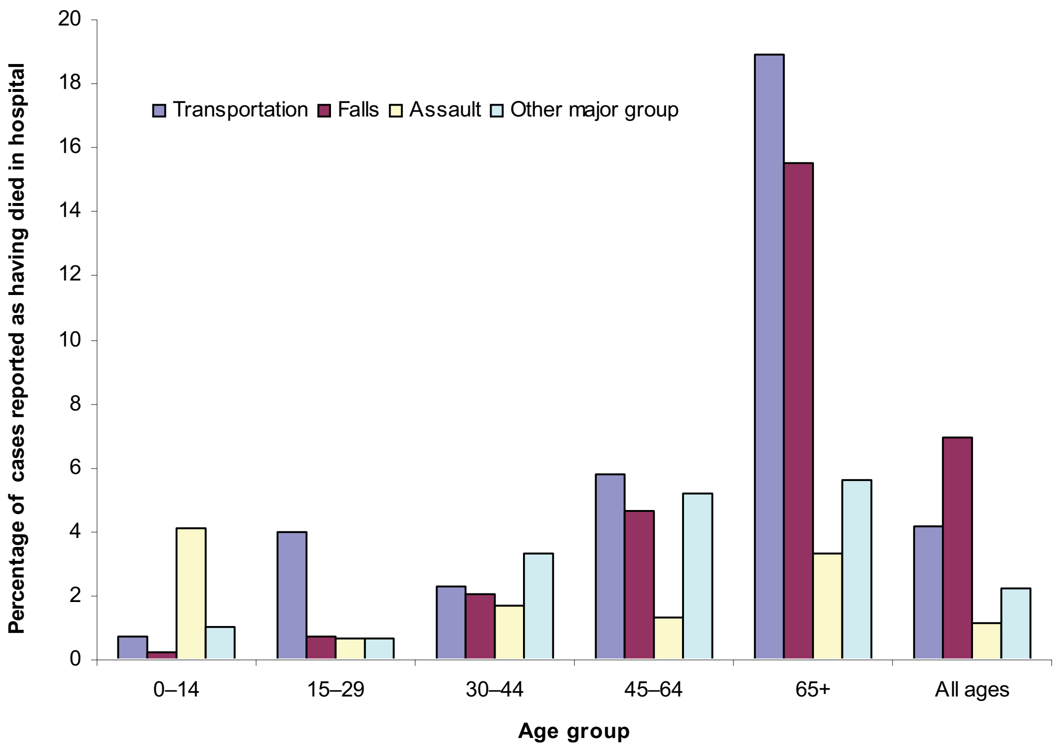


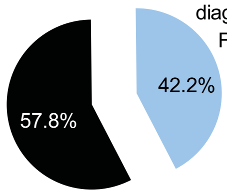
Figure 2.4: Proportion of TBI as Principal Diagnosis cases that resulted in death in hospital by age groups, persons, Australia 2004–05

Fall related injury

Overview

Injury from *Falls* was the External Cause that contributed the largest proportion (42.2%) of all Principal Diagnosis TBI cases (Table 2.9). Males were affected at 1.8 times the rate of females. Mean length of stay was similar for males and females, and the longest bed stay was less than 150 days. Of the three major External Causes of Principal Diagnosis TBI cases (*Falls, Transportation* and *Assault*), *Falls* caused the most cases and resulted in the largest number of total bed days.

Table 2.9: TBI as Principal Diagnosis cases due to Falls reported 2004–05, selected indicators, Australia

	Reported Falls cases in TBI as Principal Diagnosis cases				In proportion to all TBI as Principal Diagnosis cases
Indicators	Males	Females	Persons	Ratio m:f	
Number of TBI as Principal Diagnosis cases caused by Falls injury[(a)]	3,610	2,364	5,974	1.5	
Proportion of all TBI as Principal Diagnosis cases	*37.1*	*53.2*	*42.1*		
Age standardised (direct) rate/100,000 population	37.6	21.3	29.1	1.8	
Mean length of stay	5.8	5.6	5.4		
Total bed days[(b)]	20,995	13,245	34,240		

(a) Excludes inward transfers from other acute care hospitals (m=453, f=277).
(b) Includes inward transfers from other acute care hospitals for total bed days (m=453, f=277).

Age and sex distribution

Rates of TBI due to *Fall* injuries increased from the 60–64 years age group upward, and rates were highest in the 85+ age bracket (Figure 2.5). Rates were higher for males and females from 0–24 years than for the middle age years, and rates for males were higher than rates for females in all age brackets.

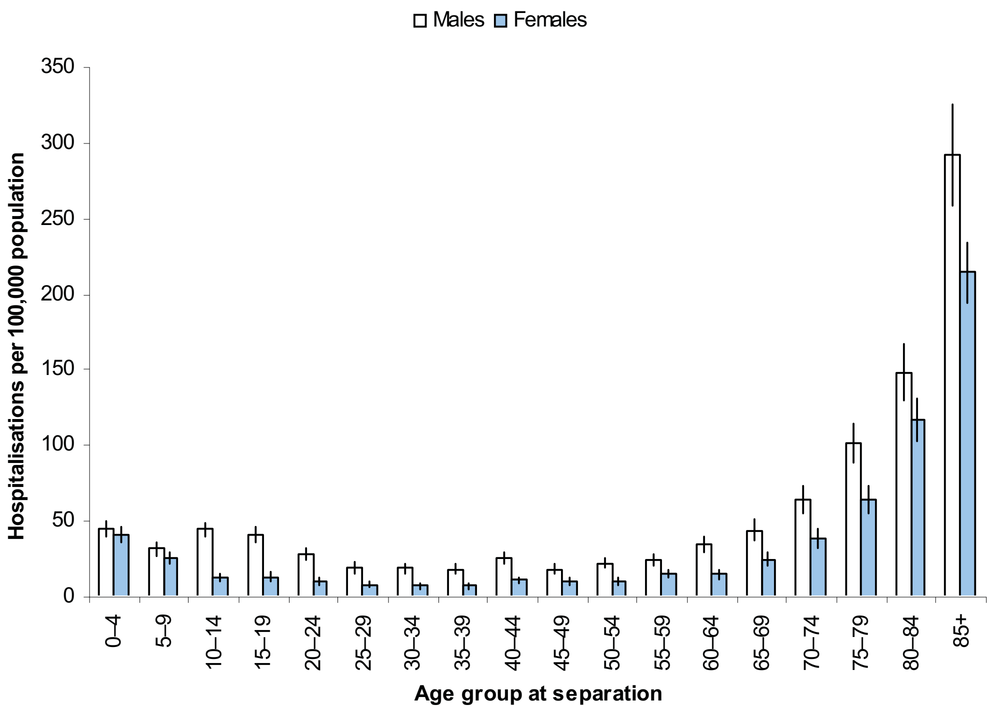


Figure 2.5: Hospitalisations due to Fall-related TBI as Principal Diagnosis cases by age and sex, Australia 2004–05

Trend over time

The pattern of rates for *Falls* over the six year period were similar for males and females, with the rate for males being much higher than the rate for females in each year (Figure 2.6).

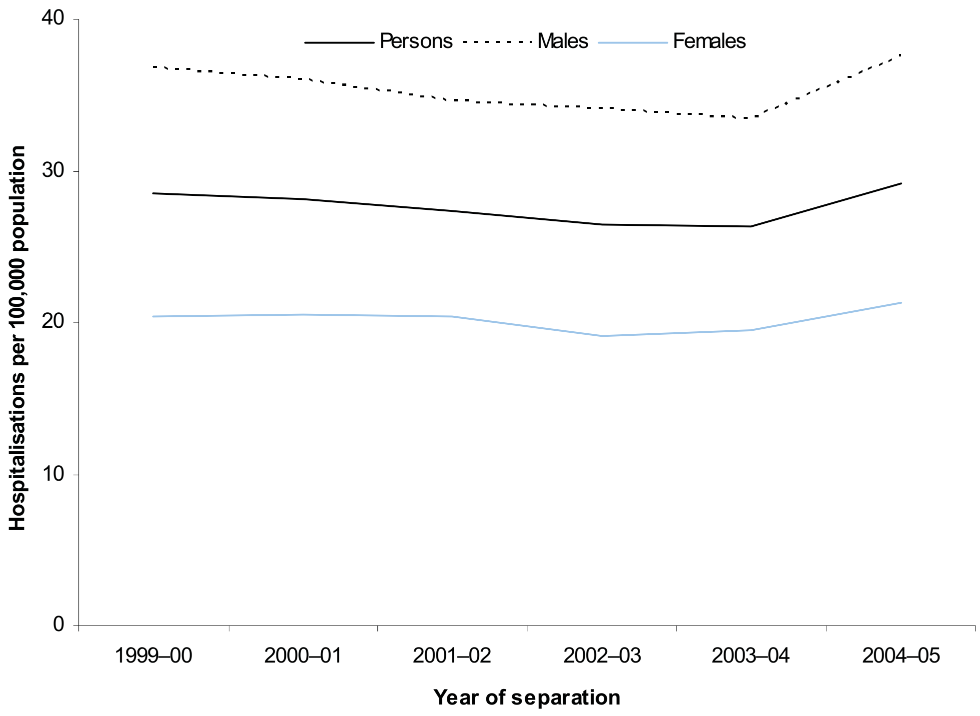


Figure 2.6: Hospitalisations due to Fall-related TBI as Principal Diagnosis cases, Australia 1999–00 to 2004–05: age standardised rates

Nature of fall

Of all specified types of *Fall* reported, the highest number of cases was for *Other fall on same level* (n=1,141), with the proportion of cases for females being higher than that for males (Table 2.10). *Other falls on same level* accounted for nearly one fifth of all Falls cases. *Fall on same level from slipping, tripping and stumbling* was reported as the second highest nature of Fall (905 cases), again the proportion was higher for females than for males. The next highest group was *Fall on and from steps and stairs* with 548 cases, with little difference between males and females in the proportion of cases. A total of 400 cases were reported for *Other fall on same level due to collision with, or pushing by, another person*, and in this group a higher proportion of males were affected than females. A substantial number (n=352) of cases were reported for *Other fall from one level to another*. This grouping includes a number of cases (n=23) that involved a *Fall from wheelchair*. Other categories that involved specified products included *Fall involving chair* (n=221), *Fall involving ladder* (n=219), *Fall involving bed* (n=163), and *Fall involving playground equipment* (n=143), *Fall involving skateboard* (n=84) *Fall from* tree (n=53), and *Fall involving ice-skates, skis and roller skates* (n=50).

Table 2.10: TBI as Principal Diagnosis cases due to Falls by nature of fall and sex, Australia 2004–05

	Males		Females		Persons	
Nature of fall[a]	**Count**	**Per cent**	**Count**	**Per cent**	**Count**	**Per cent**
Fall on same level from slipping, tripping and stumbling (W01)	447	*12.4*	458	*19.4*	905	*15.1*
Fall involving skateboard (W02.1)	74	*2.0*	10	*0.4*	84	*1.4*
Fall involving ice-skates, skis and roller skates (W02.0, W02.2–W02.5)	32	*0.9*	18	*0.8*	50	*0.8*
Other fall on same level due to collision with, or pushing by, another person (W03)	334	*9.3*	66	*2.8*	400	*6.7*
Fall while being carried or supported by other persons (W04)	25	*0.7*	27	*1.1*	52	*0.9*
Fall involving bed (W06)	84	*2.3*	79	*3.3*	163	*2.7*
Fall involving chair (W07)	133	*3.7*	88	*3.7*	221	*3.7*
Fall involving other furniture (W08)	37	*1.0*	28	*1.2*	65	*1.1*
Fall involving playground equipment (W09)	86	*2.4*	57	*2.4*	143	*2.4*
Fall on and from steps and stairs (W10)	300	*8.3*	248	*10.5*	548	*9.2*
Fall on and from ladder (W11)	202	*5.6*	17	*0.7*	219	*3.7*
Fall on and from scaffolding (W12)	19	*0.5*	..	..	..	..
Fall from, out of or through building or structure (W13)	203	*5.6*	44	*1.9*	247	*4.1*
Fall from tree (W14)	42	*1.2*	11	*0.5*	53	*0.9*
Fall from cliff (W15)	11	*0.3*	..	..	..	..
Diving or jumping into water causing injury other than drowning and submersion (W16)	14	*0.4*	..	..	..	..
Other fall from one level to another (W05, W17)[a]	236	*6.5*	116	*4.9*	352	*5.9*
Other fall on same level (W00, W18) [a]	643	*17.8*	498	*21.1*	1,141	*19.1*
Unspecified fall (W19)	688	*19.1*	594	*25.1*	1,282	*21.5*
Total	**3,610**	***100***	**2,364**	***100***	**5,974**	***100***

(a) Some sub categories have been merged with others where small cell counts did not allow meaningful analysis, and may not be directly comparable with the categories in Table 2.5.
.. Cell counts in tables that are 4 cases or fewer have been suppressed, as have percentages derived from them, to protect confidentiality.

Age group

In the 0–14 age group, the most common type of specified fall was that *involving furniture*. Of those 228 cases, nearly 42% involved a chair, and 34% involved a bed (Table 2.11). *Fall on same level from slipping, tripping and stumbling* was the next most common type of fall, accounting for nearly 12% of falls in that age group. A further 11% of cases were attributed to *Other fall on same level due to collision with, or pushing by, another person*, and 11% of cases were due to an *Other fall from one level to another*. Of the 10% of cases caused by a *Fall involving playground equipment*, 27% involved a trampoline, 21% involved climbing apparatus, and nearly 14% involved a swing.

For the 15–29 age group, one quarter of cases were due to *Other fall on same level due to collision with , or pushing by, another person*. For nearly 17% of cases the cause was *Other fall on same level*, and for 11% of cases the cause was *Fall on same level from slipping, tripping and stumbling*. *Other fall from one level to another* was next common (8%), followed by *Fall on and from steps and stairs* (7%).

Other fall on same level was the most common nature of fall for people aged 30–44 years (22% of cases), followed by *Fall on and from steps and stairs* (16%). Next common was *Fall on same level from slipping, tripping and stumbling* (15%), and *Other fall from one level to another* (8%).

Other fall on same level was also the most common nature of fall for people aged 45–64 years (21%), with *Fall on same level from slipping, tripping and stumbling* being the next most common (18%), followed by *Fall on and from steps and stairs* (13%), and *Fall on and from ladder* (9%).

In the 65+ age group, the most cases were reported for *Other fall on same level* (24%), followed by *Fall on same level from slipping, tripping and stumbling* (18%) and *Fall on and from steps and stairs* (9%). *Fall involving furniture* was reported for 6% of cases, with just over half of those cases involving a bed, and nearly all the rest involving a chair.

Table 2.11: TBI as Principal Diagnosis cases due to falls by age group and nature of fall, Australia 2004–05

	0–14 years		15–29 years		30–44 years		45–64 years		65+ years		All ages	
Nature of fall	**Count**	**Per cent**	**Count**	**Per cent**	**Count**	**Per cent**	**Count**	**Per cent**	**Count**	**Per cent**	**Count**	**Per cent**
Fall on same level from slipping, tripping and stumbling (W01)	155	*11.6*	88	*10.5*	96	*15.1*	158	*17.6*	408	*18.0*	905	*15.1*
Fall involving skateboard (W02.1)	51	*3.8*	30	*3.6*	..	..	0	*0.0*	..	..	84	*1.4*
Fall involving ice-skates, skis and roller skates (W02.0, W02.2–W02.5)	17	*1.3*	22	*2.6*	6	*0.9*	..	..	..	..	50	*0.8*
Other fall on same level due to collision with, or pushing by, another person (W03)	149	*11.2*	210	*25.1*	27	*4.3*	8	*0.9*	6	*0.3*	400	*6.7*
Fall while being carried or supported by other persons (W04)	42	*3.2*	7	*0.8*	..	..	..	..	..	..	52	*0.9*
Fall involving furniture (W06–W08)	228	*17.1*	19	*2.3*	24	*3.8*	44	*4.9*	134	*5.9*	449	*7.5*
Fall involving playground equipment (W09)	133	*10.0*	8	*1.0*	..	..	..	..	..	..	143	*2.4*
Fall on and from steps and stairs (W10)	63	*4.7*	62	*7.4*	101	*15.9*	121	*13.4*	201	*8.9*	548	*9.2*
Fall on or from ladder (W11)	..	..	16	*1.9*	27	*4.3*	83	*9.2*	88	*3.9*	219	*3.7*
Fall from, out of or through building or structure (W13)	62	*4.7*	56	*6.7*	36	*5.7*	60	*6.7*	33	*1.5*	247	*4.1*
Fall from tree (W14)	38	*2.9*	6	*0.7*	..	..	..	..	..	.	53	*0.9*
Fall from cliff (W15)	..	..	5	*0.6*	..	..	..	..	..	..	13	*0.2*
Other fall from one level to another (W05, W12, W16, W17)	146	*11.0*	70	*8.4*	53	*8.3*	61	*6.8*	58	*2.6*	388	*6.5*
Other fall on same level (W00, W18)	127	*9.5*	139	*16.6*	142	*22.4*	193	*21.4*	540	*23.8*	1,141	*19.1*
Unspecified fall (W19)	114	*8.6*	100	*11.9*	111	*17.5*	166	*18.4*	791	*34.9*	1,282	*21.5*
Total	**1,332**	***100***	**838**	***100***	**635**	***100***	**900**	***100***	**2,269**	***100***	**5,974**	***100***

.. Cell counts in tables that are 4 cases or fewer have been suppressed, as have percentages derived from them, to protect confidentiality.

Activity at time of injury

Of the 5,974 cases involving a *Fall,* only one case did not report an activity. Of the cases that did report an activity, 47% were specified activities, and the remainder were reported as having been engaged in an *unspecified activity* (Table 2.12). For those engaged in a *Sport* related activity at the time of injury, the largest proportion of cases were caused by an *Other fall on same level due to collision with, or pushing by, another person* (47% of cases). A much smaller proportion of cases were reported as being due to an *Other fall on same level* (12%), and for *Fall on same level from slipping, tripping and stumbling* (10%).

Of those people incurring a TBI whilst *Working for income* (n=37), 19% were injured in a *Fall on or from a ladder*, and 17% were injured due to a *Fall from, out of or through building or structure.* A further 17% of cases were reported as being caused by an *Other fall from one level to another.* Over one tenth of cases were due to a *Fall on same level from slipping, tripping and stumbling*.

Fall on or from a ladder (30%) was also the largest fall injury type for those engaged in *Other work*, and the proportion was larger than for those *Working for income* (19%). The proportion of *Fall on same level from slipping, tripping and stumbling* injuries was next highest (17%), followed by *Other fall on same level* (13%) and *Fall from, out of or through building or structure* (12%).

Place of occurrence of injury

For all Place of occurrence categories, the majority of types of *Fall* were reported as being *Other and unspecified* (Table 2.13). In the *Home*, 18% of cases were reported as being a *Slip, trip, stumble*, and 11% were *Falls on and from steps and stairs*. Mechanism of injury was not specified for most *Fall* cases occurring in *Residential institutions* (*Other and unspecified* 86%), with 11% of remaining cases being identified as *Slips, trips, stumbles*. Proportions for *Other and unspecified fall* and for *Slips, trips, stumbles* for Falls occurring in *Sports and athletics areas* were similar to the previous place of occurrence (89% and 9% respectively). A much higher proportion of *Slips, trips, stumbles* (32%) occurred in a *Street and highway* situation. For *Trade and service areas*, the highest proportion of cases were for Falls *on and from steps and stairs* (23%), and *Slips, trips and stumbles* (15%). In *Industrial and construction* areas, 33% of cases were *Falls from, out of or through building or* structure, and 15% were *Slips, trips, stumbles*.

Table 2.12: TBI as Principal Diagnosis cases due to Falls reported 2004–05 by activity and nature of fall, Australia 2004–05

	Sports		Working for income		Other work		Leisure		Other or unspecified		All activities	
Nature of fall	Count	Per cent	Count	Per cent	Count	Per cent	Count	Per cent	Count	Per cent	Count	Per cent
Fall on same level from slipping, tripping, stumbling (W01)	66	*9.6*	27	*13.6*	41	*17.0*	28	*14.4*	743	*16.0*	905	*15.1*
Fall involving skateboard (W02.1)	50	*7.3*	0	*0.0*	0	*0.0*	7	*3.6*	27	*0.6*	84	*1.4*
Other fall on same level due to collision with, or pushing by, another person (W03)	322	*46.8*	..	..	..	..	11	*5.7*	61	*1.3*	400	*6.7*
Fall on or from ladder (W11)	0	*0.0*	37	*18.7*	73	*30.3*	0	*0.0*	109	*2.3*	219	*3.7*
Fall on or from scaffolding (W12)	0	*0.0*	15	*7.6*	..	..	0	*0.0*	..	..	20	*0.3*
Fall from, out of or through building or structure (W13)	..	..	34	*17.2*	29	*12.0*	12	*6.2*	168	*3.6*	247	*4.1*
Other fall from one level to another (W17)	25	*3.6*	33	*16.7*	13	*5.4*	17	*8.8*	241	*5.2*	329	*5.5*
Other fall on same level (W18)	83	*12.1*	20	*10.1*	32	*13.3*	23	*11.9*	979	*21.0*	1,137	*19.0*
Other/unspecified fall (W00, 02.0, 02.2–02.5, 04–10, 14–16, 19)	138	*20.1*	32	*16.2*	48	*19.9*	96	*49.5*	2,319	*49.9*	2,633	*44.1*
Total	**688**	***100***	**200**	***100***	**241**	***100***	**194**	***100***	**4,651**	***100***	**5,974**	***100***

.. Cell counts in tables that are 4 cases or fewer have been suppressed, as have percentages derived from them, to protect confidentiality.

Table 2.13: TBI as Principal Diagnosis cases due to Falls by place of occurrence and nature of fall, Australia 2004–05

	Fall on same level from slipping, tripping and stumbling		Fall on and from steps and stairs		Fall from, out of or through building or structure		Other and unspecified fall		Total cases	
Place of occurrence	**Count**	**Per cent**	**Count**	**Per cent**	**Count**	**Per cent**	**Count**	**Per cent**	**Count**	**Per cent**
Home	419	*18.1*	263	*11.4*	118	*5.1*	1,510	*65.4*	2,310	*100*
Residential institutions	49	*11.2*	6	*1.4*	6	*1.4*	377	*86.1*	438	*100*
Aged care facilities	*48*	*98.0*	*5*	*83.3*	..	..	*359*	*95.2*	*416*	
Other specified residential institution	..	..	..	..	..	..	*18*	*4.8*	*22*	
Institution and public administrative area	52	*16.0*	24	*7.4*	7	*2.2*	241	*74.4*	324	*100*
School	*31*	*59.6*	*12*	*50.0*	*5*	*71.4*	*168*	*69.7*	*108*	
Other specified institution and public administrative area	*21*	*40.4*	*12*	*50.0*	..	..	*73*	*30.3*	*216*	
Sports and athletic area	42	*9.0*	5	*1.1*	..	..	417	*89.1*	468	*100*
Outdoor sporting ground	*18*	*42.9*	..	..	..	..	*290*	*69.5*	*312*	
Other sporting place	*24*	*57.1*	..	..	..	..	*127*	*30.5*	*156*	
Street and highway	96	*32.4*	7	*2.4*	0	*0.0*	193	*65.2*	296	*100*
Road	*32*	*33.3*	..	..	*0*	*0.0*	*72*	*37.3*	*106*	
Sidewalk	*61*	*63.5*	*5*	*71.4*	*0*	*0.0*	*113*	*58.5*	*179*	
Unspecified public highway, street or road	..	..	..	..	*0*	*0.0*	*8*	*4.1*	*12*	
Trade and service area	59	*15.3*	87	*22.5*	13	*3.4*	227	*58.8*	386	*100*
Cafe, hotel and restaurant	*32*	*54.2*	*55*	*63.2*	*8*	*61.5*	*129*	*56.8*	*224*	
Other and unspecified trade and service area	*27*	*45.8*	*32*	*36.8*	*5*	*38.5*	*98*	*43.2*	*459*	
Industrial and construction area	10	*16.4*	..	..	20	*32.8*	35	*57.4*	61	*100*
Other specified place of occurrence	57	*20.5*	15	*5.4*	12	*4.3*	189	*68.0*	278	*100*
Unspecified/Unreported place of occurrence	121	*8.6*	140	*9.9*	66	*4.7*	1,085	*76.8*	1,412	*100*
Total	**905**	***15.1***	**548**	***9.2***	**247**	***4.1***	**4,274**	***71.5***	**5,974**	***100***

.. Cell counts in tables that are 4 cases or fewer have been suppressed, as have percentages derived from them, to protect confidentiality.

Length of hospital stay

Of the top four specified natures of fall, the longest ALOS were reported for *Other fall on same level* and for *Fall on and from steps and stairs* (both 5 bed days) (Table 2.14). While the ALOS for males for *Fall on and from steps and stairs* was nearly double that for females, the ALOS for *Other fall on same* level was higher for females than for males. Both *Other fall on same level* and *Fall on and from steps and stairs* also had the highest proportion of deaths whilst in hospital, 9% and 8% respectively. The probability of survival was higher for *Other fall on same level* (mean ICISS score 0.8265) than for *Fall on and from steps and stairs* (0.8023).

Falling on same level from slipping, tripping and stumbling cases reported an ALOS of 4.4 bed days, and there was little difference between the ALOS for males and females. The proportion of cases for this group that resulted in death in hospital was 5.5%.

TBI cases resulting from *Other fall on same level due to collision with, or pushing by, another person* reported the lowest ALOS of the selected fall types (1.3 days), with no difference between the ALOS for males and females. This fall type also reported the lowest recorded proportion of cases resulting in death (0.3%), and had the highest probability of survival (ICISS mean score 0.9700).

Table 2.14: Length of hospital stay for TBI as Principal Diagnosis cases due to top four natures of Fall reported 2004–05, by sex, all ages

Principal Diagnosis by body region		Males	Females	Persons	
Other fall on same level (W00 and W18)	Cases	643	498	1,141	m:f 1.3:1
	Bed days[(a)]	2,938	2,731	5,669	
	ALOS	4.6	5.5	5.0	
	Mean ICISS[(b)]	0.8309	0.8208	0.8265	
	Died in hospital[(c)]	54	44	98	*8.9%* died
Falling on same level from slipping, tripping and stumbling (W01)	Cases	447	458	905	m:f 1:1
	Bed days[(a)]	2,033	1,987	4,020	
	ALOS	4.5	4.3	4.4	
	Mean ICISS[(b)]	0.8539	0.8698	0.8620	
	Died in hospital[(c)]	19	31	50	*5.5%* died
Fall on and from steps and stairs (W10)	Cases	300	248	548	m:f 1.2:1
	Bed days[(a)]	1,878	838	2,716	
	ALOS	6.3	3.4	5.0	
	Mean ICISS[(b)]	0.7838	0.8249	0.8023	
	Died in hospital[(c)]	26	19	45	*8.2%* died
Other fall on same level due to collision with, or pushing by, another person (W03)	Cases	334	66	400	m:f 5.1:1
	Bed days[(a)]	432	85	517	
	ALOS	1.3	1.3	1.3	
	Mean ICISS[(b)]	0.9690	0.9752	0.9700	
	Died in hospital[(c)]	..	0	..	*0.3%* died

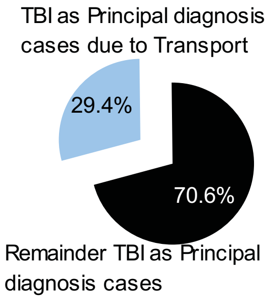
(a) Includes inward transfers for total length of hospital stay per case.
(b) Mean ICISS based on cases.
(c) Includes inward transfers for total deaths in hospital.
.. Cell counts in tables that are 4 cases or fewer have been suppressed to protect confidentiality.

Transport related injury

Overview

Transport related injury accounted for 29.4% of all TBI as Principal Diagnosis cases (Table 2.15). Nearly 70% of Principal Diagnosis transport cases were males, who acquired TBI at more than twice the rate of females. Mean length of hospital stay was elevated, due to one female case having an unusually long period of hospitalisation (more than 1,000 days).

Table 2.15: TBI as Principal Diagnosis cases due to Transport reported 2004–05, selected indicators, Australia

	Reported TBI as Principal Diagnosis cases due to Transport				In proportion to TBI as Principal Diagnosis cases
Indicators	**Males**	**Females**	**Persons**	**Ratio m:f**	
Number of TBI as Principal Diagnosis cases caused by Transport injury[(a)]	2,888	1,290,	4,178[(a)]	2.2	
Proportion of all TBI as Principal Diagnosis cases[(b)]	*29.6%*	*29.0%*	*29.4%*		
Age standardised (direct) rate/100,000 population	28.8	12.9	20.9	2.2	
Mean length of stay	5.4	7.9	6.2		
Total bed days[(b)]	15,567	10,162[(c)]	25,729[(c)]		

(a) Excludes inward transfers from other acute care hospitals (m=286, f=130).
(b) Includes inward transfers from other acute care hospitals for total bed days (m=286, f=130).
(c) Includes 1 case where the reported length of stay was greater than 1,000 days.

Age and sex distribution

The pattern of rates of Transport related cases of TBI was similar for both sexes, but males were over represented compared to females in all age groups (Figure 2.7). Rates were highest for both males and females in the 15–19 age group, the rate for males being 2.1 times higher than the rate for females. The next highest rate of hospitalisation for both groups was in the 20–24 age group, with the rate for males being nearly three times higher than the rate for females. The 10–14 age group reported the next highest rates, where again the rate for males was substantially higher for males than for females (2.3:1). Rates gradually declined for both groups from the 25–29 age group to the 70–74 age group, after which there was some increase, particularly for males and females in the 80–84 age group.

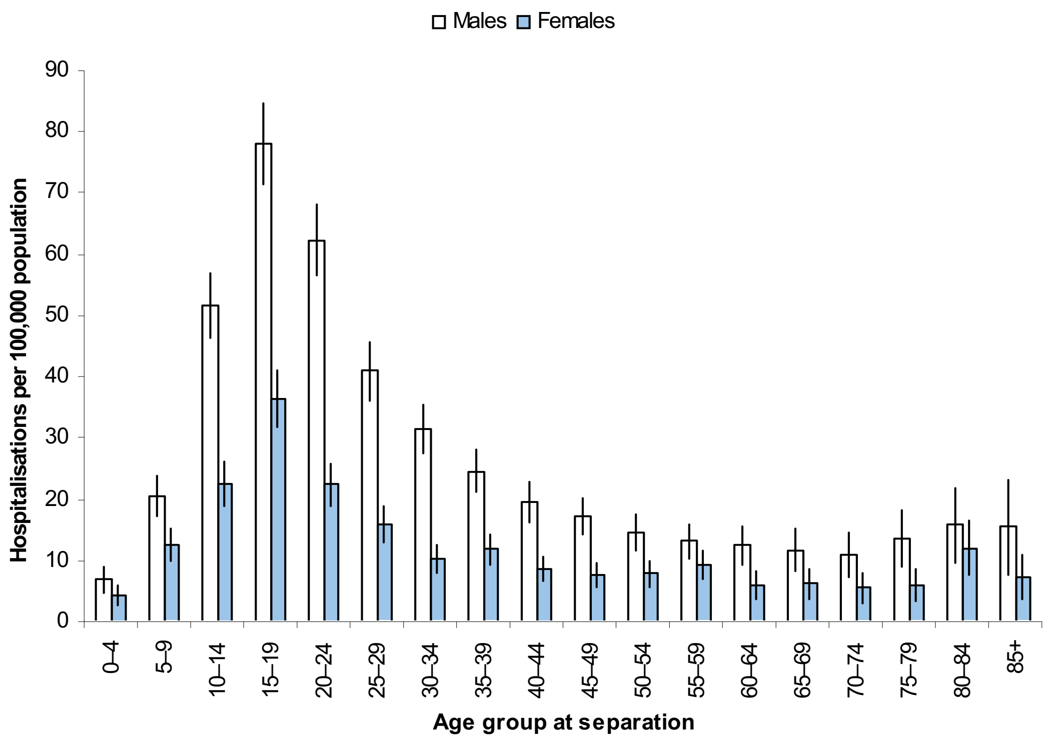


Figure 2.7: TBI as Principal Diagnosis cases due to Transport by age and sex, Australia 2004–05

Trend over time

Rates of Transport-related TBI have been consistently much higher for males than for females over the six year period from 1999–00 to 2004–05 (Figure 2.8). The rate for females declined slightly over the reporting period, while the rate for males showed small fluctuations.

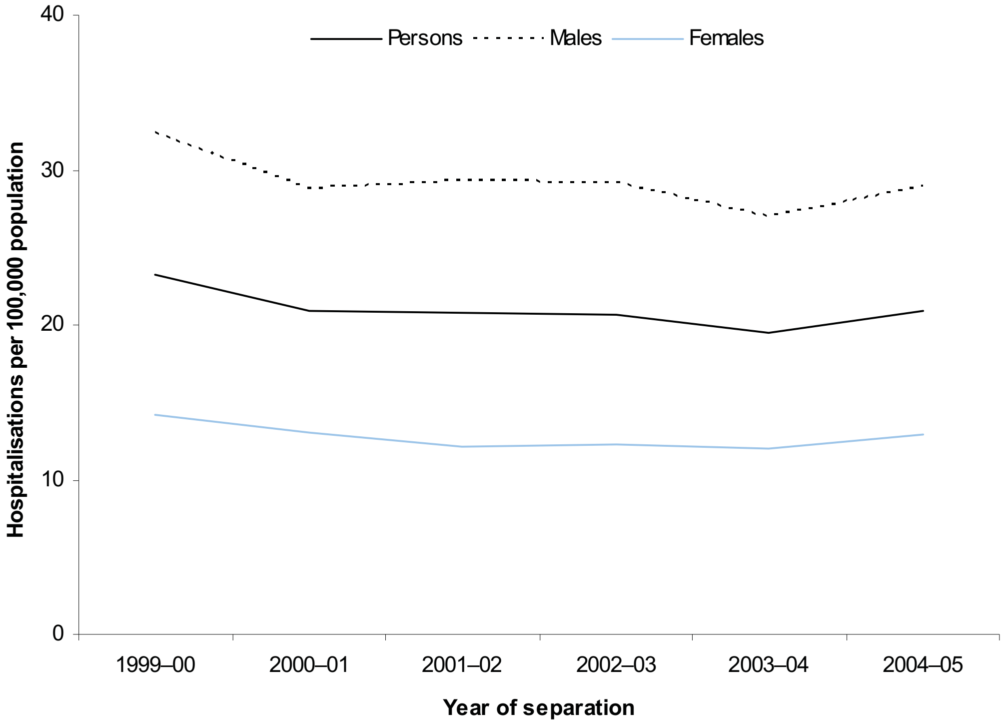


Figure 2.8: TBI as Principal Diagnosis cases due to Transport, Australia 1999–00 to 2004–05, age standardised rates

Road user type

Of the different road user types specified, the highest proportion of separations was reported for *Occupants of cars* (35%), with the proportion for females being higher than that for males (Table 2.16). Within that category, *Drivers* were most affected (63% of the category), the proportion higher for males than for females. *Passengers* were identified as the next highest proportion (28%), while only a very small percentage of cases were identified as being for *Persons on outside of car/Persons boarding or alighting*.

Motor cyclists were the road users with the second highest proportion of TBI (19% of all cases), with a much larger proportion of cases for males (24%) than for females (6%). *Pedal cyclists* accounted for 17% of cases, again with a much higher proportion of males than females affected. Where *Other land transport* could be identified, 450 cases involved an *Animal-rider or occupant of animal drawn vehicle*. Less than 10% of all cases were for *Pedestrians* (n=408), and less than 2% of cases were reported for *Occupants of heavy transport vehicles* or for *Occupants of pick-up trucks or vans*.

Table 2.16: TBI as Principal Diagnosis cases due to Transport by road user type and sex, Australia 2004–05

	Male		Female		Persons	
Road user type	**Count**	**Per cent**	**Count**	**Per cent**	**Count**	**Per cent**
Pedestrian (V01–V09)	238	*8.2*	170	*13.2*	408	*9.8*
Pedal cyclist (V10–V19)	577	*20.0*	139	*10.8*	716	*17.1*
Motor cyclist (V20–V29)	702	*24.3*	72	*5.6*	774	*18.5*
Occupant of 3-wheeled motor vehicle (V30–V39)	6	*0.2*	..	..	..	..
Occupant of car (V40–V49)	929	*32.2*	524	*40.6*	1,453	*34.8*
Driver	*614*	*66.1*	*302*	*57.6*	*916*	*63.0*
Passenger	*222*	*23.9*	*178*	*34.0*	*400*	*27.5*
Person on outside of car/Person boarding or alighting	*22*	*1.2*	*16*	*1.7*	*38*	*1.4*
Unspecified occupant	*71*	*7.6*	*28*	*5.3*	*99*	*6.8*
Occupant of pick-up truck or van (V50–V59)	49	*1.7*	8	*0.6*	57	*1.4*
Occupant of heavy transport vehicle (V60–V69)	69	*2.4*	..	..	..	..
Occupant of bus (V70–V79)	10	*0.3*	18	*1.4*	28	*0.7*
Other land transport (V80–V89)	241	*8.3*	340	*26.4*	581	*13.9*
Animal-rider or occupant of animal drawn vehicle (V80)	*137*	*56.8*	*313*	*92.1*	*450*	*77.5*
Other and unspecified land transport (V81–V89)	*104*	*43.2*	*27*	*7.9*	*131*	*22.5*
Other and unspecified transport (V90–V99)	67	*2.3*	15	*1.2*	82	*2.0*
Total	**2,888**	***100***	**1,290**	***100***	**4,178**	***100***

Subgroup proportions are percentages relating to that road user group.
.. Cell counts in tables that are 4 cases or fewer have been suppressed, as have percentages derived from them, to protect confidentiality.

The largest proportion of injury to 0–14 year olds was for road users reported as being *Pedal cyclists* (41%), followed by *Motor cyclists* (20%) (Table 2.17). *Other land transport* accounted for 19% of cases, with the majority of those being specified as *Animal-rider or occupant of animal drawn vehicle* cases, while 9.5% of cases were reported as being for *Occupant of car*.

Both the 15–29 and the 30–44 age groups had the largest proportion of cases for *Occupant of car*, followed by *Motor cyclists*, then *Other land transport*, then *Pedal cyclists* and *Pedestrians*. For both age groups, the largest proportion of *Occupant of car* were *Drivers*, although the proportion was much higher for cases in the 30–44 age group. Of 15–29 year olds, 31% were injured as *Passengers*, while in the 30–44 years age group the proportion was 15%. In the road user category *Other land transport*, the high majority of cases were reported as being for *Animal-rider or occupant of animal drawn vehicle* cases. The 30–44 age group had a slightly higher proportion of *Pedestrian* cases than the 15–29 age group.

Occupant of car cases was also the largest road user group for 45–64 year olds (33%) and for those aged 65 and older (40%). For both age groups, the most cases were reported for *Drivers*, followed by *Passengers*. *Other land transport* (16%), followed by *Pedal cyclist* (15%), *Motor cyclist* (14%) and *Pedestrian* (12%) were the next largest road user types for 45–64 year olds. For those aged 65 and older, *Pedestrian* was the second largest road user type at 27%, followed by *Pedal cyclist* and *Other land transport* (both 10%) and *Occupant of bus or 3 wheeled motor vehicle* (4%).

For all ages, the ranked top five road user types were *Occupant of car* (35%), *Motor cyclist* (19%), *Pedal cyclist* (17%), *Other land transport* (14%) and *Pedestrian* (10%).

Table 2.17: TBI as Principal Diagnosis cases due to Transport by road user type, in life stage age groups, Australia 2004–05

	Age group											
	0–14		15–29		30–44		45–64		65+		Total cases	
Road user type	**Count**	**Per cent**	**Count**	**Per cent**	**Count**	**Per cent**	**Count**	**Per cent**	**Count**	**Per cent**	**Count**	**Per cent**
Pedestrian (V01–V09)	67	*8.3*	136	*7.6*	71	*9.2*	66	*12.0*	68	*26.7*	408	*9.8*
Pedal cyclist (V10–V19)	330	*40.7*	194	*10.9*	82	*10.6*	84	*15.2*	26	*10.2*	716	*17.1*
Motor cyclist (V20–V29)	160	*19.7*	393	*22.0*	135	*17.4*	77	*14.0*	9	*3.5*	774	*18.5*
Occupant of car (V40–V49)	77	*9.5*	769	*43.0*	320	*41.3*	184	*33.4*	103	*40.4*	1,453	*34.8*
Driver	*6*	*7.8*	*459*	*59.7*	*250*	*78.1*	*133*	*72.3*	*68*	*66.0*	*916*	*63.0*
Passenger	*60*	*77.9*	*236*	*30.7*	*47*	*14.7*	*34*	*18.5*	*23*	*22.3*	*400*	*27.5*
Person on outside of car/Person boarding or alighting	..	..	*18*	*2.3*	..	..	*7*	*3.8*	*7*	*6.8*	*38*	*2.6*
Unspecified occupant	*7*	*9.1*	*56*	*7.3*	*19*	*5.9*	*12*	*6.5*	*5*	*4.9*	*99*	*6.8*
Occupant of pick-up truck or van (V50–V59)	6	*0.7*	32	*1.8*	14	*1.8*	..	..	..	..	57	*1.4*
Occupant of heavy transport vehicle (V60–V69)	0	*0.0*	13	*0.7*	22	*2.8*	31	*5.6*	6	*2.4*	72	*1.7*
Occupant of bus (V70–V79) or 3-wheeled motor vehicle (V30–V39) (a)	..	..	8	*0.4*	..	..	9	*1.6*	11	*4.3*	35	*0.8*
Other land transport (V80–V89)	153	*18.9*	208	*11.6*	107	*13.8*	87	*15.8*	26	*10.2*	581	*13.9*
Animal-rider or occupant of animal drawn vehicle (V80)	*120*	*78.4*	*166*	*79.8*	*88*	*82.2*	*65*	*74.7*	*11*	*42.3*	*450*	*77.5*
Other and unspecified land transport (V81–V89)	*33*	*21.6*	*42*	*20.2*	*19*	*17.8*	*22*	*25.3*	*15*	*57.7*	*131*	*22.5*
Other and unspecified transport (V90–V99)	17	*2.1*	34	*1.9*	18	*2.3*	9	*1.6*	..	..	82	*2.0*
Total	**811**	***100***	**1,787**	***100***	**774**	***100***	**551**	***100***	**254**	***100***	**4,178**	***100***

(a) Categories combined, low cell counts.
Subgroup proportions are percentages relating to that road user group.
.. Cell counts in tables that are 4 cases or fewer have been suppressed, as have percentages derived from them, to protect confidentiality.

Activity at time of injury

A high proportion of cases (91%) reported either *Activity not recorded*, or *Other specified and unspecified* activity (Table 2.18). Of the 395 cases that did have a specified Activity reported, 241 cases showed the injury event was associated with a *Cycling sport*, with 82% of those cases being for males. *BMX cycling* accounted for about a fifth of *Cycling sport* TBI.

Cases reported as occurring whilst *Working for income* amounted to 154 cases. Of these, 31% were for the *Agriculture, forestry and fishing* industries, and 18% were for *Transport and storage* work.

Table 2.18: TBI as Principal Diagnosis cases due to Transport by Activity, Australia 2004–05

	Males		Females		Persons	
Activity	**Count**	**Per cent**	**Count**	**Per cent**	**Count**	**Per cent**
While engaged in cycling sports	198	*6.9*	43	*3.3*	241	*5.8*
Cycling—BMX	*48*	*24.2*	*..*	*..*	*50*	*20.7*
Cycling—Mountain	*15*	*7.6*	*..*	*..*	*18*	*7.5*
Cycling—Road	*14*	*7.1*	*..*	*..*	*17*	*7.1*
Cycling, unspecified and other unspecified	*121*	*61.1*	*35*	*81.4*	*156*	*64.7*
While working for income	131	*4.5*	23	*1.8*	154	*3.7*
Working for income—Agriculture, forestry and fishing	*38*	*29.0*	*10*	*43.5*	*48*	*31.2*
Working for income—Transport and storage	*28*	*21.4*	*0*	*0.0*	*28*	*18.2*
Other specified work for income	*43*	*32.8*	*10*	*43.5*	*53*	*34.4*
While working for income, unspecified	*22*	*16.8*	*..*	*..*	*25*	*16.2*
Other specified and unspecified activity	8	*0.3*	10	*0.8*	18	*0.4*
Activity not recorded	2,551	*88.3*	1,214	*94.1*	3,765	*90.1*
All activities	**2,888**	***100***	**1,290**	***100***	**4,178**	***100***

Subgroup proportions are percentages relating to that diagnosis group.
.. Cell counts in tables that are 4 cases or fewer have been suppressed, as have percentages derived from them, to protect confidentiality.

Place of occurrence of injury

Close to 20% of transport-related cases had either no place of occurrence or an unspecified place reported (Table 2.19).

As might be expected, most cases with a specified place reported place of occurrence as a *Street of highway* (60% of all cases), with the proportion of cases for males closely similar to that of cases for females. Over 90% of those cases further specified *Roadway*, 2% specified *Sidewalk* and less than 1% specified *Cycleway*.

Sports and athletics areas were reported in 7% of cases, with twice the proportion of cases for males than for females. A large proportion of cases were specified as having occurred at a *Racetrack and racecourse/Equestrian facility*.

Of cases occurring at *Industrial and construction areas* (4% of all cases), most were further specified as having occurred on a *Farm*.

A very small proportion of cases (3%) were reported as having occurred at *Home*, with 18 of the 105 cases further specified as having occurred in a *Driveway*.

Table 2.19: TBI as Principal Diagnosis cases due to Transport by road user type and major specified Place of occurrence, Australia 2004–05

	Males		Females		Persons	
Place of occurrence	**Count**	**Per cent**	**Count**	**Per cent**	**Count**	**Per cent**
Home	63	*2.2*	42	*3.3*	105	*2.5*
Driveway	*10*	*15.9*	*8*	*19.0*	*18*	*17.1*
Other and unspecified place in home	*53*	*84.1*	*34*	*81.0*	*87*	*82.9*
Sports and athletics area	238	*8.2*	51	*4.0*	289	*6.9*
Racetrack and racecourse/Equestrian facility	*171*	*71.8*	*41*	*80.4*	*212*	*73.4*
Other specified and unspecified sports and athletics area	*67*	*28.2*	*10*	*19.6*	*77*	*26.6*
Street and highway	1,708	*59.1*	781	*60.*	2,489	*59.6*
Roadway	*1,592*	*93.2*	*732*	*93.7*	*2,324*	*93.4*
Sidewalk	*35*	*2.0*	*18*	*2.0*	*53*	*2.1*
Cycleway	*12*	*0.7*	..	..	*15*	*0.6*
Other specified and unspecified public highway, street or road	*69*	*4.0*	*28*	*3.6*	*97*	*3.9*
Trade and service area	..	..	..	..	8	*0.2*
Industrial and construction area	118	*4.1*	58	*4.5*	176	*4.2*
Farm	*107*	*90.7*	*57*	*98.3*	*164*	*93.2*
Other specified and unspecified industrial and construction area	..	..	..	..	*12*	*6.8*
Other specified place of occurrence	209	*7.2*	73	*5.7*	282	*6.7*
Large area of water	*20*	*9.6*	*6*	*8.2*	*26*	*9.2*
Other specified and unspecified place of occurrence	*189*	*90.4*	*67*	*91.8*	*219*	*77.7*
Unspecified place of occurrence/Place not reported	545	*18.9*	284	*22.0*	829	*19.8*
All places	**2,888**	***100***	**1,290**	***100***	**4,178**	***100***

Subgroup proportions are percentages relating to that diagnosis group.
.. Cell counts in tables that are 4 cases or fewer have been suppressed, as have percentages derived from them, to protect confidentiality.

Length of hospital stay

Of the top four specified road user types, the longest Average length of stay (ALOS) was reported for *Pedestrians* (10.7 days), followed by *Occupant of car* (10.5 days), *Motor cyclists* (5 days) and *Pedal cyclists* (3.1 days) (Table 2.20). ALOS was exactly the same for male and female *Pedal cyclists*. Cases for male *Pedestrians* reported a longer stay than cases for females, and male *Motor cyclists* had a slightly longer length of stay than did cases for females, while cases for female *Occupants of cars* reported a notably longer ALOS than did cases for males. This is in part influenced by one case for a female that reported more than 1,000 bed days. The specified road user type with the lowest case numbers (*Pedestrian*), reported a slightly higher ALOS than the road user type with the highest number of cases (*Occupant of car*).The highest proportion of road users who died in hospital were unprotected *Pedestrians* (12%), followed by *Occupant of car* (5%). *Pedestrian* cases reported the lowest mean ICISS scores, with males having a 65%, and females a 66% probability of survival. *Motor cyclists* cases had much higher survival probabilities: 85% for males and 88% for females, and the survival probability was higher still for *Pedal cyclist* cases (90% for males and 92% for females).

Table 2.20: Length of hospital stay for TBI as Principal Diagnosis cases due to transport injury by top four road user types, by sex, all ages, Australia 2004–05

Principal Diagnosis by body region		Males	Females	Persons	
Pedestrian (V01–V09)	Cases	238	170	408	m:f 1.4:1
	Bed days[(a)]	2,690	1,689	4,379	
	ALOS	11.3	9.9	10.7	
	Mean ICISS[(b)]	0.6453	0.6647	0.6534	
	Died in hospital[(d)]	29	27	56	*13.7%* died
Pedal cyclist (V10–V19)	Cases	577	139	716	m:f 4.2:1
	Bed days[(a)]	1,798	424	2,222	
	ALOS	3.1	3.1	3.1	
	Mean ICISS[(b)]	0.8992	0.9162	0.9025	
	Died in hospital[(d)]	5	..	..	*1.0%* died
Motor cyclist (V20–V29)	Cases	702	72	774	m:f 9.8:1
	Bed days[(a)]	3,538	309	3,847	
	ALOS	5.0	4.3	5.0	
	Mean ICISS[(b)]	0.8526	0.8841	0.8555	
	Died in hospital[(d)]	16	..	..	*2.2%* died
Occupant of car (V40–V49)	Cases	929	524[(c)]	1,453[(c)]	m:f 1.7:1
	Bed days[(a)]	7,541	7,740[(c)]	15,281[(c)]	
	ALOS	8.1	14.8	10.5	
	Mean ICISS[(b)]	0.7954	0.8125	0.8016	
	Died in hospital[(d)]l	49	26	75	*5.2%* died

(a) Includes inward transfers for total length of hospital stay per case.
(b) Mean ICISS based on cases.
(c) Includes 1 case where the reported length of stay was greater than 1,000 days.
(d) Includes inward transfers for total deaths in hospital.
.. Cell counts in tables that are 4 cases or fewer have been suppressed, as have percentages derived from them, to protect confidentiality.

Assault related injury

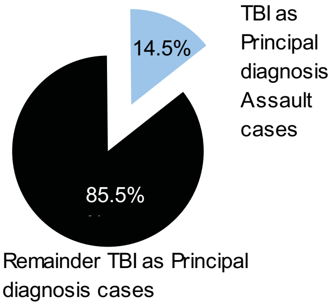
Overview

Assault related TBI made up 15% of all Principal Diagnosis TBI cases (Table 2.21). The age standardised rate for Assault injuries for persons (10.3) was much lower than for cases due to Falls (29.1) or due to Transport (20.9) injuries. While males were over represented compared to females, by five assault cases to one, the mean length of bed stay was slightly lower for males than for females.

Table 2.21: TBI as Principal Diagnosis cases due to Assault reported 2004–05, selected indicators, Australia

	Reported TBI as Principal Diagnosis cases due to Assault			
Indicators	**Males**	**Females**	**Persons**	**Ratio m:f**
Number of TBI as Principal Diagnosis cases caused by Assault[(a)]	1,711	334	2,045	5.1
Proportion of all TBI as Principal Diagnosis cases	*17.6*	*7.5*	*14.4*	
Age standardised (direct) rate/100,000 population	17.2	3.4	10.3	5.1
Mean length of stay	3.3	3.8	3.4	
Total bed days[(b)]	5,690	1,258	6,948	

In proportion to all TBI as Principal Diagnosis cases



(a) Excludes inward transfers from other acute care hospitals (m=120, f=30).
(b) Includes inward transfers from other acute care hospitals for total bed days (m=120, f=30).

Age and sex distribution

The pattern of rates was similar for males and females across age groups (Figure 2.9). In almost all age groups, rates for males were much higher than rates for females. The rate was highest for males in the 20–24 age group, and rates for males were five to seven times the rates for females from 15–19 years through to 30–34 years.

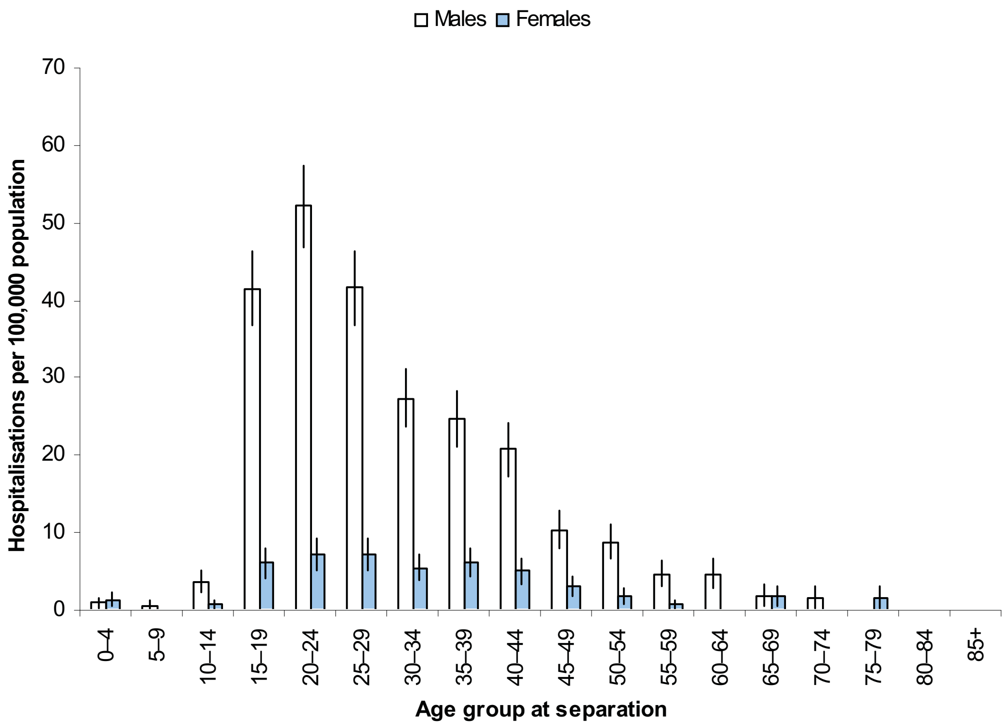


Figure 2.9: TBI as Principal Diagnosis cases due to Assault by age and sex, Australia 2004–05

Trend over time

Rates of hospitalisation for Principal Diagnosis cases of TBI due to assault were between four and six times higher for males than for females over the six year period (Figure 2.10). The rate for females declined from 2001–02 to finish slightly lower in 2004–05 than the starting period.

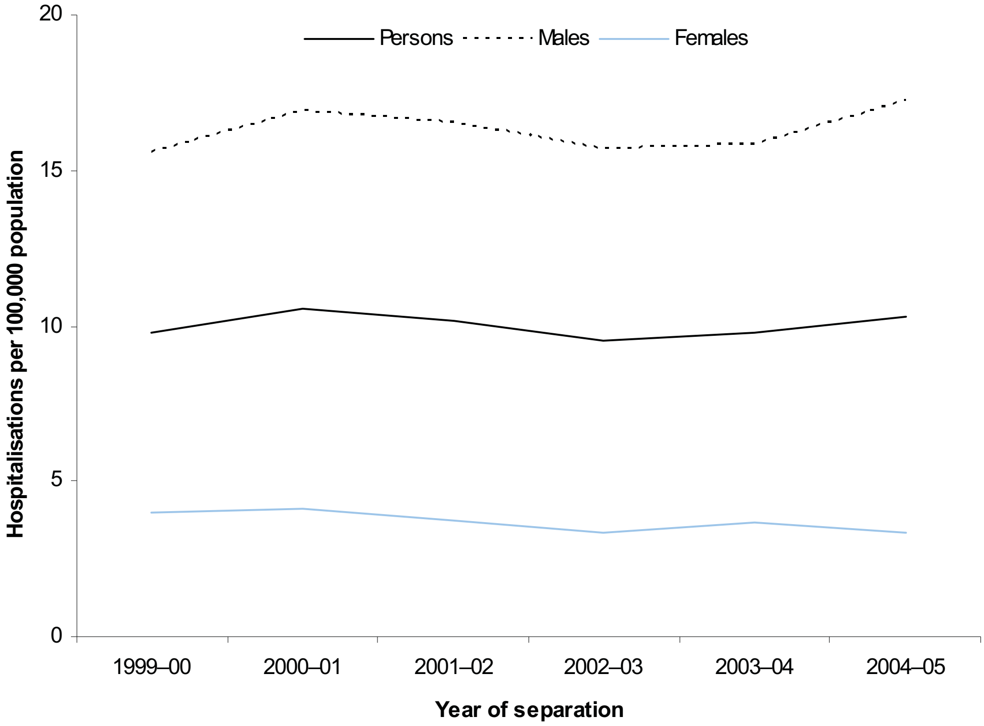


Figure 2.10: TBI as Principal Diagnosis cases due to Assault, Australia 1999–00 to 2004–05, age standardised rates

Mechanism of assault by sex

Assault by bodily force was the mechanism that accounted for the highest proportion of Principal Diagnosis TBI assault cases for both males (67% of cases) and females (62% of cases) (Table 2.22). *Assault by blunt object* was reported as the mechanism of injury for a higher proportion of cases for females (19%) than cases for males (14%). A much smaller proportion of cases were reported as being due to *Assault by sharp object* (less than 2% of cases for both males and females).

Table 2.22: TBI as Principal Diagnosis cases due to Assault by mechanism and sex, Australia 2004–05

	Male		Female		Persons	
Mechanism of assault	**Count**	**Per cent**	**Count**	**Per cent**	**Count**	**Per cent**
Assault by sharp object (X99)	25	*1.5*	6	*1.8*	31	*1.5*
Assault by glass	..	..	..	..	*15*	*48.4*
Assault by other and unspecified sharp object	..	..	..	.	*16*	*51.6*
Assault by blunt object (Y00)	238	*13.9*	63	*18.9*	301	*14.7*
Assault by bodily force (Y04)	1,139	*66.6*	206	*61.7*	1,345	*65.8*
Assault by other specified means (X85–X98, Y01–Y03,Y05–Y08, Y35.6)	32	*1.9*	23	*6.9*	55	*2.7*
Assault by unspecified means (Y09, Y87.1)	277	*16.2*	36	*10.8*	313	*15.3*
Total	**1,711**	***100***	**334**	***100***	**2,045**	***100***

Subgroup proportions are percentages relating to that diagnosis group.
.. Cell counts in tables that are 4 cases or fewer have been suppressed, as have percentages derived from them, to protect confidentiality.

Mechanism of assault by age group

In all age groups *Assault by bodily force* accounted for the majority of cases, with the largest proportion being for 15–29 year olds (70%) (Table 2.23). Cases of *Assault by blunt object* ranged between 10% of cases for 0–14 year olds, and 18% of cases for 30–44 year olds and 45–64 year olds. A very small proportion of cases (less than 2% in any age group) were reported as being due to *Assault by sharp object*, and no cases for this mechanism were reported for the 0–14 age group. *Assault by other specified* and *Assault by unspecified means* accounted for 36% of cases for 0–14 year olds, and around 20% of cases in the other age groups.

Table 2.23: TBI as Principal Diagnosis cases due to Assault by mechanism, in life stage age groups, Australia 2004–05

	Age group											
	0–14		15–29		30–44		45–64		65+		Total cases	
Mechanism of assault	**Count**	**Per cent**	**Count**	**Per cent**	**Count**	**Per cent**	**Count**	**Per cent**	**Count**	**Per cent**	**Count**	**Per cent**
Assault by sharp object (X99)	0	*0.0*	21	*1.9*	8	*1.2*	..	..	..	..	31	*1.5*
Assault by blunt object (Y00)	5	*10.2*	132	*12.1*	119	*18.4*	40	*17.8*	5	*16.7*	301	*14.7*
Assault by bodily force (Y04)	26	*53.1*	771	*70.4*	389	*60.2*	142	*63.1*	17	*56.7*	1,345	*65.8*
Assault by other specified means (X85–X98, Y01–Y03, Y05–Y08, Y35.6)	9	*18.4*	23	*2.1*	18	*2.8*	..		..	..	55	*2.7*
Assault by unspecified means (Y09, Y87.1)	9	*18.4*	148	*13.5*	112	*17.3*	38	*16.9*	6	*20.0*	313	*15.3*
Total	**49**	***100***	**1,095**	***100***	**646**	***100***	**225**	***100***	**30**	***100***	**2,045**	***100***

.. Cell counts in tables that are 4 cases or fewer have been suppressed, as have percentages derived from them, to protect confidentiality.

Relationship of victim to perpetrator

A high proportion of males (66%) reported the assault as being perpetrated by an *Unspecified person*, compared to 39% of females (Table 2.24). For females, the largest proportion of cases with a specified perpetrator was for *Spouse or domestic partner* (34%), only a small proportion of cases for males were reported for this category (2%). *Other family member* was the second most common perpetrator relationship for females (11%), followed by *Acquaintance or friend* (5%) and *Person unknown to the victim* (5%). *Person unknown to victim* was the most common specified perpetrator relationship for males (10%), followed by *Multiple persons unknown to the victim* (9%).

Table 2.24: TBI as Principal Diagnosis cases due to Assault by sex and relationship of victim to perpetrator, Australia 2004–05

	Males		Females		Persons	
Relationship to perpetrator	**Count**	**Per cent**	**Count**	**Per cent**	**Count**	**Per cent**
Spouse or domestic partner	25	*1.5*	114	*34.1*	139	*6.8*
Parent	..	..	..	..	11	*0.5*
Other family member	43	*2.5*	36	*10.8*	79	*3.9*
Acquaintance or friend	69	*4.0*	15	*4.5*	84	*4.1*
Official authorities	19	*1.1*	0	*0.0*	19	*0.9*
Person unknown to the victim	177	*10.3*	15	*4.5*	192	*9.4*
Multiple persons unknown to the victim	151	*8.8*	..	..	158	*7.7*
Other specified person	84	*4.9*	13	*3.9*	97	*4.7*
Unspecified person/not violence related	1,135	*66.3*	131	*39.2*	1,266	*61.9*
Total	**1,711**	***100***	**334**	***100***	**2,045**	***100***

.. Cell counts in tables that are 4 cases or fewer have been suppressed, as have percentages derived from them, to protect confidentiality.

Activity at time of injury

Of all Principal Diagnosis TBI hospitalisations resulting from Assault, 70% of cases reported the activity at the time of the injury as *Unspecified*, 18% of cases as *Other specified* activity, and 7% as occurring during a *Leisure* activity. Only 2% were reported as occurring whilst performing a *Work* function, and less than 1% during a *Sport* activity.

Place of occurrence of injury

Of all Assault related TBI as Principal Diagnosis cases, 49% reported place of occurrence as being either *Other specified* or *Other unspecified assault* (Table 2.25).

Of all Assaults resulting in Principal Diagnosis cases of injury that occurred in a specified place, the highest proportion (20%) were reported as occurring in a *Trade and service area*, with a higher proportion of cases reported for males (23%) than for females (8%). Of all *Trade and service area* assaults, 82% occurred in a *Café, hotel or restaurant*, with the proportion for males similar to that for females. For Assaults incurred on a *Street or highway* (14%), the proportion for males (16%) was more than twice that for females (7%). Of Assaults occurring in the *Home* (13%), the proportion for females (37%) was more than four times higher than the proportion for males (9%).

Of total assaults occasioning TBI, 15% were reported to be caused by a *Sharp object*, with 21% being committed in the *Home*. Of the 12% of TBI *Sharp object* assault cases that occurred on a *Street or highway*, nearly two thirds occurred on a *Roadway*, and one third on a *Sidewalk*. A further 11% of assault cases caused by a *Sharp* object were perpetrated in a *Trade and service area*, with 62% of those cases occurring in a *Cafe, hotel and restaurant*, and 21% occurring in a *Shop and store* environment. Of those injuries sustained in a *Trade and service area* (n=418), 80% occurred in a *Cafe, hotel and restaurant*.

Table 2.25: TBI as Principal Diagnosis cases due to Assault by place of occurrence, Australia 2004–05

	Males		Females		Persons	
Place of occurrence	**Count**	**Per cent**	**Count**	**Per cent**	**Count**	**Per cent**
Home	145	*8.5*	122	*36.5*	267	*13.1*
Residential institution	13	*0.8*	5	*1.5*	18	*0.9*
School	18	*1.1*	..	..	22	*1.1*
Health Service area	15	*0.9*	0	*0.0*	15	*0.7*
Sports and athletics area	18	*1.1*	..	..	20	*1.0*
Street and highway	269	*15.7*	22	*6.6*	291	*14.2*
Roadway	*96*	*35.7*	..	..	*100*	*34.4*
Sidewalk	*159*	*59.1*	*17*	*77.3*	*176*	*60.5*
Other specified and unspecified street and highway	*14*	*5.2*	..	..	*15*	*5.2*
Trade and service area	390	*22.8*	28	*8.4*	418	*20.4*
Cafe, hotel and restaurant	*321*	*82.3*	*22*	*78.6*	*343*	*82.1*
Other and unspecified trade and service area	*69*	*17.7*	*6*	*21.4*	*75*	*17.9*
Other specified place of occurrence	123	*7.2*	14	*4.2*	137	*6.7*
Unspecified place of occurrence	720	*42.1*	137	*41.0*	857	*41.9*
All places	**1,711**	***100***	**334**	**100**	**2,045**	***100***

Subgroup proportions are percentages relating to that diagnosis group.
.. Cell counts in tables that are 4 cases or fewer have been suppressed, as have percentages derived from them, to protect confidentiality.

Length of hospital stay

The longest ALOS was reported for Principal Diagnosis cases of TBI caused by *Assault by sharp object* (5.1 days for persons), with cases for females (6.5 days) reporting a longer stay than cases for males (4.7 days) (Table 2.26). The mean ICISS score indicates the probability of survival for TBI injury from *Assault by sharp object* estimated as being 90% for males, and 85% for females. The ICISS score is not an indicator of predicted return to previous level of functioning.

Cases for males injured by *Assault by blunt object* reported a longer bed stay than cases for females (3.8 versus 2.8 days), and the estimated probability of survival was a little better for females (87%) than for males (84%).

Assault by bodily force cases reported the lowest ALOS (2.4 days for males, 2.3 days for females), but the highest proportion of cases of the three mechanisms reported in this table. The probability of survival for females (93%) was the highest of the three mechanisms, and the survival probability for males (89%) was also high. The ratio of male to female cases (5.5:1) was lower than that for cases of *Assault by blunt object* (3.8 male cases to 1 female case).

The number of cases resulting in death in hospital were smaller than can be reported on for confidentiality considerations, in each mechanism reported here, except for cases of *Assault by bodily force* for males (n=8), where less than 1% of cases resulted in death. Probability of survival was highest for *Assault by bodily force* (0.8980). The survival probability was also high for *Assault by sharp object* (0.8888), and a little lower for *Assault by blunt object* (0.8439).

Table 2.26: Length of hospital stay for TBI as Principal Diagnosis cases due to Assault, top three specified Assault related TBI injury by mechanism reported by sex, all ages, Australia 2004–05

Mechanism		Males	Females	Persons	
Assault by sharp object (X99)	Cases	25	6	31	m:f 4:1
	Bed days[(a)]	118	39	157	
	ALOS	4.7	6.5	5.1	
	Mean ICISS[(b)]	0.8973	0.8533	0.8888	
	Died in hospital	..	0	..	..% died
Assault by blunt object (Y00)	Cases	238	63	301	m:f 3.8:1
	Bed days[(a)]	912	178	1,090	
	ALOS	3.8	2.8	3.6	
	Mean ICISS[(b)]	0.8374	0.8683	0.8439	
	Died in hospital	..	0	..	..% died
Assault by bodily force (Y04)	Cases	1,139	206	1,345	m:f 5.5:1
	Bed days[(a)]	2,749	464	3,213	
	ALOS	2.4	2.3	2.4	
	Mean ICISS[(b)]	0.8931	0.9253	0.8980	
	Died in hospital	8	..	..	*0.7*% died

(a) Includes inward transfers for total length of hospital stay per case.
(b) Mean ICISS based on cases.
.. Cell counts in tables that are 4 cases or fewer have been suppressed, as have percentages derived from them, to protect confidentiality.

3 Injury cases with TBI as an Additional Diagnosis

This chapter describes TBI cases in which an injury other than TBI was recorded as the Principal Diagnosis. Injury was the main explanation for these episodes of in-hospital care, and TBI was recorded as being present. TBI alone might not account for the admission, although an injury to the head was the Principal Diagnosis for a little over half of these cases.

Table 3.1: Case selection for injury cases with TBI as an Additional Diagnosis by sex, Australia 2004–05

Selection criteria	Males	Females	Persons
Cases with a Principal Diagnosis in the ICD-10-AM injury range S00–T75, T79 (excluding S06) and S06 as an Additional Diagnosis and			
An External Cause code in the community injury range (V01–Y36, Y85–Y87, Y89)	4,252	1,667	5,919
An External Cause code in the Complications of surgical and medical care range (Y40–Y84, Y88) OR no External Cause code present	..	..	6
Total S06 Additional Diagnosis TBI cases[(a)]	**4,257**	**1,668**	**5,925**

(a) Excludes inward transfers from other acute care hospitals (m=506, f=200).
.. Cell counts in tables that are 4 cases or fewer have been suppressed, to protect confidentiality.

Overview

Injury cases with TBI as an Additional Diagnosis accounted for about 26% (n=5,925) of all TBI hospitalisations and about 0.7% of all hospitalised injury cases during 2004–05 (Table 3.2). Male cases outnumbered female cases by a ratio of 2.6:1. This difference is reflected in hospitalisation rates with males recording a rate of 42.9 hospitalisations per 100,000 population compared to the female rate of 15.7. The mean number of bed days was lower for males who recorded a mean of 7.1 days, compared to females who recorded a mean of 7.7 days.

Table 3.2: Injury cases with TBI as an Additional Diagnosis, selected indicators, Australia 2004–05

Indicators	Males	Females	Persons	Ratio m:f
Number of TBI cases[(a)]	4,257	1,668	5,925	2.6
Proportion of all injury hospitalised injury separations[(b)]	*1.0%*	*0.4%*	*0.7%*	*2.5*
Age standardised (direct) rate/100,000 population	42.9	15.7	29.3	2.7
Mean length of stay (bed days)	7.1	7.7	7.2	
Total patient days[(c)]	30,018	12,925	42,493	

(a) Excludes inward transfers from other acute care hospitals (m=506, f=200)
(b) Derived from (AIHW 2006).
(c) Includes inward transfers from other acute care hospitals for total bed days (m=506, f=200).

Principal Diagnosis

More than half (57%) of the cases in this group had a Principal Diagnosis code for a head injury. Fractures of skull and facial bones (S02) were the Principal Diagnosis in 30% (n=1,770) of the cases (Table 3.3). Fractures of either the vault or base of skull were responsible for just over 60% (n=1,075) of these cases. These type of fractures were more prominent in males (33%; n=1,386) than in females (23%; n=384). Other prominent Principal diagnoses included *Open wound of head* (16%; n=921), *Superficial injury of head* (6%, n=328) and *Other and unspecified injuries of head* (5%; n=307). Hence, although TBI (i.e. S06) was not recorded as the Principal Diagnosis for these cases, most of them were predominantly head injury cases. The remaining cases in this group (43%; n=2,591) have codes for injuries of other parts of the body as the Principal Diagnosis. These are best regarded as being cases in which that other injury was the condition chiefly accounting for the stay in hospital.

Table 3.3: Injury cases with TBI as an Additional Diagnosis by Principal Diagnosis, by sex, Australia 2004–05

	Males		Females		Persons	
Principal Diagnosis	**Count**	**Per cent**	**Count**	**Per cent**	**Count**	**Per cent**
S00 Superficial injury of head	188	*4.4*	140	*8.4*	328	*5.5*
S01 Open wound of head	653	*15.3*	268	*16.1*	921	*15.5*
S02 Fracture of skull and facial bones	1,386	*32.6*	384	*23.0*	1,770	*29.9*
S02.0 Fracture of vault of skull	*283*	*20.4*	*67*	*17.4*	*350*	*19.8*
S02.1 Fracture of base of skull	*536*	*38.7*	*189*	*49.2*	*725*	*41.0*
S02.2–S02.9 Other fracture of skull and facial bones	*567*	*40.9*	*128*	*33.3*	*695*	*39.3*
S09 Other and unspecified injuries of head	212	*5.0*	95	*5.7*	307	*5.2*
S12 Fracture of neck	113	*2.7*	37	*2.2*	150	*2.5*
S22 Fracture of ribs, sternum and thoracic spine	181	*4.3*	53	*3.2*	234	*3.9*
S27 Injury of other and unspecified intrathoracic organs	110	*2.6*	36	*2.2*	146	*2.5*
S32 Fracture of lumbar spine and pelvis	116	*2.7*	75	*4.5*	191	*3.2*
S36 Injury of intra-abdominal organs	81	*1.9*	24	*1.4*	105	*1.8*
S42 Fracture of shoulder and other arm	164	*3.9*	68	*4.1*	232	*3.9*
S52 Fracture of forearm	169	*4.0*	71	*4.3*	240	*4.1*
S72 Fracture of femur	109	*2.6*	65	*3.9*	174	*2.9*
S82 Fracture of lower leg, including ankle	129	*3.0*	61	*3.7*	190	*3.2*
Other Principal Diagnosis in range S00–T75, T79, T89	646	*15.2*	291	*17.4*	937	*15.8*
Total	**4,257**	***100***	**1,668**	***100***	**5,925**	***100***

Subgroup proportions are percentages relating to that diagnosis group.

Intracranial injury

Table 3.4 shows the distribution of cases by intracranial injury based on the first encountered S06 code in each hospital record for cases where the Principal Diagnosis is a head injury code. *Concussive injury* accounted for 74% (n=2,489) of cases in this group. Of these cases, 57% (n=1,421) experienced a brief LOC of less than 30 minutes and 27% (n=668) experienced a LOC of an unspecified duration. Percentages for most types of intracranial injury were generally similar for both males and females. Percentages of other types of intracranial injury were low with *Focal brain injury* (6%, n=198) and *Traumatic subdural haemorrhage* (5%, n=174) being the most prominent.

The cases in Table 3.5 met the same criteria as those in Table 3.4, other than their Principal Diagnosis is not a head injury. The percentage of cases in this group sustaining a concussive injury was slightly larger at 86% (n=2,200). Of these cases, 59% (n=1,296) experienced a brief LOC of less than 30 minutes and 29% (n=631) experienced a LOC of an unspecified duration. Similar to the cases in Table 3.4, percentages for most types of intracranial injury were generally similar for both males and females. Percentages of other types of intracranial injury were generally lower than for cases in Table 3.4 with *Focal brain injury* (4%, n=93) and *Traumatic subdural haemorrhage* (3%, n=80) being the most prominent.

Table 3.4: Nature of intracranial injury for injury cases with TBI as an Additional Diagnosis, where Principal Diagnosis is a head injury, by sex, Australia 2004–05

	Males		Females		Persons	
Nature of injury	**Count**	**Per cent**	**Count**	**Per cent**	**Count**	**Per cent**
S06.0 Concussive injury	1,808	*72.9*	681	*76.0*	2,489	*73.7*
S06.00 Concussion	*245*	*13.6*	*99*	*14.5*	*344*	*13.8*
S06.01 Loss of concussion of unspecified duration	*469*	*25.9*	*199*	*29.2*	*668*	*26.8*
S06.02 Loss of concussion of brief duration [less than 30 minutes]	*1,054*	*58.3*	*367*	*53.9*	*1,421*	*57.1*
S06.03, S06.04, S06.05 Loss of concussion of moderate/prolonged duration [30 minutes to more than 24 hrs] with/without return to pre-existing conscious level	*40*	*2.2*	*16*	*2.4*	*56*	*2.3*
S06.1 Traumatic cerebral oedema	8	*0.3*	..	*..*	10	*0.3*
S06.2 Diffuse brain injury	73	*2.9*	19	*2.1*	92	*2.7*
S06.21 Diffuse cerebral contusions	*34*	*46.6*	*10*	*52.6*	*44*	*47.8*
S06.23 Multiple intracerebral and cerebellar haematomas	*24*	*32.9*	*5*	*26.3*	*29*	*31.5*
S06.20, S06.22, S06.28 Other diffuse cerebral and cerebellar injury	*15*	*20.5*	*4*	*21.1*	*19*	*20.7*
S06.3 Focal brain injury	151	*6.1*	47	*5.2*	198	5.9
S06.31 Focal cerebral contusions	*126*	*83.4*	*40*	*85.1*	*166*	*83.8*
S06.33 Focal cerebral haematomas	*19*	*12.6*	*5*	*10.6*	*24*	*12.1*
S06.30, S06.32, S06.34, S06.38 Other focal cerebral and cerebellar injury	*..*	*..*	*..*	*..*	*8*	*4.0*
S06.4 Epidural haemorrhage	107	*4.3*	26	*2.9*	133	*3.9*
S06.5 Traumatic subdural haemorrhage	124	*5.0*	50	*5.6*	174	*5.2*
S06.6 Traumatic subarachnoid haemorrhage	99	*4.0*	39	*4.4*	138	*4.1*
S06.8 Other intracranial injuries	57	*2.3*	21	*2.3*	78	*2.3*
S06.9 Intracranial injury, unspecified	54	*2.2*	11	*1.2*	65	*1.9*
Total	**2,481**	***100***	**896**	***100***	**3,377**	***100***

Subgroup proportions are percentages relating to that diagnosis group.
.. Cell counts in tables that are 4 cases or fewer have been suppressed, as have percentages derived from them, to protect confidentiality.

Table 3.5: Nature of intracranial injury for injury cases with TBI as an Additional Diagnosis, where Principal Diagnosis is not a head injury, by sex, Australia 2004–05

	Males		Females		Persons	
Nature of injury	**Count**	**Per cent**	**Count**	**Per cent**	**Count**	**Per cent**
S06.0 Concussive injury	1,564	*88.1*	636	*82.4*	2,200	*86.3*
S06.00 Concussion	*158*	*10.1*	*55*	*8.6*	*213*	*9.7*
S06.01 Loss of concussion of unspecified duration	*433*	*27.7*	*198*	*31.1*	*631*	*28.7*
S06.02 Loss of concussion of brief duration [less than 30 minutes]	*938*	*60.0*	*358*	*56.3*	*1296*	*58.9*
S06.03 Loss of concussion of moderate duration [30 minutes to 24 hrs]	*28*	*1.8*	*16*	*2.5*	*44*	*2.0*
S06.04, S06.05 Loss of concussion of prolonged duration [more than 24 hours], with/without return to pre-existing conscious level	*7*	*0.5*	*9*	*1.4*	*16*	*0.7*
S06.1 Traumatic cerebral oedema	10	*0.6*	..	*..*	12	*0.5*
S06.2 Diffuse brain injury	27	*1.5*	21	*2.7*	48	*1.9*
S06.23 Multiple intracerebral and cerebellar haematomas	*13*	*48.1*	*15*	*71.4*	*28*	*58.3*
S06.20, S06.21, S06.28 Other diffuse cerebral and cerebellar injury	*14*	*51.9*	*6*	*28.6*	*20*	*41.7*
S06.3 Focal brain injury	56	*3.2*	37	*4.8*	93	*3.6*
S06.31 Focal cerebral contusions	*38*	*67.9*	*26*	*70.3*	*64*	*68.8*
S06.33 Focal cerebral haematomas	*16*	*28.6*	*10*	*27.0*	*26*	*28.0*
S06.30,S06.38 Other focal cerebral and cerebellar injury	*..*	*..*	*..*	*..*	*..*	*..*
S06.4 Epidural haemorrhage	17	*1.0*	9	*1.2*	26	*1.0*
S06.5 Traumatic subdural haemorrhage	47	*2.6*	33	*4.3*	80	*3.1*
S06.6 Traumatic subarachnoid haemorrhage	25	*1.4*	15	*1.9*	40	*1.6*
S06.8 Other intracranial injuries	10	*0.6*	7	*0.9*	17	*0.7*
S06.9 Intracranial injury, unspecified	20	*1.1*	12	*1.6*	32	*1.3*
Total	**1,776**	***100***	**772**	***100***	**2,548**	***100***

Subgroup proportions are percentages relating to that diagnosis group.
.. Cell counts in tables that are 4 cases or fewer have been suppressed, as have percentages derived from them, to protect confidentiality.

Age and sex distribution

Figure 3.1 shows age specific hospitalisation rates for all cases included in this chapter. Male rates were significantly higher than female rates for all age groups except for children aged 0–4 years and those aged 75 or more years. Males aged 15–34 years accounted for 34% (n=2,011) of all S06 Additional Diagnosis TBI cases while females in the same age group accounted for a further 9% (n=517).

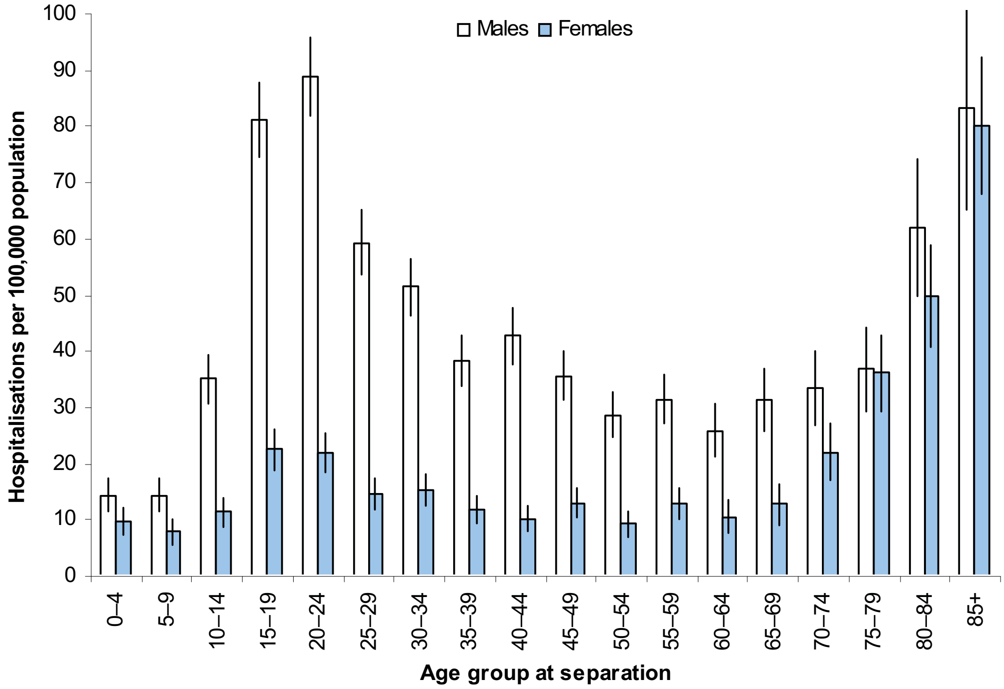


Figure 3.1: Injury cases with TBI as an Additional Diagnosis by sex and age group, Australia 2004–05

Comparison to Principal Diagnosis TBI cases

The pattern of age and sex specific rates of hospitalised TBI was broadly similar for cases whose TBI was recorded as the Principal Diagnosis (Figure 2.1) and where TBI was only recorded as an Additional Diagnosis (Figure 3.1). For both, rates were higher for young men, and for older people of both sexes. Differences are that the peak at older ages is smaller for the group described in this chapter, as is the difference between rates for males and females at older ages.

Trends over time

Figure 3.2 shows age-adjusted rates for all injury cases with TBI as an Additional Diagnosis for the period from 1999–00 to 2004–05. Overall, rates for persons remained relatively steady with only a 7% increase over this period. Similar increases were seen for males and females separately.

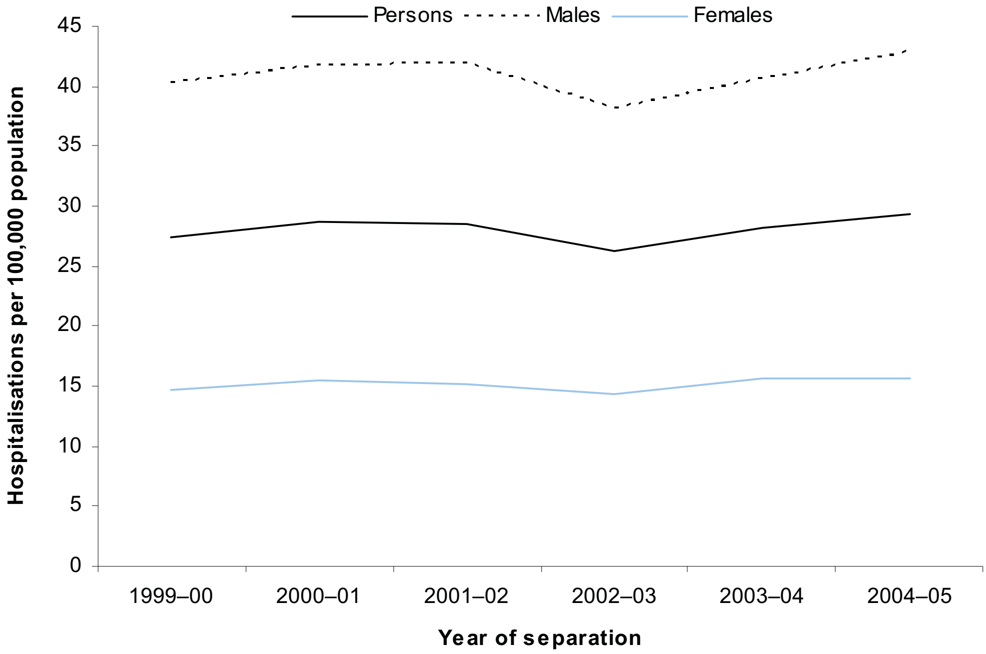


Figure 3.2: Injury cases with TBI as an Additional Diagnosis, Australia 1999–00 to 2004–05: age standardised rates

Comparison to Principal Diagnosis TBI cases

The trend over time for injury cases with TBI as an Additional Diagnosis differed from the trend for cases with TBI as a Principal Diagnosis in several ways (Figure 2.2). Rates for males, females and persons were less than half those reported for Principal Diagnosis cases. Rates for Additional Diagnosis cases rose slightly from 1999–00 to 2001–02 and then declined to the lowest data point in 2002–03, while rates for Principal Diagnosis cases declined slightly from 1999–00 to 2003–04. Rates for Additional Diagnosis cases were slightly higher in 2004–05 than in 1999–00, while rates for Principal Diagnosis cases did not differ for 1999–00 and 2004–05.

External Causes of injury

Transport-related injuries accounted for 42% (n=2,489) of all cases included in this chapter (Table 3.6). Other prominent External Causes of injury were *Falls* and *Assault*, which accounted for 30% (n=1,787) and 16% (n=942) of hospitalisations respectively. *Fall*-related injuries were more prominent among females (41%; n=676) than males (26%; n=1,111), while *Assault*-related injuries where more prominent for males (19%; n=803) than when compared to females (8%; n=139).

Table 3.6: External Causes for injury cases with TBI as an Additional Diagnosis, Australia 2004–05

	Males		Females		Persons	
Major groups	**Count**	**Per cent**	**Count**	**Per cent**	**Count**	**Per cent**
Transportation (V01–V99)	1,792	*42.1*	697	*41.8*	2,489	*42.0*
Falls (W00–W19)	1,111	*26.1*	676	*40.5*	1,787	*30.2*
Intentional, inflicted by another (X85–Y09, Y35–Y36, Y87.1, Y89.0, Y89.1)	803	*18.9*	139	*8.3*	942	*15.9*
Other unintentional injuries (W20–W64, W75–W99, X20–X39, X50–X59, Y85, Y86, Y89.9)	435	*10.2*	104	*6.2*	539	*9.1*
Intentional self-harm (X60–X84, Y87.0)	57	*1.3*	27	*1.6*	84	*1.4*
Undetermined intent (Y10–Y34, Y87.2)	14	*0.3*	9	*0.5*	23	*0.4*
Poisoning, pharmaceuticals (X40–X44)	8	*0.2*	9	*0.5*	17	*0.3*
No External Cause reported	..	..	..	..	14	*0.2*
Drowning (W65–W74)	..	..	..	..	13	*0.2*
Fires/burns/scalds (X00–X19)	..	..	..	..	8	*0.1*
Poisoning, other substances (X45–X49)	5	*0.1*	0	*0.0*	5	*0.1*
Complications of surgical and medical care (Y40–Y84)	..	..	..	..	..	..
Major groups total	**4,257**	***100***	**1,668**	***100***	**5,925**	***100***

.. Cell counts in tables that are 4 cases or fewer have been suppressed, as have percentages derived from them, to protect confidentiality.

Comparison to Principal Diagnosis TBI cases

When compared to Principal Diagnosis cases, the first and second major External Causes of injury are reversed, in almost exactly the same proportions (Table 2.4). Although the size of *Transport*-related Principal Diagnosis cases differed from the Additional Diagnosis cases, males and females were represented at similar proportions to one another in both groups. While the proportion of *Falls* was lower for the Additional Diagnosis cases than for the Principal Diagnosis cases, the ratio of males to females for *Falls* (0.7) was the same for both groups. *Assault* was the third highest cause of hospitalisation for both groups, the proportions for males and females being slightly higher in the Additional Diagnosis group (m:f rate ratio 5.8) than in the Principal Diagnosis group (m:f rate ratio 5.1). There were slightly more Additional Diagnosis cases for *Self-harm* than Principal Diagnosis *Self-harm* cases, and for both groups males were represented at twice the rate of females.

Activity at time of injury

The activity at the time of injury was only specified in 47% (n=2,789) of cases, with almost half of these (n=1,275) being classified to *Other specified activity* (Table 3.7). *Sport* activities accounted for 11% (n=661) of all cases included in this chapter. *Football* accounted for 24% of all *Sport* injuries, with *motorcycling* and *cycling* accounting for a further 20% and 19% respectively. Traumatic brain injuries sustained while *Working for income* accounted for 6% (n=332) of all hospitalisations, with the most prominent industry being *Agriculture, forestry and fishing* which accounted for 18% of these types of injuries.

Table 3.7: Injury cases with TBI as an Additional Diagnosis by reported activity, Australia 2004–05

	Males		Females		Persons	
Activity	**Count**	**Per cent**	**Count**	**Per cent**	**Count**	**Per cent**
While engaged in sports	558	*13.1*	103	*6.2*	661	*11.2*
Football	*150*	*26.9*	*9*	*8.7*	*159*	*24.0*
Motorcycling	*124*	*22.2*	*6*	*5.8*	*130*	*19.7*
Cycling	*107*	*19.2*	*16*	*15.5*	*123*	*18.6*
Trail or general horseback riding	*8*	*1.4*	*36*	*35.0*	*44*	*6.7*
Skate boarding	*21*	*3.8*	*..*	*..*	*25*	*3.8*
Other and unspecified sports activity	*148*	*26.5*	*32*	*31.1*	*180*	*27.2*
While engaged in leisure	148	*3.5*	37	*2.2*	185	*3.1*
While working for income	294	*6.9*	38	*2.3*	332	*5.6*
Working for income—Agriculture, forestry and fishing	*49*	*16.6*	*11*	*28.9*	*60*	*18.0*
Working for income—Construction	*41*	*14.0*	*0*	*0.0*	*41*	*12.4*
Working for income—Transport and storage	*37*	*12.6*	*0*	*0.0*	*37*	*11.2*
Working for income—other and unspecified	*167*	*56.8*	*27*	*71.1*	*194*	*58.4*
While engaged in other types of work	107	*2.5*	44	*2.6*	151	*2.5*
While resting, sleeping, eating or engaging in other vital activities	104	*2.4*	81	*4.9*	185	*3.1*
Other specified activity	875	*20.6*	400	*24.0*	1,275	*21.5*
Unspecified activity	2,171	*51.0*	965	*57.9*	3,136	*52.9*
All activities	**4,257**	***100***	**1,668**	***100***	**5,925**	***100***

Subgroup proportions are percentages relating to that diagnosis group.
.. Cell counts in tables that are 4 cases or fewer have been suppressed, as have percentages derived from them, to protect confidentiality.

Comparison to Principal Diagnosis TBI cases

While a slightly lower proportion of Additional Diagnosis cases (11%) were reported as having been engaged in *Sport* activities than in Principal Diagnosis cases (16%), *Football* was the main sport type for both groups. In *Working for income,* 6% of Additional Diagnosis cases were reported, compared to Principal Diagnosis cases 4%, and the main area of occupation for both groups was *Agriculture, forestry and fishing* (Table 2.5).

Place of occurrence of injury

Streets and highways were the most common places of occurrence for cases included in this chapter, accounting for 33% (n=1,966) of all admissions (Table 3.8). Injuries occurring on a *Roadway* were responsible for almost 88% (n=1,727) of these cases. The *Home* was also a prominent place of occurrence, accounting for 19% (n=1,125) of all Additional Diagnosis TBI hospitalisations. Females (28%, n=461) were far more likely to sustain an injury in this setting than males (16%, n=664). Injuries occurring in *Aged care facilities* accounted for 79% of all injuries occurring in a *Residential institution* (2.3%, n=135), while injuries sustained while in a *Café, hotel or restaurant* accounted for 70% of all injuries occurring in a *Trade and service area*.

Table 3.8: Injury cases with TBI as an Additional Diagnosis by place of occurrence, Australia 2004–05

	Males		Females		Persons	
Place of occurrence	**Count**	**Per cent**	**Count**	**Per cent**	**Count**	**Per cent**
Home	664	*15.6*	461	*27.6*	1,125	*19.0*
Residential institution	62	*1.5*	73	*4.4*	135	*2.3*
Aged care facilities	*40*	*64.5*	*67*	*91.8*	*107*	*79.3*
Other and unspecified residential institution	*22*	*35.5*	*6*	*8.2*	*28*	*20.7*
School	32	*0.8*	11	*0.7*	43	*0.7*
Health Service area	23	*0.5*	12	*0.7*	35	*0.6*
Other specified institution and public administrative area	11	*0.3*	12	*0.7*	23	*0.4*
Sports and athletics area	285	*6.7*	40	*2.4*	325	*5.5*
Sporting grounds (outdoor)	*135*	*47.4*	*14*	*35.0*	*149*	*45.8*
Racetrack and racecourse	*86*	*30.1*	*8*	*20.0*	*94*	*28.9*
Other and unspecified sports and athletics area	*64*	*22.5*	*18*	*45.0*	*82*	*25.3*
Street and highway	1,373	*32.3*	593	*35.6*	1,966	*33.2*
Roadway	*1,199*	*87.4*	*528*	*89.0*	*1,727*	*87.8*
Sidewalk	*124*	*9.0*	*47*	*7.9*	*171*	*8.7*
Other and unspecified street and highway	*50*	*3.6*	*18*	*3.1*	*68*	*3.5*
Trade and service area	293	*6.9*	63	*3.8*	356	*6.0*
Cafe, hotel and restaurant	*217*	*74.1*	*31*	*49.2*	*248*	*69.7*
Other and specified trade and service area	*76*	*25.9*	*32*	*50.8*	*108*	*30.3*
Industrial and construction area	111	*2.6*	..	..	..	..
Farm	83	*1.9*	26	*1.6*	109	*1.8*
Other specified place of occurrence	280	*6.6*	73	*4.4*	353	*6.0*
Unspecified place of occurrence	1,040	*24.4*	302	*18.1*	1,342	*22.6*
All places	**4,257**	***100***	**1,668**	***100***	**5,925**	***100***

Subgroup proportions are percentages relating to that diagnosis group.
.. Cell counts in tables that are 4 cases or fewer have been suppressed, as have percentages derived from them, to protect confidentiality.

Comparison to Principal Diagnosis TBI cases

Streets and highways was also the main place of occurrence for Principal Diagnosis cases and the proportion for males was similar to that for females, but the overall proportion was smaller (22%) than reported for Additional Diagnosis cases (Table 2.6). Within that main code, over 80% of cases for both Principal Diagnosis cases and for Additional Diagnosis cases were reported as having occurred on a *Roadway*. *Home* was also the second most common place of occurrence of injury for Principal Diagnosis cases, again with females much more frequently represented than males.

Severity of injury cases with TBI as an Additional Diagnosis

Mean ICISS score

Figure 3.3 shows the mean ICISS by age group for selected External Cause groups for the cases included in this chapter. The severity of injury was highest for the 0–4 and 5–9 age groups and tends to decrease slightly from the 10–14 age group onwards for each of the External Cause groups. For those aged 15–19 years through to 35–39 years, the most severe injuries were transport-related.

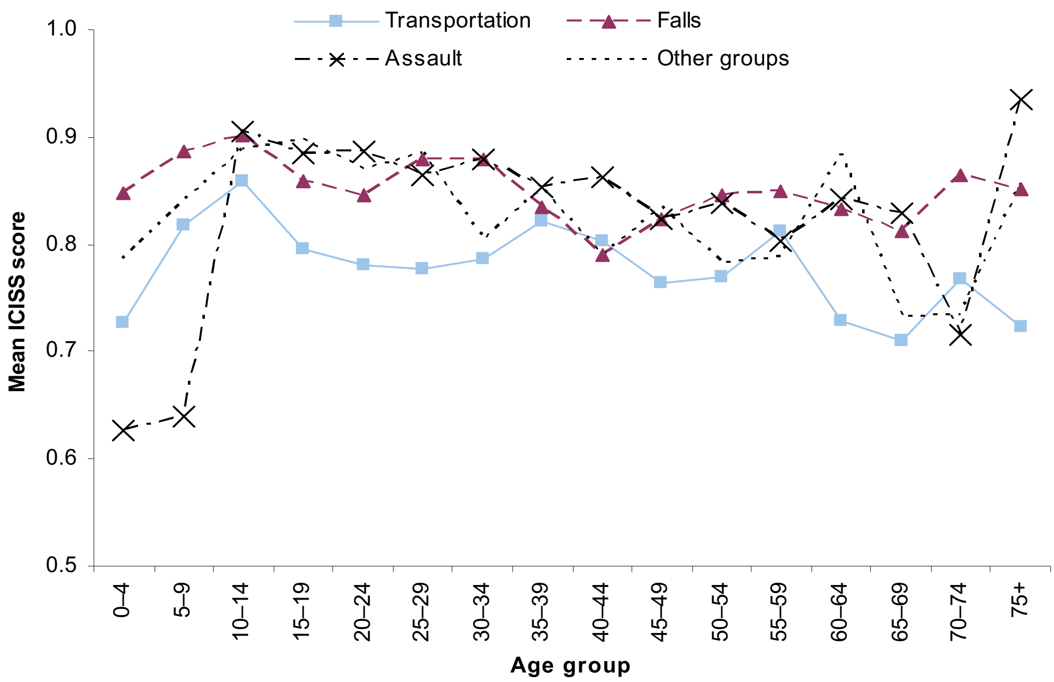


Figure 3.3: Mean ICISS for injury cases with TBI as an Additional Diagnosis by age group and External Cause group, Australia 2004–05

Comparison to Principal Diagnosis TBI cases

In common with Principal Diagnosis cases, probability of survival was best for those in the 10–14 age group, for *Assault, Falls* and *Transportation* (Figure 2.3). ICISS scores for Principal Diagnosis cases for the same External Causes in that age group were higher (between 0.9 and 1.0), indicating a slightly improved chance of survival than for the Additional Diagnosis cases. Decline of mean ICISS with age is less marked in this group than for the Principal Diagnosis TBI cases.

Loss of consciousness

Nearly 49% (n=2,894) of patients in this group sustained a loss of consciousness (LOC) of a brief duration, with a further 26% of patients sustaining a LOC of unspecified duration (Table 3.9). Only 1% (n=63) of patients sustained a LOC of a prolonged duration. Patients who sustained a LOC of prolonged duration with return to pre-existing conscious level had the longest mean length of stay (LOS) of 34.6 days. This was more than double the value of 14.3 days for patients who sustained a LOC of prolonged duration without return to pre-existing conscious level. This difference is most likely explained by the much lower survival rate to discharge of less than 28% for the latter group, compared to 95% for those patients who returned to a pre-existing conscious level.

TBI patients for whom no concussion was recorded had a relatively long mean LOS of 16.7 days, when compared to patients who sustained a concussion (3.7 days) and patients who sustained a LOC of a brief duration (5 days). This difference was also reflected in survival rates of 93%, 99.2% and 99.7% respectively.

Table 3.9: Reported loss of consciousness for Additional Diagnosis TBI cases by measures of severity, Australia 2004–05

ICD-10-AM category	Count	Per cent	Mean LOS	Mean ICISS	Surv prop[(a)]
No concussion	731	*12.3*	16.7	0.603	0.934
S06.00 Concussion	591	*10.0*	3.7	0.925	0.992
S06.01 LOC of unspecified duration	1,525	*25.7*	7.9	0.803	0.965
S06.02 LOC of brief duration [less than 30 minutes]	2,894	*48.8*	5.0	0.895	0.997
S06.03 LOC of moderate duration [30 minutes to 24 hours]	121	*2.0*	6.6	0.664	0.884
S06.04 LOC of prolonged duration [more than 24 hours], with return to pre-existing conscious level	20	*0.3*	34.6	0.440	0.950
S06.05 LOC of prolonged duration [more than 24 hours], without return to pre-existing conscious level	43	*0.7*	14.3	0.036	0.163
Total	**5,925**	***100.0***	**7.2**	**0.826**	**0.972**

(a) Observed proportion of patients who survived to discharge.

Comparison to Principal Diagnosis TBI cases

Both Principal (Table 2.8) and Additional Diagnosis TBI groups had similar combined percentages of concussion and LOC of brief duration cases of close to 60%. Both groups also had similar percentages of cases with LOC of moderate duration or longer. Mean LOS for each of the LOC categories was similar for both groups, although cases in the Additional Diagnosis TBI group tended to have a moderately longer mean LOS, particularly for categories where the length of LOC was relatively short. The survival rates for each of the categories were also similar between the two groups.

Proportion of deaths for injury cases with TBI as an Additional Diagnosis

Figure 3.4 indicates the proportion of injury cases with TBI as an Additional Diagnosis who died while in hospital. For all ages and all External Causes, death was reported for 2.8% (n=167) of cases.

The major External Cause of death was *Transportation* (51% of deaths), followed by *Falls* (35% of deaths). The proportion of deaths attributed to *Assault* (2%) was much smaller than the proportion reported for the *Other major group* (13%). Overall, 3.4% of those admitted with a TBI as a result of a transport accident, died in hospital. The equivalent figures for *Falls* and *Assault* were 3.2% and 0.3% respectively.

Those aged 65 years and over accounted for 46% (n=77) of all deaths in hospital, with 58% of these deaths being *Fall*-related. Overall, 8% of people in this age group died in hospital, with 13% of those involved in a *Transport* accident, and 6% of those involved in a *Fall*, dying in hospital.

Those aged 15–29 years accounted for a further 23% (n=38) of all deaths in hospital. Over 84% of deaths in this age group were *Transport*-related, representing 3% of all those admitted after sustaining a TBI as a result of a transport accident.

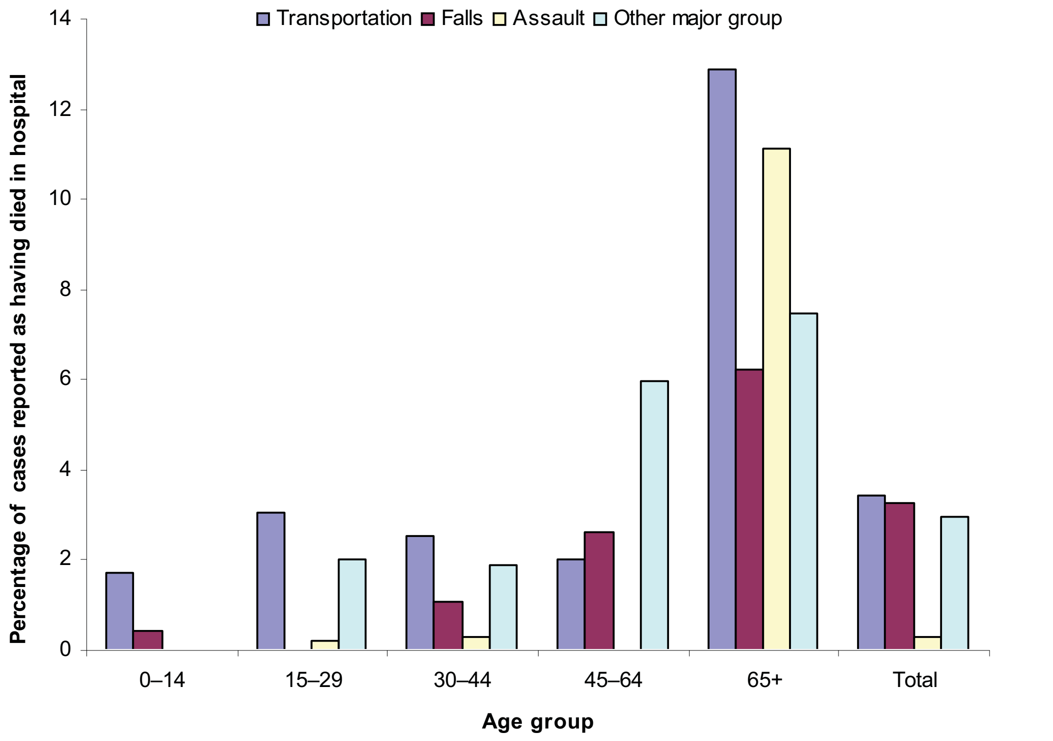


Figure 3.4: Percentage of deaths in hospital for injury cases with TBI as an Additional Diagnosis by age group and External Cause group, persons, Australia 2004–05

4 Other TBI cases

This chapter reports cases with a TBI code (S06) that do not meet the criteria for inclusion in Chapter 2 (S06 is Principal Diagnosis) or chapter 3 (Principal Diagnosis is any other injury, and S06 is an Additional Diagnosis). Cases reported as being inward transfers from other acute hospitals were excluded from case counts to avoid double counting (Table 4.1).

Table 4.1: Cases in selection for 'Other TBI' cases of TBI by sex, Australia 2004–05

Selection criteria	Males	Females	Persons
Cases with a Principal Diagnosis not in the community injury range (S00–T75 & T79) and with an S06 code in any other diagnosis field and;			
An External Cause code in the community injury range (V01–Y36, Y85–Y87, Y89)	1,517	901	2,418
An External Cause code in the Complications of surgical and medical care range (Y40–Y84, Y88)	89	74	163
No External Cause code	5	9	14
Total other TBI cases	**1,611**	**984**	**2,595**

(a) Excludes inward transfers from other acute care hospitals (m=823, f=423).

Overview

The 'Other TBI' cases included in this chapter accounted for 11.4% (n=2,595) of all TBI hospitalisations and about 0.3% of all hospitalised injury cases during 2004–05 (Table 4.2). Male cases outnumbered female cases by a ratio of about 1.6:1. This difference is reflected in hospitalisation rates with males recording a rate of 16.7 hospitalisations per 100,000 population compared to the female rate of 8.5. The mean number of bed days was higher for males who recorded a mean of 34.3 days, compared to females who recorded a mean of 32.4 days.

Table 4.2: 'Other TBI' cases, selected indicators, Australia 2004–05

Indicators	Males	Females	Persons	Ratio m:f
Number of TBI separations[(a)]	1,611	984	2,595	1.6
Proportion of all injury hospital separations[(b)]	*0.4%*	*0.3%*	*0.3%*	1.3
Age standardised (direct) rate/100,000 population	16.7	8.5	12.4	2.0
Mean length of stay (bed days)	34.3	32.4	33.6	
Total patient days[(c)]	55,257	31,924	87,181	

(a) Excludes inward transfers from other acute care hospitals (m=823, f=423).
(b) Derived from (AIHW 2006).
(c) Includes inward transfers from other acute care hospitals for total bed days (m=823, f=423).

Principal Diagnosis

Factors influencing health status and contact with health services (Z00–Z99) were the Principal Diagnosis in 42% (n=1,077) of all hospitalised cases, with *Care involving use of rehabilitation procedures* (Z50) accounting for 88% of these cases (Table 4.3). Almost 42% (n=676) of hospitalisations for males had a Principal Diagnosis involving *Rehabilitation procedures*, compared to only 27% (n=268) for females. Other prominent Principal diagnoses included *Syncope and collapse* (R55) and *Diseases of the circulatory system* (I00–I99) which represented 13% and 12% of all hospitalisations respectively.

Table 4.3: Distribution of Principal Diagnosis of 'Other TBI' cases, by sex, Australia 2004–05

	Males		Females		Persons	
Principal Diagnosis	**Count**	**Per cent**	**Count**	**Per cent**	**Count**	**Per cent**
A00–Q99 Chapters 1–17 ICD-10-AM	571	*35.4*	422	*42.9*	993	*38.3*
A00–B99 Infectious and parasitic diseases	*22*	*3.9*	*15*	*3.6*	*37*	*3.7*
C00–D48 Neoplasms	*38*	*6.7*	*29*	*6.9*	*67*	*6.7*
E00–E89 Endocrine, Nutritional and Metabolic Diseases	*26*	*4.6*	*35*	*8.3*	*61*	*6.1*
F00–F99 Mental and behavioural disorders	*110*	*19.3*	*40*	*9.5*	*150*	*15.1*
G00–G99 Diseases of the nervous system	*64*	*11.2*	*42*	*10.0*	*106*	*10.7*
I00–I99 Diseases of the circulatory system	*161*	*28.2*	*143*	*33.9*	*304*	*30.6*
J00–J99 Diseases of the respiratory system	*52*	*9.1*	*23*	*5.5*	*75*	*7.6*
K00–K93 Diseases if the digestive system	*40*	*7.0*	*22*	*5.2*	*62*	*6.2*
M00–M99 Diseases of the musculoskeletal system	*28*	*4.9*	*19*	*4.5*	*47*	*4.7*
N00–N99 Diseases of the genitourinary system	*13*	*2.3*	*20*	*4.7*	*33*	*3.3*
Other codes A00–Q99	*17*	*3.0*	*34*	*8.1*	*51*	*5.1*
R00–R99 Symptoms, signs and abnormal clinical and laboratory findings, nec	266	*16.5*	232	*23.6*	498	*19.2*
R55 Syncope (fainting) and collapse	*151*	*56.8*	*176*	*75.9*	*327*	*65.7*
R56.8 Other and unspecified convulsions	*54*	*20.3*	*11*	*4.7*	*65*	*13.1*
Other codesR00–R99	*61*	*22.9*	*45*	*19.4*	*106*	*21.3*
T78, T81–T89, T90 Adverse effects, Complications of surgical and medical care, and Sequelae codes	21	*1.3*	6	*0.6*	27	*1*
Z00–Z99 Factors influencing health status and contact with health services	753	*46.7*	324	*32.9*	1,077	*41.5*
Z50 Care involving use of rehabilitation procedures	*676*	*89.8*	*268*	*82.7*	*944*	*87.7*
Z75 Problems awaiting admission to adequate facility elsewhere	*49*	*6.5*	*47*	*14.5*	*96*	*8.9*
Other codes Z00–Z99	*28*	*3.7*	*9*	*2.8*	*37*	*3.4*
Total	**1,611**	***100***	**984**	***100***	**2,595**	***100***

Subgroup proportions are percentages relating to that diagnosis group.

Intracranial injury

Table 4.4 shows the distribution of cases by intracranial injury based on the first encountered S06 code in each hospital record. *Concussive injury* (S06.0) accounted for 45% (n=1,154) of all other TBI hospitalisations for 2004–05. Of these cases, 57% (n=659) experienced a brief LOC of less than 30 minutes and 28% (n=326) experienced a LOC of an unspecified duration. Another prominent type of intracranial injury was *Traumatic subdural haemorrhage* (S06.5) which accounted for 21% (n=546) of all hospitalisations.

Table 4.4: Distribution of intracranial injury diagnoses of 'Other TBI' cases, by sex, Australia 2004–05

	Males		Females		Persons	
Description	**Count**	**Per cent**	**Count**	**Per cent**	**Count**	**Per cent**
S06.0 Concussive injury	612	*38.0*	542	*55.1*	1,154	*44.5*
S06.00 Concussion	*66*	*10.8*	*52*	*9.6*	*118*	*10.2*
S06.01 Loss of consciousness of unspecified duration	*176*	*28.8*	*150*	*27.7*	*326*	*28.3*
S06.02 Loss of consciousness of brief duration [less than 30 minutes]	*341*	*55.7*	*318*	*58.7*	*659*	*57.1*
S06.03 Loss of consciousness of moderate duration [30 minutes to 24 hours]	*19*	*1.0*	*18*	*3.3*	*37*	*3.2*
S06.04, S06.05 Loss of concussion of prolonged duration [more than 24 hours], with/without return to pre-existing conscious level	*10*	*1.6*	..	..	*14*	*1.2*
S06.1 Traumatic cerebral oedema	7	*0.4*	5	*0.5*	12	*0.5*
S06.2 Diffuse brain injury	153	*9.5*	49	*5.0*	202	*7.8*
S06.20 Diffuse cerebral and cerebellar brain injury	*19*	*12.4*	..	..	..	..
S06.21 Diffuse cerebral contusions	*45*	*29.4*	*8*	*16.3*	*53*	*26.2*
S06.23 Multiple intracerebral and cerebellar haematomas	*71*	*46.4*	*33*	*67.4*	*104*	*51.5*
S06.24, S06.28 Other diffuse cerebral and cerebellar injury	*18*	*11.8*	*6*	*12.3*	*24*	*11.9*
S06.3 Focal brain injury	121	*7.5*	62	*6.3*	183	*7.1*
S06.31 Focal cerebral contusion	*92*	*76.0*	*41*	*66.1*	*133*	*72.7*
S06.33 Focal cerebral haematomas	*24*	*19.8*	*19*	*30.7*	*43*	*23.5*
S06.32, S06.34, S06.38 Other focal cerebral and cerebellar injury	*5*	*4.1*	..	..	..	..
S06.4 Epidural haemorrhage	40	*2.5*	48	*4.9*	88	*3.4*
S06.5 Traumatic subdural haemorrhage	368	*22.8*	178	*18.1*	546	*21.0*
S06.6 Traumatic subarachnoid haemorrhage	133	*8.3*	59	*6.0*	192	*7.4*
S06.8 Other intracranial injuries	70	*4.3*	13	*1.3*	83	*3.2*
S06.9 Intracranial injury, unspecified	107	*6.6*	28	*2.8*	135	*5.2*
Total	**1,611**	***100***	**984**	***100***	**2,595**	***100***

Subgroup proportions are percentages relating to that diagnosis group.
.. Cell counts in tables that are 4 cases or fewer have been suppressed, as have percentages derived from them, to protect confidentiality.

Age and sex distribution

Figure 4.1 shows age specific hospitalisation rates for all 'Other TBI' cases for 2004–05. Rates of hospitalisation per 100,000 population tended to increase with age and were particularly high in the 75 years and over age groups. Males aged 75 years and over accounted for 28% (n=451) of all male hospitalisations while females in the same age group accounted for 48.0% (n=472) of all female hospitalisations.

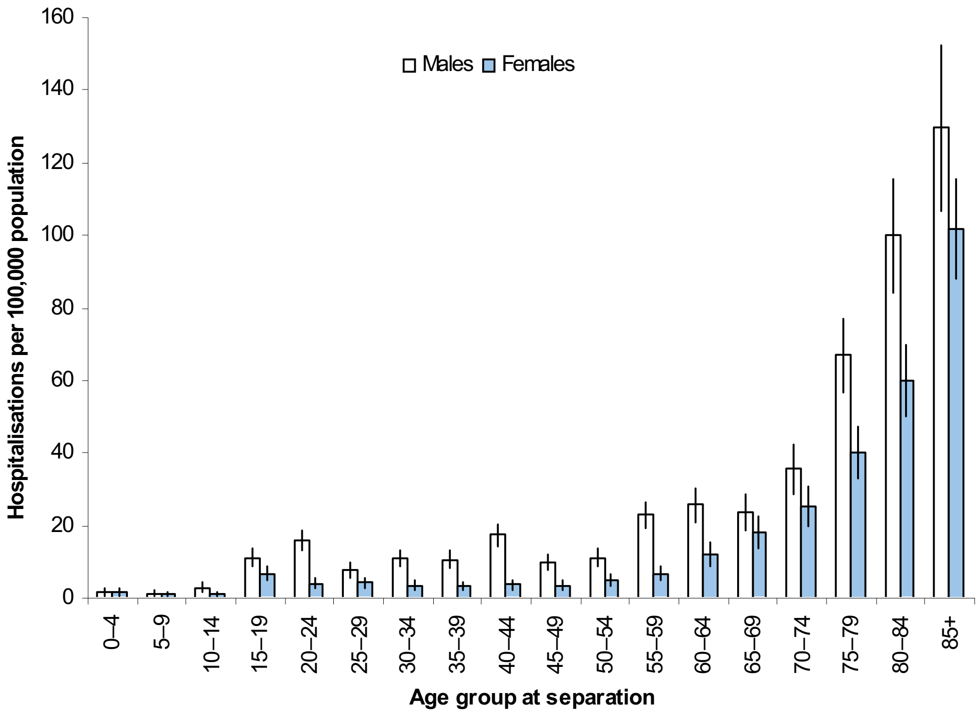


Figure 4.1: 'Other TBI' cases by sex and age group, Australia 2004–05

Comparison to Principal Diagnosis TBI cases

Rates of hospitalisation for 'Other TBI' cases were several times lower than rates for Principal Diagnosis TBI cases (Figure 2.1). The age distribution of cases in the 'Other TBI' group differs markedly from cases with TBI as a Principal Diagnosis (Figure 2.1), which show a marked peak for young adult males.

Trends over time

Rates tended to increase for 'Other TBI' cases for the period from 1999–00 to 2004–05 (Figure 4.2). Rates tended to increase during this period. For males, rates increased from 12.6 in 1999–00 to 16.7 in 2004–05, representing a rise of 33%. For females there was also a 33% increase in rates, with rates rising from 6.4 in 1999–00 to 8.5 in 2004–05.

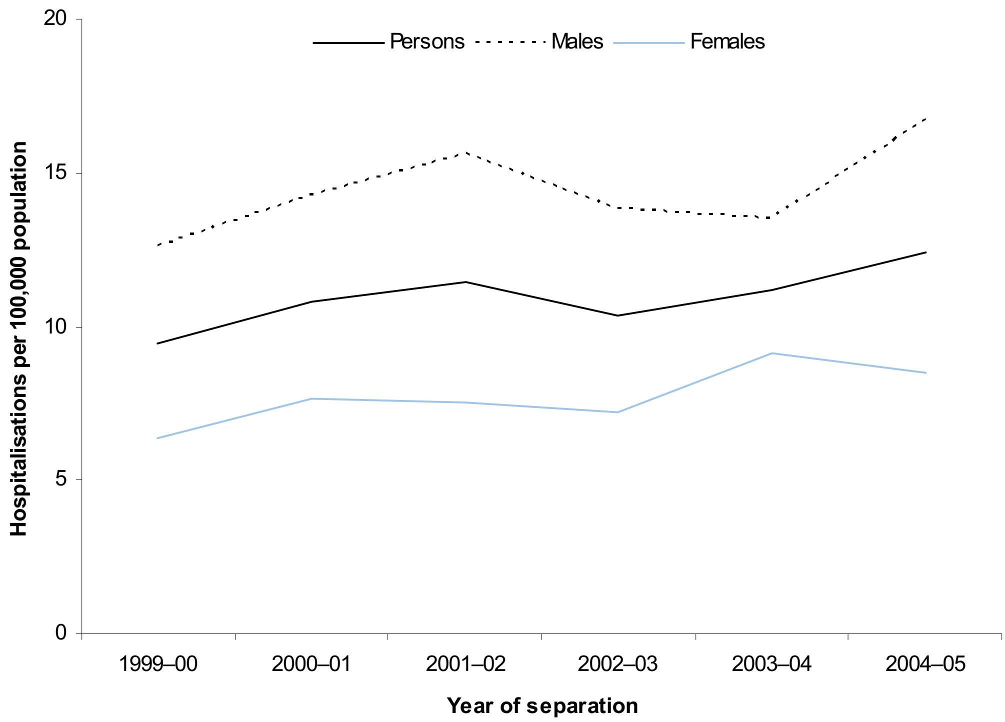


Figure 4.2: 'Other TBI' cases, Australia 1999–00 to 2004–05: age standardised rates

Comparison to Principal Diagnosis TBI cases

The trend over time for injury cases 'Other TBI' cases differed from the trend for cases with TBI as a Principal Diagnosis (Figure 2.2). Rates were less than one sixth those reported for Principal Diagnosis cases. Rates for 'Other TBI' cases tended to rise during the reported period, while rates for Principal Diagnosis cases tended to decline.

External Causes of injury

Fall-related injuries accounted for 57% (n=1,472) of all 'Other TBI' cases during 2004–05 (Table 4.5). Another prominent External Cause of injury was *Transport*, which accounted for 19% (n=486) of hospitalisations. *Fall*-related injuries were more prominent among females (63%, n=622) than males (53%; n=850), while *Transport*-related injuries were more prominent for males (23%; n=369) than when compared to females (12%; n=117).

Table 4.5: External Causes 'Other TBI' cases, Australia 2004–05

	Males		Females		Persons	
Major groups	**Count**	**Per cent**	**Count**	**Per cent**	**Count**	**Per cent**
Falls (W00–W19)	850	*52.8*	622	*63.2*	1,472	*56.7*
Transportation (V01–V99)	369	*22.9*	117	*11.9*	486	*18.7*
Other unintentional injuries (W20–W64, W75–W99, X20–X39, X50–X59, Y85, Y86, Y89.9)	164	*10.2*	129	*13.1*	293	*11.3*
Complications of surgical and medical care (Y40–Y84)	89	*5.5*	74	*7.5*	163	*6.3*
Intentional, inflicted by another (X85–Y09, Y35–Y36, Y87.1, Y89.0, Y89.1)	97	*6.0*	21	*2.1*	118	*4.5*
No External Cause reported	12	*0.7*	10	*1.0*	22	*0.8*
Intentional self-harm (X60–X84, Y87.0)	14	*0.9*	6	*0.6*	20	*0.8*
Poisoning (X40–X49)	8	*0.5*	..	..	12	*0.5*
Other major groups (W65–W74, Y10–Y34, Y87.2, X00–X19)	8	*0.5*	..	..	..	..
Major groups total	**1,611**	***100***	**984**	***100***	**2,595**	***100***

.. Cell counts in tables that are 4 cases or fewer have been suppressed, as have percentages derived from them, to protect confidentiality.

Comparison to Principal Diagnosis TBI cases

Although sharing *Falls* as the most common External Cause of TBI, the proportion of *Falls* was higher for 'Other TBI' cases (57% compared to 42%), than for Principal Diagnosis cases (Table 2.4). The proportion of *Transportation* cases was higher for Principal Diagnosis cases (29%) than for 'Other TBI' cases (19%). The proportion of *Assault* cases was also much higher for Principal Diagnosis cases (14%) than for 'Other TBI' cases (5%).

Activity at time of injury

The activity at the time of injury was only specified in 37% (n=952) of 'Other TBI' cases, with almost half of these (n=446) being classified to *Other specified activity* (Table 4.6). Those engaging in *Resting, eating, sleeping or engaging in other vital activities* accounted for 11% (n=279) of all other TBI hospitalisations during 2004–05. Traumatic brain injuries sustained while *Working for income* accounted for 3% (n=79) of all hospitalisations, while S*porting activities* accounted for a further 2.3% (n=60) of all hospitalisations.

Table 4.6: 'Other TBI' cases by reported activity, Australia 2004–05

	Males		Females		Persons	
Activity	**Count**	**Per cent**	**Count**	**Per cent**	**Count**	**Per cent**
While engaged in sports	52	*3.2*	8	*0.8*	60	*2.3*
While engaged in leisure	22	*1.4*	10	*1.0*	32	*1.2*
While working for income	65	*4.0*	14	*1.4*	79	*3.0*
While engaged in other types of work	38	*2.4*	18	*1.8*	56	*2.2*
While resting, sleeping, eating or engaging in other vital activities	126	*7.8*	153	*15.5*	279	*10.8*
Other specified activity	274	*17.0*	172	*17.5*	446	*17.2*
Unspecified activity	1,034	*64.2*	609	*61.9*	1,643	*63.3*
Total	**1,611**	***100***	**984**	***100***	**2,595**	***100***

Comparison to Principal Diagnosis TBI cases

A higher proportion (48%) of Principal Diagnosis cases reported a specified activity, with a lower proportion (40%) being reported as an *'Other specified'* activity (Table 2.5). *'Sport'* accounted for a higher proportion of Principal Diagnosis activity codes (16%), and the proportion of cases recording *'Working for income'* was similar (4%). Only 4% of Principal Diagnosis cases reported resting, eating, sleeping or other vital activities, compared to 11% of 'Other TBI' cases.

Place of occurrence of injury

The *Home* was the most common place of occurrence for 'Other TBI' hospitalisations in 2004–05, accounting for 28% (n=726) of all admissions (Table 4.7). Females (38%, n=373) were far more likely to sustain an injury in this setting than males (22%, n=353). *Streets and highways* were also prominent places of occurrence, accounting for 19% (n=479) of all 'Other TBI' cases, with injuries occurring on *Roadways* being responsible for 82% of injuries in this setting. *Health service areas* were also a prominent setting for injuries, account for 14% (n=365) of 'Other TBI' cases.

Table 4.7: 'Other TBI' cases by place of occurrence, Australia 2004–05

	Males		Females		Persons	
Place of occurrence	**Count**	**Per cent**	**Count**	**Per cent**	**Count**	**Per cent**
Home	353	*21.9*	373	*37.9*	726	*28.0*
Driveway to home	*20*	*5.7*	..	..	..	..
Other and unspecified place in home	*329*	*93.2*	*371*	*99.5*	*700*	*96.4*
Residential institution	48	*3.0*	63	*6.4*	111	*4.3*
Aged care facilities	*39*	*81.3*	*62*	*98.4*	*101*	*91.0*
Other and unspecified residential institution	..	..	..	..	*10*	*9.0*
School	8	*0.5*	..	..	..	..
Health service area	202	*12.5*	163	*16.6*	365	*14.1*
Other specified institution and public administrative area	10	*0.6*	5	*0.5*	15	*0.6*
Sports and athletics area	31	*1.9*	..	..	..	..
Street and highway	367	*22.8*	112	*11.4*	479	*18.5*
Roadway	*306*	*83.4*	*87*	*77.7*	*393*	*82.0*
Sidewalk	*34*	*9.3*	*22*	*19.6*	*56*	*11.7*
Other and unspecified roadway and sidewalk	*27*	*7.4*	..	..	..	..
Trade and service area	90	*5.6*	48	*4.9*	138	*5.3*
Shop and store	*23*	*25.6*	*16*	*33.3*	*39*	*28.3*
Cafe, hotel and restaurant	*46*	*51.1*	*19*	*39.6*	*65*	*47.1*
Other and unspecified shop and store	*21*	*23.3*	*13*	*27.1*	*34*	*24.6*
Industrial and construction area	23	*1.4*	0	*0.0*	23	*0.9*
Farm	12	*0.7*	5	*0.5*	17	*0.7*
Other specified place of occurrence	54	*3.4*	30	*3.0*	84	*3.2*
Unspecified place of occurrence	413	*25.6*	182	*18.5*	595	*22.9*
Total	**1,611**	***100***	**984**	***100***	**2,595**	***100***

Subgroup proportions are percentages relating to that diagnosis group.
.. Cell counts in tables that are 4 cases or fewer have been suppressed, as have percentages derived from them, to protect confidentiality.

Comparison to Principal Diagnosis TBI cases

The most common place of occurrence of Principal Diagnosis TBI cases was *Street and highway* (22%), and *Roadway* was reported for the same proportion of cases as for 'Other TBI' cases (82%). The next highest proportion of cases was for injury sustained in the *Home* (21%), a lower proportion than for 'Other TBI' cases. *Health service areas* accounted for less than 1% of Principal Diagnosis cases, compared to 14% of 'Other TBI' cases. Around 6% of Principal Diagnosis cases occurred in *Trade or service areas.*

Severity

Mean ICISS score

Figure 4.3 shows the mean ICISS by age group for selected External Cause groups for 'Other TBI' cases in 2004–05. The severity of injury was generally higher for children aged 0–4 years compared to older children, and tended to increase from the 10–14 year age group onwards for each of the External Cause groups. For those aged 10–14 years through to 60–64 years, the most severe injuries were *Transport*-related.

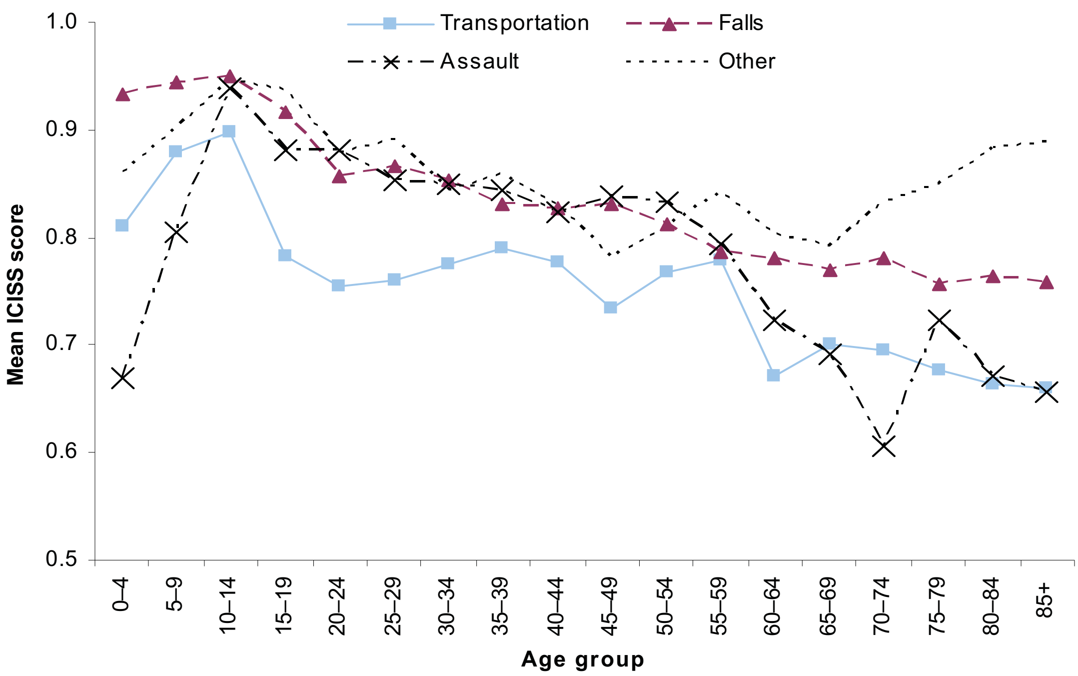


Figure 4.3: Mean ICISS for 'Other TBI' cases by age group and External Cause group, Australia 2004–05

Comparison to Principal Diagnosis TBI cases

The pattern of ICISS scores for Principal Diagnosis cases was similar, but generally slightly less severe than for 'Other TBI' cases.

Loss of consciousness

A relatively high percentage of cases in this group (41%, n=1,074) were recorded as having no concussion, with a further 29% (n=751) sustaining a loss of consciousness (LOC) of a brief duration (Table 4.8). Only 1.7% (n=45) of cases had a LOC of a prolonged duration. Cases recorded as having no concussion also had the longest mean length of stay (LOS) of 53.9 days, longer than both the cases who sustained a LOC of prolonged duration with return to pre-existing consciousness (40.7 days) and cases who sustained a LOC of prolonged duration without return to pre-existing consciousness (21.1 days). The mean LOS for the last group is likely to be reduced due to the fact that 48% of these cases died while in hospital.

Table 4.8: Reported loss of consciousness (LOC) for 'Other TBI' cases by measures of severity, Australia 2004–05

ICD-10-AM category	Count	Per cent	Mean LOS	Mean ICISS	Surv prop[(b)]
No concussion	1,074	*41.4*	58.7	0.673	0.924
S06.00 Concussion	125	*4.8*	16.4	0.950	0.960
S06.01 LOC of unspecified duration	554	*21.4*	22.2	0.766	0.946
S06.02 LOC of brief duration [less than 30 minutes]	751	*29.0*	10.4	0.932	0.977
S06.03 LOC of moderate duration [30 minutes to 24 hours]	45	*1.7*	14.7	0.781	0.911
S06.04 LOC of prolonged duration [more than 24 hours], with return to pre-existing conscious level	18	*0.7*	40.7	0.592	0.944
S06.05 LOC of prolonged duration [more than 24 hours], without return to pre-existing conscious level	27	*1.0*	21.1	0.057	0.519
Total	**2,594[(a)]**	***100***	**33.6**	**0.776**	**0.941**

(a) Excludes 1 case (female) with length of stay of 5,154 days.

(b) Observed proportion of patients who survived to discharge.

Comparison to Principal Diagnosis TBI cases

Compared to Principal Diagnosis TBI cases (Table 2.8), 'Other TBI' cases had a much higher percentage of cases where no concussion was recorded (41% to 18%), and a much lower percentage of cases with a concussion without LOC (5% to 22%). The percentage of cases with LOC of moderate duration or longer was similar at 3.4% for 'Other TBI cases', compared to 2.9% for Principal Diagnosis. Overall, 'Other TBI' cases had a much higher mean LOS of 33.6 days, compared to a mean of only 5.4 days for Principal Diagnosis TBI cases. Despite the overall survival rate being similar for both groups, patients in the 'Other TBI' group with a LOC of prolonged duration without return to pre-existing conscious level had a survival rate of 52% compared to only 14% for the equivalent cases in the Principal Diagnosis TBI group.

Proportion of deaths in hospital among 'Other TBI' cases

Figure 4.4 indicates the proportion of 'Other TBI' cases who died while in hospital. For all ages and all External Causes, death was reported for 5.9% (n=152) of cases. The major External Cause of death was *Falls* (70% of deaths), followed by *Other major group* (25% of deaths). There were only five deaths from *Transport*-related injury and one death from A*ssault*-related injury. Overall, 7% of those admitted with a TBI as a result of a fall, died in hospital.

Those aged 65 years and over accounted for 82% of all deaths in hospital, with 73% of these deaths being *Fall*-related. Overall, 10% of people in this age group died in hospital, with 10% of those admitted as a result of a fall, dying in hospital.

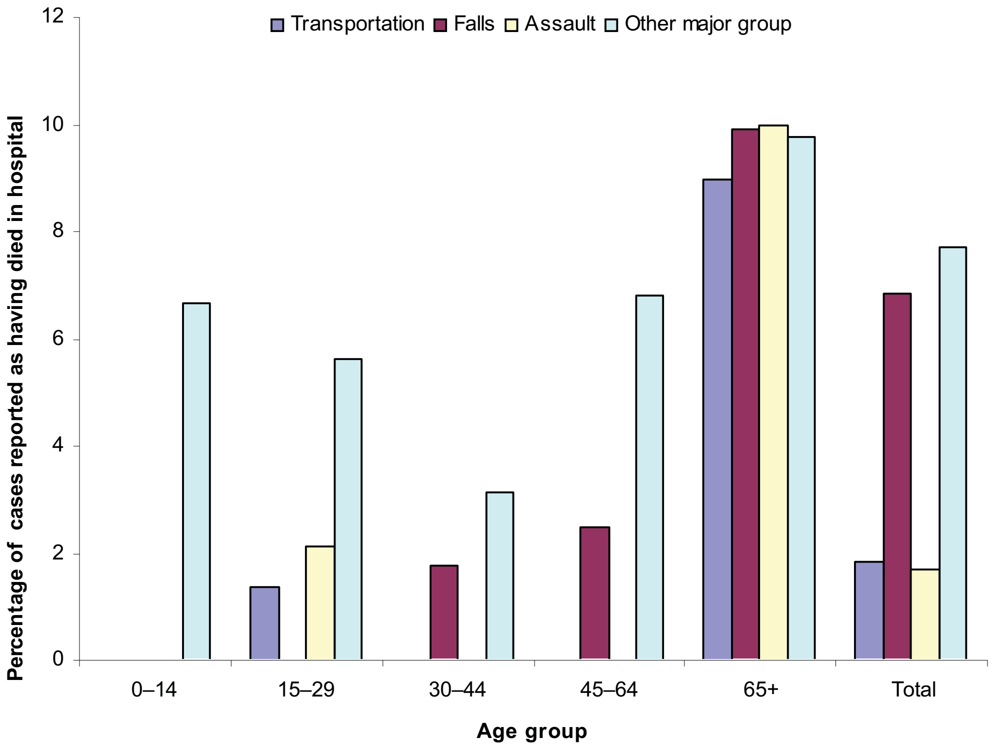


Figure 4.4: Percentage of deaths in hospital for 'Other TBI' cases by age group and External Cause group, Australia 2004–05

5 Analysis of multiple head injury codes

Introduction

A single head injury can be represented in the hospital separation data collection by one ICD-10-AM code, or by a combination of codes. When two or more codes are present, they usually describe different aspects of the injury, the main ones being the presence and type of brain injury, associated bleeding and its volume, the duration of any accompanying loss of consciousness, and the general location and type of an accompanying skull fracture, if present. In the previous chapters of this report, cases with more than one head injury code have been analysed in terms of the first-mentioned of these. In this chapter, analysis takes account of all of the relevant codes. This approach has two main advantages. First, it provides a more complete description of the nature and extent of head injury among admitted patients. Second, this approach enables identification of groups of cases that differ in terms of severity, defined here as threat to life.

This section looks at comparisons based on different combinations of head injury. Cases were divided into four major groups:

1. Those whose only significant head injury was an intracranial injury (i.e. at least one diagnosis code in the ICD-10-AM code range S06.1–S06.9),
2. Those whose only significant head injury was a concussion (i.e. at least one diagnosis ICD-10-AM code beginning with S06.0),
3. Those who had a skull fracture in combination with a concussion (i.e. at least one ICD-10-AM diagnosis code beginning with S02 and at least one code beginning with S06.0), and
4. Those whose only significant head injury was a skull fracture (i.e. at least one ICD-10-AM diagnosis code in the range S02.0–S02.1, S02.7–S02.9)[1].

It should be noted that the last group is an additional group which is not included in any of the other sections of this report. A case with a skull fracture (S02) but no code for intracranial injury (S06) clearly involved a head injury. Whether such cases also involve intracranial injury is uncertain. The lack of a code specifying the presence of intracranial injury suggests that such a diagnosis was not made. However, this does not exclude the possibility that such a condition was present, but undiagnosed, in some of these cases. In this chapter, cases are compared on the basis of how they are distributed across these four groups for a range of factors. Injury severity is also compared by looking at the mean ICISS, which represents threat to life, as well as the observed proportion of patients surviving to discharge.

[1] Note that this group excludes cases who sustained fractures to the head region, but where these fractures were only to facial bones. This group included 13,186 cases.

Overview

Table 5.1 shows mean ICISS and observed proportions of patients who survived to discharge for various combinations of head injury for all patients admitted to hospital with a TBI or a skull fracture during 2004–05. Patients whose only significant head injury was a *Concussion*, accounted for 56% (n=13,983) of patients in this group. Interestingly, the chance of survival of these patients was slightly lower than that of patients who had both a concussion and a skull fracture. This latter group had the best chance of survival of all the head injury combinations. Not surprisingly, patients who sustained a combination of a *Concussion*, an *Intracranial* injury, and a *Skull fracture* had the lowest chance of survival. For all combinations, head injuries contributed significantly more to the overall severity of a patient's condition than other types of injuries.

Table 5.1: Mean ICISS and observed survival proportions, various combinations of head injury involving TBI or skull fracture, Australia 2004–05

			Mean ICISS			
Head injury combinations	**Count**	**Per cent**	**Head injury[(a)]**	**Other injury[(b)]**	**All injury**	**Prop surv[(c)]**
Intracranial injury only	2,945	*11.7*	0.728	0.965	0.704	*0.892*
Intracranial injury and skull fracture	1,348	*5.4*	0.603	0.937	0.567	*0.927*
Concussion only	13,983	*55.7*	0.971	0.980	0.952	*0.993*
Concussion and skull fracture	1,456	*5.8*	0.898	0.967	0.869	*0.996*
Concussion and intracranial injury	1,714	*6.8*	0.638	0.950	0.611	*0.855*
Concussion, intracranial injury and skull fracture	1,264	*5.0*	0.499	0.912	0.464	*0.840*
Skull fracture without TBI	2,393	*9.5*	0.896	0.962	0.863	*0.989*
Total	**25,103**	***100***	**0.865**	**0.968**	**0.841**	***0.960***

(a) Mean ICISS for injury diagnoses related only to the head (i.e. any diagnosis in range S00–S09).
(b) Mean ICISS for injury diagnoses other than head injury diagnoses (i.e. any diagnosis in range S10–T89).
(c) Observed proportion of patients who survived to discharge.

Case type

Table 5.2 shows the mean ICISS and observed proportions of patients who survived to discharge for various combinations of head injury by case type[2] for all patients admitted to hospital with a TBI during 2004–05. The pattern for all 'Principal Diagnosis TBI' and 'Additional Diagnosis TBI' case types was similar to that depicted in Table 5.1 with those patients whose only significant head injury was a *Concussion*, having the best chance of survival of all the combinations, and patients who suffered *Intracranial* injury in conjunction with a *Skull fracture* and a *Concussion*, having the lowest chance of survival. For 'Other TBI' cases, this same pattern was evident in terms of mean ICISS, but differed in terms of the observed proportion surviving to discharge, where those patients who sustained a *Concussion* in combination with an *Intracranial* injury had the best chance of survival. This difference could in part be attributed to the significant proportion of rehabilitation cases (i.e. patients sustained serious injuries but were able to be transferred to a rehabilitation ward, rather than their injuries leading to death) in this group, compared to the Principal Diagnosis and Additional Diagnosis groups, neither of which contained any rehabilitation cases.

Table 5.2: Mean ICISS and observed survival proportions, various combinations of head injury by case type for all TBI hospitalisations, Australia 2004–05

	Principal Diagnosis TBI			Additional Diagnosis TBI			Other TBI		
Head injury combinations	**Count**	**Mean ICISS**	**Prop surv[(a)]**	**Count**	**Mean ICISS**	**Prop surv[(a)]**	**Count**	**Mean ICISS**	**Prop surv[(a)]**
Intracranial TBI only	1,940	0.709	*0.883*	202	0.625	*0.911*	803	0.713	*0.908*
Intracranial TBI & skull fracture	547	0.546	*0.889*	529	0.595	*0.943*	272	0.555	*0.971*
Concussion only	9,371	0.968	*0.998*	3,514	0.908	*0.988*	1,098	0.950	*0.964*
Concussion & skull fracture	274	0.922	*1.000*	1,135	0.859	*0.997*	47	0.817	*0.957*
Concussion & intracranial injury	1,382	0.611	*0.847*	92	0.560	*0.859*	240	0.627	*0.900*
Concussion & TBI and skull fracture	676	0.436	*0.793*	453	0.515	*0.872*	135	0.435	*0.970*
Total	**14,190**	**0.856**	***0.954***	**5,925**	**0.826**	***0.972***	**2,595**	**0.776**	***0.941***

(a) Observed proportion of patients who survived to discharge.

[2] For definition of case types see Chapter 1.

External Cause

Table 5.3 shows the percentage of cases for various combinations of head injury by External Cause group for all patients admitted to hospital with a TBI during 2004–05. Excluding *Other and unspecified* cases, patients who sustained an injury as a result of a *Fall* or due to *Intentional self–harm* had the highest percentage of intracranial injuries (both 37%), while patients who sustained an injury as a result of an *Assault* or from *Other unintentional* causes had the lowest percentages (20% and 16% respectively). Patients whose External Cause was *Other Unintentional* had the highest percentage of concussion only injuries (65%), while patients who sustained an injury as a result of an *Assault* had the lowest percentage (52%). Patients who sustained an injury as a result of an *Assault* or due to *Other unintentional* causes had the highest percentage of skull fracture only injuries (16% and 13% respectively) while patients who sustained an injury as a result of a *Self-inflicted* injury had the lowest percentage (6%).

Table 5.3: Percentage of cases for various combinations of head injury by External Cause group for all TBI hospitalisations, Australia 2004–05

	Intracranial TBI		Concussion TBI only		Concussion TBI & skull fracture		Skull fracture without TBI		All cases
External Cause group	**Count**	**%Total cases**	**Count**	**%Total cases**	**Count**	**%Total cases**	**Count**	**%Total cases**	**Total cases**
Transportation	2,152	*27.7*	4,504	*58.0*	497	*6.4*	616	*7.9*	7,769
Falls	3,677	*36.9*	5,239	*52.6*	317	*3.2*	729	*7.3*	9,962
Other unintentional	518	*16.3*	2,064	*65.0*	168	*5.3*	423	*13.3*	3,173
Intentional, self inflicted	69	*36.9*	102	*54.0*	6	*3.2*	12	*6.3*	189
Assault	731	*19.8*	1,917	*51.8*	457	*12.4*	594	*16.1*	3,699
Other and unspecified	124	*39.0*	157	*50.7*	11	*3.5*	19	*6.1*	311
Total	**7,271**	***29.0***	**13,983**	***55.7***	**1,456**	***5.8***	**2,393**	***9.5***	**25,103**

(a) Per cent of total cases are row percentages.

Table 5.4 shows mean ICISS and observed proportions of patients who survived to discharge for various combinations of head injury by External Cause group for all TBI hospitalisations during 2004–05. Overall, patients who sustained their head injuries due to an *Assault* had the highest chance of survival of all the External Cause groups, while patients who sustained injuries that were self-inflicted (*Self-harm*) had the lowest chance of survival. This difference may, in part, be a reflection of the younger age profile of the *Assault victims*. This pattern was generally observed for each of the various head injury combinations. Patients who sustained an intracranial injury had a lower chance of survival than patients who did not sustain this type of injury, regardless of their External Cause of injury.

Table 5.4: Mean ICISS and observed survival proportions, various combinations of head injury by External Cause group for all TBI hospitalisations, Australia 2004–05

	Intracranial TBI		Concussion TBI		Concussion TBI & skull fracture		Skull fracture without TBI		All cases	
External Cause group	**Mean ICISS**	**Prop surv[(a)]**	**Mean ICISS**	**Prop surv[(a)]**	**Mean ICISS**	**Prop surv[(a)]**	**Mean ICISS**	**Prop surv[(a)]**	**Mean ICISS**	**Prop surv[(a)]**
Transportation	0.530	*0.891*	0.931	*0.993*	0.828	*0.994*	0.802	*0.987*	0.803	*0.964*
Falls	0.658	*0.857*	0.964	*0.991*	0.877	*0.997*	0.880	*0.981*	0.842	*0.941*
Other unintentional	0.675	*0.919*	0.968	*0.994*	0.897	*1.000*	0.889	*0.998*	0.906	*0.983*
Intentional, self-inflicted	0.461	*0.725*	0.884	*0.951*	0.643	*0.667*	0.750	*0.833*	0.713	*0.852*
Assault	0.622	*0.963*	0.954	*0.999*	0.901	*1.000*	0.889	*1.000*	0.871	*0.992*
Other and unspecified	0.605	*0.831*	0.948	*0.981*	0.878	*1.000*	0.872	*0.947*	0.804	*0.920*
Total	**0.615**	***0.880***	**0.952**	***0.993***	**0.869**	***0.996***	**0.863**	***0.989***	**0.841**	***0.960***

(a) Observed proportion of patients who survived to discharge.

Mode of transport

Table 5.5 shows the percentage of cases for various combinations of head injury by mode of transport for all patients admitted to hospital with a TBI during 2004–05. *Pedestrians* (52%) had the highest percentage of intracranial injuries, while those modes of transport experiencing the lowest percentage of intracranial injuries included *Pedal cyclists* (15%), *Animal riders or occupants of animal drawn vehicles* (12%) and occupants of *All-terrain vehicles* (13%). Patients injured while riding an *Animal or as occupants of an animal-drawn vehicle* had the highest percentage of concussion only injuries (80%), while those injured while an occupant of a *Pickup truck or van*, had the highest proportion of skull fracture only injuries (12%). A combination of concussion and skull fracture was relatively uncommon among most modes of transport.

Table 5.5: Percentage of cases for various combinations of head injury by mode of transport for all TBI hospitalisations, Australia 2004–05

	Intracranial TBI		Concussion TBI only		Concussion TBI & skull fracture		Skull fracture without TBI		All cases
Mode of transport	**Count**	**%Total cases**	**Count**	**%Total cases**	**Count**	**%Total cases**	**Count**	**%Total cases**	**Total**
Pedestrian	478	*51.8*	291	*31.5*	62	*6.7*	92	*10.0*	923
Pedal cycle	177	*15.3*	772	*66.8*	113	*9.8*	93	*8.1*	1,155
Motorcycle	315	*21.4*	1,003	*68.1*	86	*5.8*	68	*4.6*	1,472
Car	931	*31.9*	1,544	*53.0*	161	*5.5*	278	*9.5*	2,914
Pickup truck or van	31	*29.0*	56	*52.3*	7	*6.5*	13	*12.1*	107
Heavy transport vehicle	36	*27.1*	78	*58.6*	5	*3.8*	14	*10.5*	133
Bus	15	*33.3*	25	*55.6*	..	..	..	..	45
Animal rider/ occupant of animal drawn vehicle	77	*12.3*	501	*80.3*	29	*4.6*	17	*2.7*	624
All terrain vehicle	13	*13.1*	71	*71.7*	10	*10.1*	5	*5.1*	99
Other land transport	42	*29.4*	83	*58.0*	..	..	15	*10.5*	143
Watercraft	25	*29.1*	43	*50.0*	10	*11.6*	8	*9.3*	86
Air and space	..	..	8	*38.1*	6	*28.6*	..	..	21
Other and unspecified	..	..	29	*61.7*	..	..	7	*14.9*	47
Total	**2,152**	***27.7***	**4,504**	***58.0***	**497**	***6.4***	**616**	***7.9***	**7,769**

(a) Per cent of total cases are row percentages.
.. Cell counts in tables that are 4 cases or fewer have been suppressed, as have percentages derived from them, to protect confidentiality.

Table 5.6 shows mean ICISS and observed proportions of patients who survived to discharge for various combinations of head injury by mode of transport for all TBI hospitalisations during 2004–05. Overall, it appeared that *Pedestrians* and those whose mode of transport was a *Bus* had the lowest chance of survival when compared to other modes of transport. In general, these two modes of transport were among those with the lowest chance of survival when looking at the various head injury combinations. Patterns for the other modes of transport were less able to be distinguished. Patients who sustained an intracranial injury had a lower chance of survival than patients who did not sustain this type of injury, regardless of their mode of transport.

Table 5.6: Mean ICISS and observed survival proportions, various combinations of head injury by mode of transport for all TBI hospitalisations, Australia 2004–05

	Intracranial TBI		Concussion TBI only		Concussion TBI & skull fracture		Skull fracture without TBI		All head injury	
Mode of transport	**Mean ICISS**	**Prop surv[(a)]**	**Mean ICISS**	**Prop surv[(a)]**	**Mean ICISS**	**Prop surv[(a)]**	**Mean ICISS**	**Prop surv[(a)]**	**Mean ICISS**	**Prop surv[(a)]**
Pedestrian	0.515	*0.845*	0.900	*0.976*	0.776	*0.968*	0.786	*0.989*	0.681	*0.909*
Pedal cycle	0.624	*0.932*	0.952	*1.000*	0.882	*1.000*	0.845	*0.989*	0.886	*0.989*
Motorcycle	0.539	*0.933*	0.923	*0.996*	0.811	*1.000*	0.820	*0.985*	0.830	*0.982*
Car	0.498	*0.886*	0.920	*0.989*	0.822	*0.994*	0.779	*0.986*	0.766	*0.956*
Pickup truck or van	0.558	*0.968*	0.916	*1.000*	0.849	*1.000*	0.783	*0.923*	0.792	*0.981*
Heavy transport vehicle	0.575	*0.889*	0.929	*1.000*	0.860	*1.000*	0.842	*1.000*	0.821	*0.970*
Bus	0.636	*0.733*	0.947	*0.960*	0.802	*1.000*	0.888	*1.000*	0.831	*0.889*
Animal rider/ occupant of animal drawn vehicle	0.645	*0.948*	0.961	*0.998*	0.851	*1.000*	0.825	*1.000*	0.913	*0.992*
All terrain vehicle	0.534	*0.923*	0.945	*1.000*	0.818	*1.000*	0.833	*1.000*	0.873	*0.990*
Other land transport	0.689	*0.905*	0.931	*0.976*	0.920	*1.000*	0.846	*1.000*	0.851	*0.958*
Watercraft	0.459	*0.920*	0.954	*1.000*	0.799	*1.000*	0.891	*1.000*	0.786	*0.977*
Air and space	0.290	*0.667*	0.904	*1.000*	0.624	*1.000*	0.706	*1.000*	0.699	*0.952*
Other and unspecified	0.586	*1.000*	0.975	*1.000*	0.793	*1.000*	0.886	*1.000*	0.880	*1.000*
Total	**0.530**	***0.891***	**0.931**	***0.993***	**0.828**	***0.994***	**0.802**	***0.987***	**0.803**	***0.964***

(a) Observed proportion of patients who survived to discharge.

Falls

Table 5.7 shows the percentage of cases for various combinations of head injury by nature of Fall for all patients admitted to hospital with a TBI during 2004–05. Patients who sustained an injury as a result of falling out of a *Wheelchair* had the highest percentage of intracranial injuries (62%), followed closely by falls from a *Cliff* (48%), *Falls on and from steps and stairs* (45%), and *Falls on and from ladder (42%).* Patients who sustained an injury as a result of a *Collision with, or pushing by, another person* had the lowest percentage of intracranial injuries (7%), followed closely by *Falls from tree* (8%). Patients who sustained an injury as a result of a *Collision with, or pushing by, another person* had the highest proportion of concussion only injuries (90%), followed by *Falls from playground equipment* (81%). Patients who fell while being *Carried or supported by other persons* had the highest percentage of skull fracture only injuries (37%). Some of these results should be treated with caution due to low case numbers.

Table 5.7: Percentage of cases for various combinations of head injury by nature of fall for all TBI hospitalisations, Australia 2004–05

	Intracranial TBI		Concussion TBI only		Concussion TBI & skull fracture		Skull fracture without TBI		All head injury
Nature of fall	**Count**	**%Total cases**	**Count**	**%Total cases**	**Count**	**%Total cases**	**Count**	**%Total cases**	**Total**
On same level from tripping, slipping and stumbling	460	*32.7*	795	*56.5*	48	*3.4*	105	*7.5*	1,408
Ice skates, skis, roller skates or skate boards	60	*28.7*	124	*59.3*	15	*7.2*	10	*4.8*	209
Collision with, or pushing by another person	31	*6.6*	422	*90.2*	6	*1.3*	9	*1.9*	468
Carried or supported by other persons	..	..	49	*41.9*	..	.	43	*36.8*	117
Wheelchair	21	*61.8*	9	*26.5*	..	..	..	..	34
Furniture	249	*33.3*	408	*54.5*	12	*1.6*	79	*10.6*	748
Playground equipment	13	*7.0*	149	*80.5*	..	..	20	*10.8*	185
Steps and stairs	433	*44.8*	431	*44.6*	40	*4.1*	63	*6.5*	967
Ladder	164	*41.6*	185	*47.0*	12	*3.0*	33	*8.4*	394
Scaffolding	11	*25.6*	23	*53.5*	..	..	6	*14.0*	43
From, out of or through building	194	*37.5*	224	*43.3*	40	*7.7*	59	*11.4*	517
Tree	7	*8.0*	64	*73.6*	..	..	13	*14.9*	87
Cliff	18	*47.4*	16	*42.1*	..	..	..	..	38
Diving/jumping into water	..	..	23	*74.2*	0	*0.0*	..	..	31
Other fall from one level to another	142	*27.7*	296	*57.8*	20	*3.9*	54	*10.5*	512
Other fall on same level	769	*36.9*	1,149	*55.1*	63	*3.0*	105	*5.0*	2,086
Unspecified	1,077	*50.8*	872	*41.2*	47	*2.2*	122	*5.8*	2,118
Total	**3,677**	***36.9***	**5,239**	***52.6***	**317**	***3.2***	**729**	***7.3***	**9,962**

(a) Per cent of total cases are row percentages.
.. Cell counts in tables that are 4 cases or fewer have been suppressed, as have percentages derived from them, to protect confidentiality.

Table 5.8 shows mean ICISS and observed proportions of patients who survived to discharge for various combinations of head injury by nature of fall for all TBI hospitalisations during 2004–05. In general, there was relatively poor correlation between the observed proportion and the predicted proportion of patients surviving to discharge. Overall, both measures indicated that persons suffering a *Fall involving wheelchair* had one of the lowest chances of survival when compared to those injured from other types of Falls. The mean ICISS also predicted lower chances of survival for *Falls from a cliff*, a *Building*, or a *Ladder*, although chances of survival for these types of Falls were not particularly low for the observed measure. Patterns in chance of survival were generally difficult to distinguish when looking at the various head injury combinations, although predicted chances of survival were generally lower for *Falls from cliff*, while observed chances of survival were generally lower for *Fall involving wheelchair*. Patients who sustained an intracranial injury had a lower chance of survival than patients who did not sustain this type of injury, regardless of the nature of their Fall.

Table 5.8: Mean ICISS and observed survival proportions, various combinations of head injury by nature of fall for all TBI hospitalisations, Australia 2004–05

	Intracranial TBI		Concussion TBI only		Concussion TBI and skull fracture		Skull fracture without TBI		All head injury	
Nature of fall	**Mean ICISS**	**Prop surv[(a)]**	**Mean ICISS**	**Prop surv[(a)]**	**Mean ICISS**	**Prop surv[(a)]**	**Mean ICISS**	**Prop surv[(a)]**	**Mean ICISS**	**Prop surv[(a)]**
On same level from tripping, slipping and stumbling	0.680	*0.863*	0.966	*0.996*	0.866	*0.979*	0.879	*1.000*	0.863	*0.952*
Ice skates, skis, roller skates or skate boards	0.657	*0.933*	0.972	*1.000*	0.873	*1.000*	0.875	*1.000*	0.870	*0.981*
Collision with, or pushing by another person	0.707	*0.935*	0.984	*1.000*	0.947	*1.000*	0.929	*1.000*	0.964	*0.996*
Carried or supported by other persons	0.743	*0.958*	0.984	*1.000*	0.839	*1.000*	0.895	*1.000*	0.901	*0.991*
Wheelchair	0.680	*0.667*	0.925	*1.000*	0.902	*1.000*	0.888	*1.000*	0.770	*0.794*
Furniture	0.692	*0.807*	0.978	*0.990*	0.901	*1.000*	0.889	*0.962*	0.872	*0.926*
Playground equipment	0.762	*1.000*	0.987	*1.000*	0.892	*1.000*	0.899	*1.000*	0.960	*1.000*
Steps and stairs	0.632	*0.871*	0.956	*0.991*	0.888	*1.000*	0.882	*1.000*	0.803	*0.938*
Ladder	0.597	*0.921*	0.940	*0.995*	0.872	*1.000*	0.847	*1.000*	0.787	*0.965*
Scaffolding	0.482	*0.909*	0.946	*1.000*	0.864	*1.000*	0.822	*1.000*	0.804	*0.977*
From, out of or through building	0.552	*0.933*	0.945	*1.000*	0.823	*1.000*	0.863	*0.983*	0.779	*0.973*
Tree	0.700	*0.857*	0.950	*1.000*	0.861	*1.000*	0.867	*1.000*	0.914	*0.988*
Cliff	0.584	*0.944*	0.880	*1.000*	0.779	*1.000*	0.752	*1.000*	0.728	*0.973*
Diving/jumping into water	0.576	*1.000*	0.952	*1.000*	**	**	0.867	*1.000*	0.893	*1.000*
Other fall from one level to another	0.665	*0.908*	0.965	*0.997*	0.873	*1.000*	0.880	*1.000*	0.869	*0.973*
Other fall on same level	0.654	*0.835*	0.963	*0.988*	0.886	*1.000*	0.878	*0.981*	0.842	*0.932*
Unspecified	0.681	*0.837*	0.957	*0.976*	0.906	*1.000*	0.886	*0.934*	0.811	*0.903*
Total	**0.658**	***0.857***	**0.964**	***0.991***	**0.877**	***0.997***	**0.880**	***0.981***	**0.842**	***0.941***

(a) Observed proportion of patients who survived to discharge.
** No cases were recorded for this combination of nature of fall and head injury combination.

Assault

Table 5.9 shows the percentage of cases for various combinations of head injury by nature of Assault for all patients admitted to hospital with a TBI during 2004–05. Excluding *Other specified* and *Unspecified means*, patients who were assaulted by a *Blunt object* had the highest percentage of I*ntracranial* injuries (26%), while patients who were assaulted by *Bodily force* had the lowest percentage of *Intracranial* injuries (14%). Patients who were assaulted by a *Bodily force* had the highest percentage of *Concussion* only injuries, while those assaulted by a *Sharp object* had the highest percentage of *Skull fracture* only injuries (21%).

Table 5.9: Percentage of cases for various combinations of head injury by nature of assault for all TBI hospitalisations, Australia 2004–05

	Intracranial TBI		Concussion TBI only		Concussion TBI & skull fracture		Skull fracture without TBI		All head injury
Nature of assault	**Count**	**% Total cases[(a)]**	**Count**	**% Total cases[(a)]**	**Count**	**% Total cases[(a)]**	**Count**	**% Total cases[(a)]**	**Total**
Sharp object	17	*15.7*	58	*53.7*	10	*9.3*	23	*21.3*	108
Blunt object	171	*26.0*	300	*45.7*	63	*9.6*	123	*18.7*	657
Bodily force	326	*14.2*	1,296	*56.3*	310	*13.5*	371	*16.1*	2,303
Other specified means	41	*27.3*	41	*27.3*	6	*4.0*	62	*41.3*	150
Unspecified means	176	*36.6*	222	*46.2*	68	*14.1*	15	*3.1*	481
Total	**731**	***19.8***	**1,917**	***51.8***	**457**	***12.4***	**594**	***16.1***	**3,699**

(a) Per cent of total cases are row percentages.

Table 5.10 shows mean ICISS and observed proportions of patients who survived to discharge for various combinations of head injury by nature of Assault for all TBI hospitalisations during 2004–05. The small number of observed deaths resulting from Assaults led to a relatively poor correlation between the observed proportion and the predicted proportion of patients surviving to discharge. With the exception of *Intracranial* injury, the observed proportions of survivors were 1 or close to 1. Patients who sustained an *Intracranial* injury had a lower chance of survival than patients who did not sustain this type of injury, regardless of the nature of Assault.

Table 5.10: Mean ICISS and observed survival proportions, various combinations of head injury by nature of assault for all TBI hospitalisations, Australia 2004–05

	Intracranial TBI		Concussion TBI only		Concussion TBI & skull fracture		Skull fracture without TBI		All head injury	
Nature of assault	Mean ICISS	Prop surv[(a)]	Mean ICISS	Prop surv[(a)]	Mean ICISS	Prop surv[(a)]	Mean ICISS	Prop surv[(a)]	Mean ICISS	Prop surv[(a)]
Sharp object	0.625	*0.941*	0.921	*1.000*	0.767	*1.000*	0.815	*1.000*	0.838	*0.991*
Blunt object	0.591	*0.982*	0.949	*1.000*	0.874	*1.000*	0.859	*1.000*	0.832	*0.995*
Bodily force	0.638	*0.972*	0.958	*0.999*	0.914	*1.000*	0.905	*1.000*	0.898	*0.996*
Other specified means	0.635	*0.829*	0.947	*1.000*	0.891	*1.000*	0.881	*1.000*	0.832	*0.953*
Unspecified means	0.621	*0.960*	0.923	*0.995*	0.876	*1.000*	0.864	*1.000*	0.804	*0.983*
Total	**0.622**	***0.963***	**0.954**	***0.999***	**0.901**	***1.000***	**0.889**	***1.000***	**0.871**	***0.992***

(a) Observed proportion of patients who survived to discharge.

Age groups

Table 5.11 shows the percentage of cases for various combinations of head injury by age group for all patients admitted to hospital with a TBI during 2004–05. Older patients experienced the highest proportions of *Intracranial* injuries, with those aged 75 years and older experiencing a percentage of 55%. Children aged 10–14 years experienced the highest percentage of *Concussion* only injuries (79%), while children aged 0–4 years had the highest proportion of *Skull fracture* only injuries (23%).

Table 5.11: Percentage of cases for various combinations of head injury by age group for all TBI hospitalisations, Australia 2004–05

	Intracranial TBI		Concussion TBI only		Concussion TBI & skull fracture		Skull fracture without TBI		All head injury
Age group	Count	% Total cases[(a)]	Count	% Total cases[(a)]	Count	% Total cases[(a)]	Count	% Total cases[(a)]	Total
0–4	212	*18.1*	673	*57.5*	22	*1.9*	263	*22.5*	1,170
5–9	141	*14.8*	691	*72.5*	28	*2.9*	93	*9.8*	953
10–14	166	*9.8*	1,338	*79.0*	101	*6.0*	89	*5.3*	1,694
15–24	1,182	*20.7*	3,523	*61.8*	487	*8.5*	505	*8.9*	5,697
25–34	789	*22.1*	2,105	*58.8*	265	*7.4*	418	*11.7*	3,577
35–54	1,257	*25.9*	2,744	*56.6*	330	*6.8*	519	*10.7*	4,850
55–64	735	*40.2*	830	*45.4*	86	*4.7*	177	*9.7*	1,828
65–74	727	*45.9*	713	*45.0*	41	*2.6*	102	*6.4*	1,583
75+	2,062	*55.0*	1,366	*36.4*	96	*2.6*	227	*6.1*	3,751
Total	**7,271**	***29.0***	**13,983**	***55.7***	**1,456**	***5.8***	**2,393**	***9.5***	**25,103**

(a) Per cent of total cases are row percentages.

Table 5.12 shows mean ICISS and observed proportions of patients who survived to discharge for various combinations of head injury by age group for all TBI hospitalisations during 2004–05. Overall, both predicted and observed chances of survival tended to decrease with age. While similar trends were observed for patients whose only serious injury was a *Concussion*, the trends in other head injury combination groups were less clear. While the observed proportion of patients who survived appeared to decline with age for patients who sustained an *Intracranial* injury, and for those patients whose only significant head injury was a *Skull fracture*, the predicted proportions showed more variability. Patients who sustained an *Intracranial* injury had a lower chance of survival than patients who did not sustain this type of injury, regardless of their age group.

Table 5.12: Mean ICISS and observed survival proportions, various combinations of head injury by age group for all TBI hospitalisations, Australia 2004–05

	Intracranial TBI		Concussion TBI only		Concussion TBI & skull fracture		Skull fracture without TBI		All head injury	
Age group	**Mean ICISS**	**Prop surv[(a)]**	**Mean ICISS**	**Prop surv[(a)]**	**Mean ICISS**	**Prop surv[(a)]**	**Mean ICISS**	**Prop surv[(a)]**	**Mean ICISS**	**Prop surv[(a)]**
0–4	0.708	*0.958*	0.986	*1.000*	0.864	*0.955*	0.890	*1.000*	0.912	*0.992*
5–9	0.683	*0.972*	0.981	*1.000*	0.854	*1.000*	0.876	*1.000*	0.923	*0.996*
10–14	0.648	*0.946*	0.974	*1.000*	0.888	*1.000*	0.876	*0.989*	0.932	*0.994*
15–24	0.549	*0.927*	0.955	*0.997*	0.880	*1.000*	0.866	*0.992*	0.856	*0.982*
25–34	0.569	*0.928*	0.943	*0.998*	0.878	*0.996*	0.859	*0.998*	0.846	*0.982*
35–54	0.590	*0.924*	0.939	*0.995*	0.851	*0.994*	0.854	*0.994*	0.833	*0.976*
55–64	0.625	*0.909*	0.942	*0.992*	0.861	*1.000*	0.831	*0.989*	0.800	*0.959*
65–74	0.626	*0.854*	0.941	*0.972*	0.837	*1.000*	0.865	*0.980*	0.789	*0.919*
75+	0.662	*0.789*	0.943	*0.964*	0.861	*0.979*	0.866	*0.943*	0.782	*0.867*
Total	**0.615**	***0.880***	**0.952**	***0.993***	**0.869**	***0.996***	**0.863**	***0.989***	**0.841**	***0.960***

(a) Observed proportion of patients who survived to discharge.

Remoteness

Table 5.13 shows the percentage of cases for various combinations of head injury by remoteness of usual residence for all patients admitted to hospital with a TBI during 2004–05. Patients living in *Major cities* and *Inner regional* areas were more likely to suffer from an *Intracranial* injury than those living in the *Remote* or *Very remote* regions. Patients residing in *Remote* regions were more likely than those residing in any other region to sustain a *Concussion* as their only significant head injury (75%), while those residing in *Major cities* were more likely than those residing in any other region to sustain a *Skull fracture* as their only significant head injury (10%).

Table 5.13: Percentage of cases for various combinations of head injury by remoteness of usual residence for all TBI hospitalisations, Australia 2004–05

	Intracranial TBI		Concussion TBI only		Concussion TBI & skull fracture		Skull fracture without TBI		All head injury
Remoteness area	**Count**	**% Total cases[(a)]**	**Count**	**% Total cases[(a)]**	**Count**	**% Total cases[(a)]**	**Count**	**% Total cases[(a)]**	**Count**
Major cities	4,859	*33.7*	7,241	*50.2*	886	*6.1*	1,429	*9.9*	14,415
Inner regional	1,459	*26.0*	3,328	*59.4*	318	*5.7*	501	*8.9*	5,606
Outer regional	641	*18.5*	2,339	*67.5*	158	*4.6*	327	*9.4*	3,465
Remote	91	*13.4*	508	*74.7*	33	*4.9*	48	*7.1*	680
Very remote	87	*16.6*	360	*68.7*	33	*6.3*	44	*8.4*	524
Not reported	134	*32.4*	207	*50.1*	28	*6.8*	44	*10.7*	413
Total	**7,271**	***29.0***	**13,983**	***55.7***	**1,456**	***5.8***	**2,393**	***9.5***	**25,103**

(a) Per cent of total cases are row percentages.

Table 5.14 shows mean ICISS and observed proportions of patients who survived to discharge for various combinations of head injury by remoteness area for all TBI hospitalisations during 2004–05. Overall, both predicted and observed chances of survival tended to increase very slightly with degree of remoteness. This apparent trend might be, at least in part, due to a 'survivor effect' where the period between injury and admission to hospital is likely to be relatively longer for people living in remoter areas, resulting in more opportunity for pre-hospital death than for people living in less remote zones. When looking at the various head injury combinations, there was generally little difference across remoteness groups when looking at both the predicted and observed measures. Patients who sustained an *Intracranial* injury had a lower chance of survival than patients who did not sustain this type of injury, regardless of the remoteness of their usual residence.

Table 5.14: Mean ICISS and observed survival proportions, various combinations of head injury by remoteness of usual residence for all TBI hospitalisations, Australia 2004–05

	Intracranial TBI		Concussion TBI		Concussion TBI & skull fracture		Skull fracture without TBI		All head injury	
Remoteness area	**Mean ICISS**	**Prop surv[(a)]**	**Mean ICISS**	**Prop surv[(a)]**	**Mean ICISS**	**Prop surv[(a)]**	**Mean ICISS**	**Prop surv[(a)]**	**Mean ICISS**	**Prop surv[(a)]**
Major cities	0.617	*0.874*	0.948	*0.992*	0.870	*0.995*	0.868	*0.988*	0.824	*0.952*
Inner regional	0.618	*0.890*	0.952	*0.991*	0.863	*1.000*	0.858	*0.994*	0.852	*0.965*
Outer regional	0.606	*0.906*	0.963	*0.996*	0.879	*0.987*	0.853	*0.991*	0.883	*0.978*
Remote	0.628	*0.868*	0.954	*0.998*	0.860	*1.000*	0.842	*1.000*	0.898	*0.981*
Very remote	0.603	*0.920*	0.954	*0.997*	0.870	*1.000*	0.867	*1.000*	0.883	*0.985*
Not reported	0.542	*0.873*	0.948	*0.990*	0.879	*1.000*	0.833	*0.932*	0.799	*0.947*
Total	**0.615**	***0.880***	**0.948**	***0.993***	**0.869**	***0.996***	**0.863**	***0.989***	**0.841**	***0.960***

(a) Observed proportion of patients who survived to discharge.

Mode of separation

Table 5.15 shows the percentage of cases for various combinations of head injury by mode of separation for all patients admitted to hospital with a TBI during 2004–05. Patients who *Died* while in hospital had the highest proportion of *Intracranial* injuries (86%), while patients who underwent a *Statistical discharge-type change* (74%), and those transferred to a *Nursing home* (71%) also had a high proportion of *Intracranial* injuries. Patients discharged to their *Usual residence* had the lowest proportion of *Intracranial* injuries (19%), followed by patients who chose to *Discharge own risk* (22%). Nearly 75% of patients who were transferred to their place of *Usual residence* had either a *Concussion* or *Skull fracture* as their only significant head injury, compared to only 14% for those who *Died* in hospital.

Table 5.15: Percentage of cases for various combinations of head injury by mode of separation for all TBI hospitalisations, Australia 2004–05

	Intracranial TBI		Concussion TBI only		Concussion TBI and skull fracture		Skull fracture without TBI		All head injury
Mode of separation	**Count**	**% Total cases[(a)]**	**Count**	**% Total cases[(a)]**	**Count**	**% Total cases[(a)]**	**Count**	**% Total cases[(a)]**	**Total cases**
Transfer—other acute	2,050	*48.9*	1,390	*33.1*	295	*7.0*	459	*10.9*	4,194
Transfer—nursing	234	*70.7*	77	*23.3*	8	*2.4*	12	*3.6*	331
Transfer—psychiatric	10	*40.0*	9	*36.0*	..	..	..	..	25
Transfer—other health	60	*52.6*	31	*27.2*	7	*6.1*	16	*14.0*	114
Statistical discharge—type change	562	*74.2*	144	*19.0*	18	*2.4*	33	*4.4*	757
Discharge own risk	112	*21.7*	342	*66.4*	29	*5.6*	32	*6.2*	515
Statistical discharge leave	12	*66.7*	5	*27.8*	0	*0.0*	..	..	18
Died	706	*85.2*	94	*11.3*	5	*0.6*	24	*2.9*	829
Other—usual residence	3,514	*19.2*	11,885	*64.9*	1093	*6.0*	1810	*9.9*	18,302
Unknown/not supplied	11	*61.1*	6	*33.3*	0	*0.0*	..	..	18
Total	**7,271**	***29.0***	**13,983**	***55.7***	**1,456**	***5.8***	**2,393**	***9.5***	**25,103**

(a) Per cent of total cases are row percentages.
.. Cell counts in tables that are 4 cases or fewer have been suppressed, as have percentages derived from them, to protect confidentiality.

Table 5.16 shows mean ICISS for various combinations of head injury by mode of separation for all TBI hospitalisations during 2004–05. As expected, patients who *Died* in hospital had the lowest predicted chance of survival, while patients discharged to their *Usual residence* had the highest predicted chance of survival. These results were consistent across all types of head injury combinations. Patients who sustained an *Intracranial* injury had a lowest predicted chance of survival than patients who did not sustain this type of injury, regardless of their mode of separation.

Table 5.16: Mean ICISS for various combinations of head injury by mode of separation for all TBI hospitalisations, Australia 2004–05

	Intracranial TBI	Concussion TBI only	Concussion TBI and skull fracture	Skull fracture without TBI	All head injury
Mode of separation	**Mean ICISS**	**Mean ICISS**	**Mean ICISS**	**Mean ICISS**	**Mean ICISS**
Transfer—other acute	0.587	0.906	0.810	0.820	0.734
Transfer—nursing	0.660	0.941	0.862	0.880	0.738
Transfer—psychiatric	0.648	0.910	0.774	0.864	0.791
Transfer—other health	0.608	0.874	0.807	0.790	0.718
Statistical discharge—type change	0.568	0.884	0.788	0.820	0.644
Discharge own risk	0.647	0.959	0.880	0.834	0.879
Statistical discharge—leave	0.588	0.932	**	0.886	0.700
Died	0.475	0.670	0.483	0.707	0.504
Other—usual residence	0.664	0.960	0.888	0.877	0.891
Total	**0.615**	**0.952**	**0.869**	**0.863**	**0.841**

** No cases were recorded for this combination of mode of separation and head injury combination.

Length of stay

Table 5.17 shows the percentage of cases for various combinations of head injury by length of stay for all patients admitted to hospital with a TBI during 2004–05. The presence of *Intracranial* injury tended to be associated with longer stays in hospital than other head injury cases. Close to 77% of patients who spent one day in hospital or were discharged on the same day as they were admitted had either a *Concussion* or *Skull fracture* as their only significant head injury, compared to 24% for those who spent 13 or more days in hospital.

Table 5.17: Proportion of cases for various combinations of head injury by length of stay for all TBI hospitalisations, Australia 2004–05

	Intracranial TBI		Concussion TBI only		Concussion TBI and skull fracture		Skull fracture without TBI		All head injury
Length of stay	**Count**	**% Total cases[(a)]**	**Count**	**% Total cases[(a)]**	**Count**	**% Total cases[(a)]**	**Count**	**% Total cases[(a)]**	**Total**
Sameday	1,394	*16.8*	5,791	*69.7*	484	*5.8*	639	*7.7*	8,308
1 day	807	*11.8*	5,077	*74.1*	346	*5.0*	625	*9.1*	6,855
2–5 days	1,571	*34.0*	1,963	*42.5*	392	*8.5*	692	*15.0*	4,618
6–12 days	1,459	*57.9*	681	*27.0*	141	*5.6*	238	*9.4*	2,519
13 or more days	2,040	*72.8*	471	*16.8*	93	*3.3*	199	*7.1*	2,803
Total	**7,271**	***29.0***	**13,983**	***55.7***	**1,456**	***5.8***	**2,393**	***9.5***	**25,103**

(a) Per cent of total cases are row percentages.

Table 5.18 shows mean ICISS and observed proportions of patients who survived to discharge for various combinations of head injury by length of stay for all TBI hospitalisations during 2004–05. Overall, both predicted and observed chances of survival tended to decrease as length of stay increased. This pattern was also observed within the various head injury combination groups, with the exception of the group in which patients sustained an *Intracranial* injury. For this group, the predicted chances of survival tended to decrease with length of stay in contrast to the observed chances of survival which tended to increase with length of stay. This apparent anomaly might partially be explained by an interaction effect between the length of stay and the proportion of patients who *Died* in hospital. This effect, created by the fact that more seriously injured patients are more likely to die within a few days of being admitted to hospital, is more likely to be prominent in this group due to the generally more serious consequences of *Intracranial* injuries in comparison to other types of head injury.

Table 5.18: Mean ICISS and observed survival proportions, various combinations of head injury by length of stay for all TBI hospitalisations, Australia 2004–05

	Intracranial TBI		Concussion TBI only		Concussion TBI & skull fracture		Skull fracture without TBI		All head injury	
Length of stay	**Mean ICISS**	**Prop surv[(a)]**	**Mean ICISS**	**Prop surv[(a)]**	**Mean ICISS**	**Prop surv[(a)]**	**Mean ICISS**	**Prop surv[(a)]**	**Mean ICISS**	**Prop surv[(a)]**
Sameday	0.650	*0.899*	0.962	*0.995*	0.890	*0.994*	0.873	*0.980*	0.899	*0.978*
1 day	0.653	*0.829*	0.966	*0.998*	0.898	*1.000*	0.892	*0.998*	0.919	*0.978*
2–5 days	0.653	*0.851*	0.935	*0.989*	0.874	*0.995*	0.875	*0.996*	0.825	*0.944*
6–12 days	0.635	*0.890*	0.890	*0.974*	0.822	*1.000*	0.805	*0.992*	0.731	*0.928*
13 days and over	0.533	*0.925*	0.839	*0.960*	0.707	*0.989*	0.766	*0.965*	0.607	*0.936*
Total	**0.615**	***0.880***	**0.952**	***0.993***	**0.869**	***0.996***	**0.863**	***0.989***	**0.841**	***0.960***

(a) Observed proportion of patients who survived to discharge.

Place of occurrence

Table 5.19 shows the percentage of cases for various combinations of head injury by place of occurrence for all patients admitted to hospital with a TBI during 2004–05. Patients whose head injury occurred inside a *Residential institution* (predominantly aged-care facilities) had the highest proportion of *Intracranial* injuries (58%), while only 10% of patients whose injury occurred at a *Sports and athletics area* had an *Intracranial* injury. Nearly 83% of patients whose injury occurred at a *Sports and athletics area* had either a *Concussion* or *Skull fracture* as their only significant head injury, compared to 40% for those whose injury occurred inside a *Residential institution*.

Table 5.19: Percentage of cases for various combinations of head injury by place of occurrence for all TBI hospitalisations, Australia 2004–05

	Intracranial TBI		Concussion TBI only		Concussion TBI & skull fracture		Skull fracture without TBI		All head injury
Place of occurrence	**Count**	**%Total cases[(a)]**	**Count**	**%Total cases[(a)]**	**Count**	**%Total cases[(a)]**	**Count**	**%Total cases[(a)]**	**Total**
Home	1,764	*33.7*	2,862	*54.6*	183	*3.5*	429	*8.2*	5,238
Residential institution	459	*57.5*	259	*32.5*	17	*2.1*	63	*7.9*	798
School, other institution & public administration area	314	*29.1*	662	*61.3*	44	*4.1*	60	*5.6*	1,080
Sports and athletics area	177	*9.7*	1,375	*75.7*	126	*6.9*	139	*7.6*	1,817
Street and highway	2,031	*33.0*	3,142	*51.1*	420	*6.8*	561	*9.1*	6,154
Trade and service area	364	*24.0*	873	*57.6*	145	*9.6*	133	*8.8*	1,515
Industrial and construction area	81	*26.1*	166	*53.5*	30	*9.7*	33	*10.6*	310
Farm	64	*15.8*	297	*73.2*	26	*6.4*	19	*4.7*	406
Other specified place of occurrence	273	*21.0*	824	*63.3*	109	*8.4*	95	*7.3*	1,301
Unspecified place of occurrence	1,735	*26.9*	3,507	*54.3*	355	*5.5*	857	*13.3*	6,454
Place not reported/ not applicable	9	*30.0*	16	*53.3*	..	..	..	..	30
Total	**7,271**	***29.0***	**13,983**	***55.7***	**1,456**	***5.8***	**2,393**	***9.5***	**25,103**

(a) Per cent of total cases are row percentages.
.. Cell counts in tables that are 4 cases or fewer have been suppressed, as have percentages derived from them, to protect confidentiality.

Table 5.20 shows mean ICISS and observed proportions of patients who survived to discharge for various combinations of head injury by place of occurrence for all TBI hospitalisations during 2004–05. In general, there was relatively poor correlation between the observed proportion and the predicted proportion of patients surviving to discharge. Overall, predicted chances of survival was lowest for patients whose injuries were sustained on a *Street and Highway*, while observed chances of survival was lowest for patients whose injuries were sustained in a *Residential institution*. For both measures, patients who sustained injuries on a *Sports or athletics area* had the highest chance of survival. When looking at the various head injury combinations, predicted chances of survival was generally lowest for patients who sustained injuries while on a *Street or highway*, while observed chances of survival was generally lowest for patients whose injuries were sustained in a *School, other institution and public administration area*. Patients who sustained an *Intracranial* injury had a lower chance of survival than patients who did not sustain this type of injury, regardless of the place of occurrence.

Table 5.20: Mean ICISS and observed proportions who survived for combinations of head injury by place of occurrence for all TBI hospitalisations, Australia 2004–05

	Intracranial TBI		Concussion TBI only		Concussion TBI & skull fracture		Skull fracture without TBI		All head injury	
Place	**Mean ICISS**	**Prop surv[(a)]**	**Mean ICISS**	**Prop surv[(a)]**	**Mean ICISS**	**Prop surv[(a)]**	**Mean ICISS**	**Prop surv[(a)]**	**Mean ICISS**	**Prop surv[(a)]**
Home	0.648	*0.850*	0.955	*0.988*	0.867	*0.995*	0.877	*0.998*	0.842	*0.943*
Residential institution	0.675	*0.782*	0.951	*0.961*	0.843	*1.000*	0.880	*0.921*	0.784	*0.856*
School, other institution & public administration area	0.651	*0.717*	0.972	*0.983*	0.896	*0.977*	0.880	*0.933*	0.870	*0.903*
Sports and athletics area	0.673	*0.960*	0.974	*0.996*	0.910	*1.000*	0.896	*1.000*	0.934	*0.993*
Street and highway	0.525	*0.888*	0.923	*0.991*	0.833	*0.990*	0.808	*0.986*	0.775	*0.956*
Trade and service area	0.608	*0.915*	0.961	*0.998*	0.897	*1.000*	0.884	*0.985*	0.863	*0.977*
Industrial and construction area	0.508	*0.914*	0.943	*1.000*	0.840	*1.000*	0.848	*1.000*	0.809	*0.978*
Farm	0.580	*0.938*	0.944	*0.990*	0.838	*1.000*	0.857	*1.000*	0.876	*0.983*
Other specified place of occurrence	0.558	*0.919*	0.951	*0.998*	0.868	*1.000*	0.859	*0.989*	0.855	*0.981*
Unspecified place of occurrence	0.675	*0.932*	0.962	*0.998*	0.890	*1.000*	0.882	*0.994*	0.870	*0.980*
Place not reported/not applicable	0.758	*1.000*	0.957	*1.000*	0.622	*1.000*	0.834	*1.000*	0.870	*1.000*
Total	**0.615**	***0.880***	**0.952**	***0.993***	**0.869**	***0.996***	**0.863**	***0.989***	**0.841**	***0.960***

(a) Observed proportion of patients who survived to discharge.

6 Burden of TBI on care in hospitals

This chapter looks at the burden of TBI on hospital care in terms of the number of bed days utilised and the associated costs of inpatient treatment. It includes all hospital separations where the hospital record contains either a TBI code (S06) or a code for sequelae of intracranial injury (T90.5) in any diagnosis field. It should be noted that separations for the latter of these two groups are not included in any of the other chapters in this report unless they also include an S06 code.

Separations with TBI code (S06) in any diagnosis field

Overview

Almost 92% (n=23,917) of TBI separations (i.e. S06 any diagnosis field) were acute episodes of care with a further 7% (n=1,887) being rehabilitation episodes of care (Table 6.1). The proportions of separations for each type of episode of care were almost identical for both males and females.

Table 6.1: TBI separations by type of episode of care, by sex, Australia 2004–05

	Males		Females		Persons	
Type of episode of care	**Count**	**Per cent**	**Count**	**Per cent**	**Count**	**Per cent**
Acute care	16,451	*91.9*	7,466	*91.2*	23,917	*91.7*
Rehabilitation care	1,314	*7.3*	573	*7.0*	1,887	*7.2*
Other care	136	*0.8*	145	*1.8*	281	*1.1*
Total	**17,901**	***100***	**8,184**	***100***	**26,085**	***100***

Includes separations with a sequelae of intracranial injury code (T90.5) in any diagnosis field (n=42).

Length of stay

TBI separations resulted in over 206,000 hospital bed days in 2004–05 (Table 6.2). Despite accounting for almost 92% of all separations, acute episodes of care only accounted for about 64% of all bed days, while rehabilitation episodes of care, which only accounted for 7% of all separations, accounted for almost 29% of all bed days. This is reflected in markedly different average lengths of stay (ALOS) of 6.1 days for acute episodes and 64.2 days for rehabilitation episodes. Almost 59% of separations involving acute care had a length of stay of one day or were same-day separations compared to only 17% for separations involving rehabilitation care.

Table 6.2: Length of hospital stay for TBI cases by type of episode of care, by sex, Australia 2004–05

Type of episode of care		Males	Females	Persons
Acute care	Cases	14,863	6,741	21,604
	Bed days	89,172	42,389	131,561
	ALOS	6.0	6.3	6.1
Rehabilitation care	Cases	654	261	915
	Bed days	41,310	17,452	58,762
	ALOS	63.2	66.9	64.2
Other care	Cases	94	97	191
	Bed days	3,904	12,151[(a)]	16,055
	ALOS	41.5	125.3	84.1
All types of care	Cases	15,611	7,099	22,710
	Bed days	134,386	71,992	206,378
	ALOS	8.6	10.1	9.1

Includes separations with a sequelae of intracranial injury code (T90.5) in any diagnosis field (n=42).
(a) Includes 2 separations for females whose length of stay exceeded 1,000 days.

Costs

The Australian Refined Diagnosis Related Groups (AR-DRGs) classification system categorises admitted patient episodes of care into groups with similar conditions and similar expected usage of hospital resources. This categorisation is based on information contained in the separation record such as the diagnoses, procedures and demographic characteristics of the patient (AIHW 2006). Expenditure can than be estimated by applying cost weights to the AR-DRGs. Cost weights are defined by the Department of Health and Ageing as 'a measure of the relative cost of a DRG. Usually the average cost across all DRGs is chosen as the reference value, and given a weight of one' (DoHA 2006).

Only acute episodes of care have been included in the analyses presented in this section. AR-DRG cost weights are only appropriate for acute episodes of care as they are based in part on length of stay data, and it is recognised that other types of episodes, rehabilitation for example, often require much longer hospital stays. As such, separations that were not coded as acute episodes of care have been excluded from the analysis. Additionally, separate cost weights are usually published for acute episodes of care in public and private institutions, allowing expenditure to be more accurately estimated. However, in 2004–05 (Round 9), private sector costs were not published. In this chapter, cost weights for acute care in public hospitals have been applied to acute care separations from other types of institutions to give an approximation of the total burden of hospitalised acute fall-related injuries.

Table 6.3 shows estimated direct costs (i.e. costs incurred directly as a result of hospital treatment and excludes costs related to rehabilitation care, palliative care and other non-acute care) for TBI-related separations during 2004–05. These estimates were calculated using the diagnosis related group (DRG) assigned to each hospitalisation. The total direct cost of hospital inpatient treatment of TBI in 2004–05 was estimated to be more than $184 million with *Transport*-related TBI injury accounting for 46% ($85.6 million) and *Fall*-related TBI injury accounting for 34% ($62.7 million) of these costs.

Table 6.3: Estimated cost of treatment for all TBI-related hospital admissions, Australia 2004–05

Major Groups	Males	Females	Persons	Per cent
Transportation (V01–V99)	$62,428,542	$23,231,898	$85,660,440	*46.4*
Falls (W00–W19)	$41,229,320	$21,452,576	$62,681,896	*34.0*
Intentional, inflicted by another (X85–Y09, Y35–Y36, Y87.1, Y89.0, Y89.1)	$13,371,442	$2,306,624	$15,678,066	*8.5*
Other unintentional (W20–W64, W75–W99, X20–X39, X50–X59, Y85–Y86, Y89.9)	$9,513,080	$2,989,351	$12,502,431	*6.8*
Medical misadventure, complications, etc. (Y40–Y34, Y87.2)	$2,382,958	$1,219,810	$3,602,768	*2.0*
Intentional, self inflicted (X60–X84, Y87.2)	$2,222,952	$737,249	$2,960,201	*1.6*
Drowning (W65–W74)	$307,401	$85,822	$393,223	*0.2*
Undetermined intent (Y10–Y34, Y87.2)	$254,065	$54,071	$308,136	*0.2*
Poisoning, pharmaceuticals (40–X44)	$65,593	$38,494	$104,087	*0.1*
Fires/burns/scalds (Y00–Y19)	$71,891	$22,702	$94,593	*0.1*
Poisoning, other substances (X45–X49	$20,930	$6,621	$27,551	*0.0*
No External Cause present	$242,326	$324,974	$567,300	*0.3*
Total	**$132,110,500**	**$52,470,192**	**$184,580,692**	***100***

Includes separations with a sequelae of intracranial injury code (T90.5) in any diagnosis field (n=42).
Excludes costs related to rehabilitation care, palliative care and other non-acute care.

Separations with sequelae of intracranial injury code (T90.5) in any diagnosis field

Overview

Almost 78% (n=1,437) of sequelae separations (i.e. T90.5 any diagnosis field) were acute episodes of care with a further 18% (n=1,324) being rehabilitation episodes of care (Table 6.4). The proportions of separations for each type of episode of care were similar for both males and females. This group comprises 46% of all separations with a sequelae of head injury code (T90) in any diagnosis field.

Table 6.4: Sequelae of intracranial injury separations by type of episode of care, by sex, Australia 2004–05

	Males		Females		Persons	
Type of episode of care	Count	Per cent	Count	Per cent	Count	Per cent
Acute care	1,085	*78.9*	352	*75.4*	1,437	*78.0*
Rehabilitation care	228	*16.6*	96	*20.6*	324	*17.6*
Other care	63	*4.6*	19	*4.1*	82	*4.4*
Total	**1,376**	***100***	**467**	***100***	**1,843**	***100***

Excludes separations with TBI code (S06) in any diagnosis field (n=42).

Length of stay

Sequelae of intracranial injury separations resulted in over 32,000 hospital bed days in 2004–05 (Table 6.5). Despite accounting for almost 78% of all separations, acute episodes of care only accounted for about 39% of all bed days, while rehabilitation episodes of care, which only accounted for 18% of all separations and other episodes of care, which only accounted for 4% of all separations, accounted for 29% and 32% of all bed days respectively. This is reflected in markedly different average lengths of stay (ALOS) of 9.7 days for acute episodes, 50.6 days for rehabilitation episodes, and 172.7 days for other episodes. It should be noted that this last group includes four separations where the length of stay exceeded 1,000 days. Almost 47% of separations involving acute care had a length of stay of 2 days or less compared to only 19% for separations involving rehabilitation care, and 6% for separations involving other types of care.

Table 6.5: Length of hospital stay for sequelae of intracranial injury cases by type of episode of care, by sex, Australia 2004–05

Type of episode of care		Males	Females	Persons
Acute care	Cases	986	318	1,304
	Bed days	10,305[(a)]	2,313	12,618
	ALOS	10.5	7.3	9.7
Rehabilitation care	Cases	120	64	184
	Bed days	7,564	1,753	9,317
	ALOS	63.0	27.4	50.6
Other care	Cases	43	16	59
	Bed days	9,761[(b)]	427	10,188
	ALOS	227.0	26.7	172.7
All types of care	Cases	1,149	398	1,547
	Bed days	27,630	4,493	32,123
	ALOS	24.0	11.3	20.8

Excludes separations with TBI code (S06) in any diagnosis field (n=42).

(a) Includes 1 separation for a male whose length of stay exceeded 1,000 days.

(b) Includes 4 separations for males whose lengths of stay exceeded 1,000 days.

Costs

Table 6.6 shows estimated direct costs (i.e. costs incurred directly as a result of hospital treatment and excludes costs related to rehabilitation care, palliative care and other non-acute care) for sequelae of intracranial injury separations during 2004–05. These estimates were calculated using the diagnosis related group (DRG) assigned to each hospitalisation. The total direct cost of hospital inpatient treatment of late effects of TBI in 2004–05 was estimated to be almost $8.5 million with *Transport*-related injury accounting for 43% ($3.6 million) and *Other unintentional* injury accounting for 26% ($2.2 million) of these costs.

Table 6.6: Estimated cost of treatment for all sequelae of intracranial injury hospital admissions, Australia 2004–05

Major Groups	Males	Females	Persons	Per cent
Transportation (V01–V99)	$2,737,587	$889,784	$3,627,371	*42.7*
Other unintentional (W20–W64, W75–W99, X20–X39, X50–X59, Y85–Y86, Y89.9)	$1,774,959	$434,543	$2,209,502	*26.0*
Medical misadventure, complications, etc. (Y40–Y34, Y87.2)	$725,893	$230,647	$956,540	*11.3*
Intentional, inflicted by another (X85–Y09, Y35–Y36, Y87.1, Y89.0, Y89.1)	$644,574	$124,856	$769,430	*9.1*
Falls (W00–W19)	$283,521	$118,614	$402,135	*4.7*
Undetermined intent (Y10–Y34, Y87.2)	$185,368	$39,156	$224,524	*2.6*
Intentional, self inflicted (X60–X84, Y87.2)	$141,375	$11,736	$153,111	*1.8*
Fires/burns/scalds (Y00–Y19)	$16,383	$14,968	$31,351	*0.4*
Poisoning, pharmaceuticals (40–X44)	$10,421	$3,058	$13,479	*0.2*
Drowning (W65–W74)	$2,001	$0	$2,001	*0.0*
No External Cause present	$64,774	$41,657	$106,431	*1.3*
Total	**$6,586,856**	**$1,909,019**	**$8,495,875**	***100***

Excludes separations with TBI code (S06) in any diagnosis field (n=42).

Separations involving follow-up care

Overview

Within the subset of separations that reported a Principal Diagnosis other than a code in the ICD-10-AM community injury range (S00–T75, T79), but did report a S06 code in an additional diagnosis field, a total of 2,091 separations were for follow-up care codes in the range Z47, Z48, Z50 and Z75 (Table 6.7).

When broken down into specified categories, 91% (n=1,904) of these separations had a Principal Diagnosis relating to *Care involving use of rehabilitation procedures*, with 70% of those cases being males. Almost 5.5% of separations in this group were for *Problems related to medical facilities and other health care*, and 3.5% of separations were for *Other orthopaedic follow-up care* and *Other surgical follow-up care*.

Table 6.7: Burden of injury for follow-up care separations by sex, Australia 2004–05

	Males		Females		Persons	
Principal Diagnosis	**Count**	**Per cent**	**Count**	**Per cent**	**Count**	**Per cent**
Other and unspecified orthopaedic follow-up care (Z47.8, Z47.9)	..	..	..	..	7	*0.3*
Other and unspecified surgical follow-up care (Z48.8, Z48.9)	45	*3.1*	21	*3.2*	66	*3.2*
Care involving use of rehabilitation procedures (Z50)	1,329	92.6	575	87.8	1,904	91.1
Cardiac rehabilitation (Z50.1)	*65*	*4.9*	*8*	*1.4*	*73*	*1.0*
Speech therapy (Z50.5)	*19*	*1.4*	..	..	..	..
Occupational therapy and vocational rehabilitation, nec (Z50.7)	*6*	*0.5*	*0*	*0.0*	*6*	*0.3*
Care involving use of other rehabilitation procedures (Z50.8)	*29*	*2.2*	*23*	*4.0*	*52*	*2.7*
Care involving use of rehabilitation procedures, unspecified (Z50.9)	*1,210*	*91.1*	*543*	*94.4*	*1,753*	*92.1*
Person awaiting admission to adequate facility elsewhere (Z75.1)	50	*3.5*	53	*8.1*	103	*4.9*
Other problems related to medical facilities and other health care (Z75.0, Z75.2–Z75.9)	..	..	..	..	11	*0.5*
Total	**1,436**	***100***	**655**	***100***	**2,091**	***100***

Excludes cases where External Cause code was a complication of surgical or medical care (n=33) or where no External Cause code was assigned (n=9).
.. Cell counts in tables that are 4 cases or fewer have been suppressed, as have percentages derived from them, to protect confidentiality.

Age and sex distribution

Figure 6.1 shows age–specific hospitalisation rates for TBI separations requiring follow-up care for 2004–05. Rates for both males and females were relatively steady from the mid–teens through to the early seventies, before rising markedly from the mid–seventies onwards. For both genders, those aged 85 years and over years experienced the highest rate of hospitalisations with rates of 85.2 and 68.6 hospitalisations per 100,000 population respectively. Except for children aged 0–4, rates for males were higher than for females across all age groups, although not always significantly so.

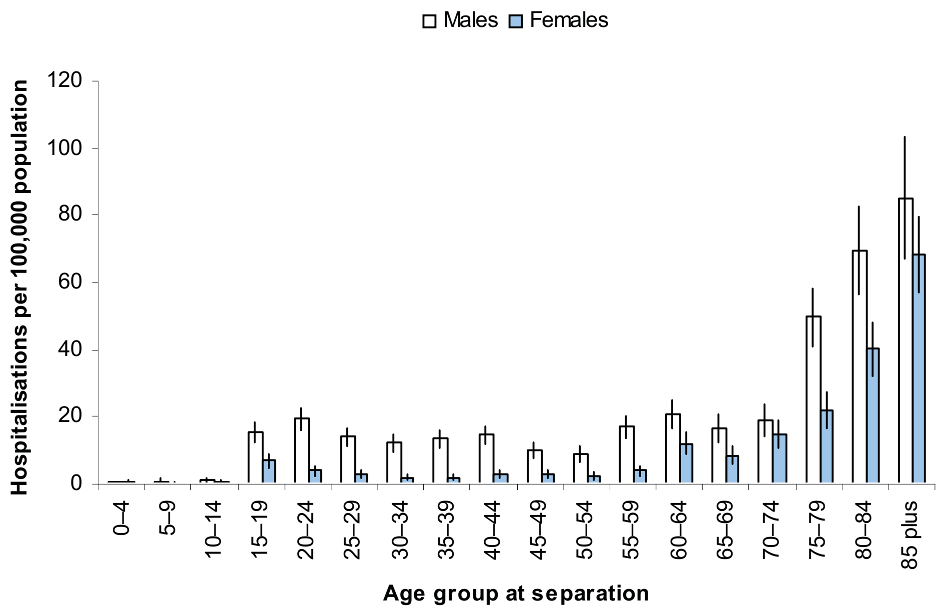


Figure 6.1: TBI separations requiring follow-up care by sex and age group, Australia 2004–05

Length of hospital stay

Separations which involved either orthopaedic or surgical follow-up care had by far the shortest average length of stay (ALOS) of 12.0 days (Table 6.8). Lengths of stay for this group ranged from same-day separations up to 49 days. Separations involving the use of rehabilitation procedures and separations involving problems related to medical facilities and other health care had similar ALOS of 30.7 days and 29.9 days respectively. Lengths of stay for these two groups ranged from same-day separations up to 830 days for separations requiring rehabilitation procedures and up to 163 days for separations involving problems related to medical facilities and other health care. The mean ICISS was similar for all three groups ranging from 0.618 for the group of separations involving rehabilitation procedures to 0.683 for the group involving orthopaedic or follow-up care.

Table 6.8: Length of hospital stay and mean ICISS due to the most common factors influencing health status and contact with health services for TBI cases requiring follow-up care, by sex, Australia 2004–05

Factor		Males	Females	Persons
Other orthopaedic follow-up care Z47/Other surgical follow-up care (Z48)	Cases	49	24	73
	Bed days	569	305	874
	ALOS	11.6	12.7	12.0
	Mean ICISS	0.660	0.729	0.683
Care involving use of rehabilitation procedures (Z50)	Cases	1,329	575	1,904
	Bed days	41,039	17,506	58,545
	ALOS	30.9	30.4	30.7
	Mean ICISS	0.599	0.661	0.618
Problems related to medical facilities and other health care (Z75)	Cases	58	56	114
	Bed days	2,025	1,385	3,410
	ALOS	34.9	24.7	29.9
	Mean ICISS	0.669	0.688	0.678

External Causes

Table 6.9 shows External Causes for TBI-related follow-up care separations for 2004–05. *Fall*-related injuries accounted for 46% (n=957) of all hospitalisations, with *Transport*-related injuries accounting for a further 42% (n=866). Falls from or on steps was the most common specified External Cause among *fall*-related follow-up care separations for both males (15%) and females (22%), while for *transport-related* separations, occupants of cars were more likely than any other road user type to receive follow-up care for both males (41%) and females (64%). For *assault*-related separations, males (8%) were far more likely than females (2%) to receive follow-up care.

Table 6.9: External Causes of TBI-related follow-up care separations by sex, Australia 2004–05

	Males		Females		Persons	
External Cause	**Count**	**Per cent**	**Count**	**Per cent**	**Count**	**Per cent**
Transportation (V01–V99)	642	*44.7*	224	*34.2*	866	*41.5*
Pedestrian (V01–V09)	*163*	*25.4*	*51*	*22.8*	*214*	*24.7*
Motorcyclist (V20–V29)	*111*	*17.3*	*8*	*3.6*	*119*	*13.7*
Car occupant (V40–V49)	*265*	*41.3*	*143*	*63.8*	*408*	*47.1*
Other and unspecified (V11–V19, V50–V99)	*103*	*16.0*	*22*	*9.8*	*125*	*14.4*
Falls (W00–W19)	580	*40.4*	377	*57.6*	957	*45.7*
Fall on same level from slipping, tripping and stumbling (W01)	*29*	*5.0*	*40*	*10.6*	*69*	*7.2*
Fall from chair (W07)	*32*	*5.5*	*7*	*1.9*	*39*	*4.1*
Fall on and from steps (W10)	*88*	*15.2*	*82*	*21.8*	*170*	*17.8*
Fall on and from ladder (W11)	*42*	*7.2*	..	..	..	..
Fall from, out of or through building or structure (W13)	*46*	*7.9*	*16*	*4.2*	*62*	*6.5*
Other specified fall (W02–W06, W08, W09, W12, W14–W18)	*163*	*28.1*	*89*	*23.6*	*252*	*26.4*
Unspecified fall (W19)	*180*	*31.0*	*140*	*37.1*	*320*	*33.5*
Assault (X85–Y09)	114	*7.9*	15	*2.3*	129	*6.2*
Other and unspecified (W20–X84, Y10–Y36,Y85–Y87, Y89)	100	*7.0*	39	*6.0*	139	*6.7*
Total	**1,436**	***100***	**655**	***100***	**2,091**	***100***

Subgroup proportions are percentages relating to that diagnosis group.
.. Cell counts in tables that are 4 cases or fewer have been suppressed, as have percentages derived from them, to protect confidentiality.

Procedures

The number of procedures listed in TBI-related follow-up care separations ranged from 0 (4.7%, n=99) to 23 (n=1) procedures per record (Table 6.10). The total number of procedures was 8,193 resulting in an average of almost four procedures for each separation. Table 6.4 shows the ten most common procedures performed on TBI follow-up care patients during 2004–05. *Physiotherapy* was the most common procedure for both sexes accounting for 22% (n=1,230) of males and 23% (n=579) of females. Other prominent procedures included *Occupational therapy* (20%), *social work* (14%) and *speech pathology* (13%). Overall, *Allied health interventions* accounted for 86% of all procedures for males, and 87% of all procedures for females.

Table 6.10: Ten most common procedures for TBI-related follow-up care separations by sex, Australia 2004–05

	Males		Females		Persons	
Procedure	**Count**	**Per cent**	**Count**	**Per cent**	**Count**	**Per cent**
Allied health intervention, physiotherapy	1,230	*21.9*	579	*22.5*	1,809	*22.1*
Allied health intervention, occupational therapy	1,067	*19.0*	532	*20.6*	1,599	*19.5*
Allied health intervention, social work	813	*14.5*	365	*14.2*	1,178	*14.4*
Allied health intervention, speech pathology	774	*13.8*	309	*12.0*	1,083	*13.2*
Allied health intervention, dietetics	427	*7.6*	212	*8.2*	639	*7.8*
Allied health intervention, psychology	333	*5.9*	127	*4.9*	460	*5.6*
Computerised tomography of brain	159	*2.8*	79	*3.1*	238	*2.9*
Allied health intervention, podiatry	35	*0.6*	30	*1.2*	65	*0.8*
Allied health intervention, audiology	50	*0.9*	11	*0.4*	61	*0.7*
Hydrotherapy	49	*0.9*	11	*0.4*	60	*0.7*
Subtotal	*4,937*	*87.9*	*2,255*	*87.4*	*7,192*	*87.8*
Total procedures	**5,614**		**2,579**		**8,193**	

7 Discussion

An estimated 22,710 cases of traumatic brain injury (TBI) were hospitalised in Australia in 2004–05. These cases resulted in 26,085 episodes and 206,738 days of inpatient care. In this report, TBI injury has been investigated in terms of several different ways in which the ICD-10-AM code most likely to be indicative of TBI (S06, *Intracranial injury*) may appear in the diagnosis fields of a record. In many reports, the Principal Diagnosis is the main selection criterion, whereas in this report consideration is also given to the occurrence of S06 codes in the Additional Diagnosis fields. We have also considered cases with the code T90.5 *Sequelae of intracranial injury*.

Cases having a Principal Diagnosis code of S06 were the most clear cut examples of TBI. Just over 14,000 cases of this type occurred in the year studied. However, it was apparent that selection of cases based only on the Principal Diagnosis falling within that code range had the potential to exclude many cases that did include TBI, but were not coded as being the Principal basis for hospital admission. To more fully capture these cases, and better describe patterns of injury, two other mutually exclusive selection criteria were applied.

The first of these criteria included cases where an injury code (ICD-10-AM range S00–T75 and T79) other than an *intracranial injury* was the Principal Diagnosis, and where an *intracranial injury* code occurred in an Additional Diagnosis field. This selection captured nearly 6,000 cases that were not in the Principal Diagnosis selection, and comprised 26% of all identified TBI episodes of inpatient care. More than half of this group had a head injury as the Principal Daignosis.

The second of these criteria gave consideration to the occurrence of an S06 *intracranial injury* code in any diagnosis field, but where the Principal Diagnosis did not fall within the ICD-10-AM injury range S00–T75 and T79. Over 2,500 further cases were identified in this category, comprising 11% of all identified TBI in the reporting period.

Cases where an *intracranial injury* was coded as the Principal Diagnosis accounted for 63% of all cases identified as involving TBI. The rate of TBI injury for males was 2.4 times higher than the rate for females. The age-specific incidence rates were highest for those aged 15–24 years, especially for males, and those aged 70 years and over. The higher rate for the younger of these two age groups can largely be attributed to high rates of hospitalisation for transport-related accidents among mid-teens and young adults, together with high rates of hospitalisation due to assault among youth and young adults, especially for young males. Not surprisingly, occupants of cars and motorcyclists were the most common type of road user to be hospitalised. Motorcycle accidents predominantly involved males (90%), while over one-fifth involved children aged 0–14 years. Of accidents involving children, more than half were non-traffic and over 40% involved some form of motorcycle racing. Falls from horses, especially among female riders, were also a significant source of hospitalisation. As expected, assaults predominantly involved males and were most commonly due to some form of bodily force. Rates for those aged 70 years and over were elevated due to the high rate of involvement in *Falls* for this age group. Rates for males were significantly higher than rates for females in all age groups. Those hospitalised as a result of a transport accidents had, on average, a longer length of stay in hospital than Fall-related or Assault-related hospitalisations, most likely due to the higher probability of sustaining high impact injuries.

Just over 82% of cases in this group sustained some form of *Concussive injury,* with more than half of these being a concussion or a loss of consciousness of less than 30 minutes. Just over 1% of cases had loss of consciousness of more than 24 hours, but survival to discharge was poor for these cases, particularly for cases without return to pre-existing conscious level, where 65% died while in hospital.

For cases with TBI as an Additional Diagnosis, the male to female rate ratio was slightly higher than that for Principal Diagnosis cases, and the age standardised rate for males and females was less than half the rates for male and female Principal Diagnosis cases. Rates for males were higher than rates for females in all age groups, significantly so in most age groups, other than in the elderly and young children. More than half (57%) of cases in this group had a Principal Diagnosis involving a head injury, with just over half of these cases having a Principal Diagnosis involving fractures of the skull and facial bones. The age and sex distribution in this group was similar to that of the Principal Diagnosis cases with the age-specific incident rates being highest for those aged 15–24 years, especially for males, and those aged 80 years and over. While individual External Causes were not analysed for these cases, the reasons for peaks in rates for these age groups are likely to be similar to those indicated above for the Principal Diagnosis cases.

While the proportions were similar to the Principal Diagnosis cases, the first and second most frequently reported External Causes of injury (i.e. *Falls* and *Transportation*) appeared in reverse order in the Additional Diagnosis selection. The reasons for this are not immediately clear, considering that the age distribution for both groups are similar. The higher proportion of Transport-related cases in this group may partially account for the moderately higher average length of stay in this group when compared to the Principal Diagnosis group.

A slightly higher proportion (88%) of cases in this group, when compared to the Principal Diagnosis group, sustained some form of *Concussive injury,* with more than half of these being a concussion or a loss of consciousness of less than 30 minutes. As with the Principal Diagnosis group, close to 1% of cases had loss of consciousness of more than 24 hours, and these cases had low survival to death, particularly for cases without return to pre-existing conscious level, where 72% died while in hospital.

The male to female rate ratio in the 'Other TBI' cases selection was moderately lower than either the Principal Diagnosis or the S06 Additional Diagnosis selections. The age standardised rate for males was about six times lower, and for females five times lower, than rates reported in the Principal Diagnosis selection. In common with the previous two groups, rates for males tended to be significantly higher for males than for females, with the exception of the 0–14 age bracket, where rates were similar.

Principal Diagnosis codes occurring most frequently in the 'Other TBI' group were Z50 *Care involving use of rehabilitation procedures* (36% of cases), R55 *Syncope (fainting) and collapse* (13% of cases), and I00–I49 *Diseases of the circulatory system* (12% of cases). Cases in this group were much less likely to have sustained a concussion than cases in the Principal Diagnosis and Additional Diagnosis groups. Conversely, they were much more likely to have sustained more serious intracranial injuries such as haematomas, haemorrhages and contusions. The seriousness of these cases is reflected in the high proportion of cases in this group which underwent some form of rehabilitation, along with their long average length of stay in hospital when compared to the Principal and Additional diagnosis groups.

When the age and sex distribution of cases in this group is examined, it is apparent that cases for those aged 65 years and older dominate this selection, accounting for 49% of 'Other TBI' cases. The likelihood of older people having a range of co-morbidities that may be more debilitating due to their age and relative health may partially account for TBI occurring in conjunction with, yet subsequent to, Principal Diagnoses such as *Diseases of the circulatory system,* and *Syncope (fainting) and collapse*. In accordance with a higher proportion of older-aged cases in this group, over half were *Fall*-related and less than 5% were *Assault*-related.

Overall, comparison of the outcomes of this study with previous research was made difficult, not only by the variations in ICD ranges used in selection of TBI cases, but also by variations in the target populations to be included and types of outcomes. Whereas this report employed broad selection criteria in terms of the target population, as well as a wide range of outcome analyses, many previous reports had much narrower selection criteria such as including only children or the elderly or a narrow range of outcomes such as reporting only on cognitive and behavioural outcomes. The exclusion of cases which sustained a skull fracture, without any reported presence of an intracranial injury (as included in many previous reports) is unlikely to have made any significant difference to severity outcome measures, since these cases had a high probability of survival (99%), although predicted survival was only about 86%.

The analysis of multiple head injury codes chapter affords a further insight into the severity of types of head injury associated with TBI. Predicted probability of survival (as measured by mean ICISS) and the observed proportions of patients who survived to discharge were compared, as well as distribution of cases across four head injury types; *Intracranial injury* only, *Concussive injury* only, *Concussive injury* in combination with a *Skull fracture* and *Skull fracture* injury only. The *Skull fracture* injury only group was not included in other parts of the report. Cases of this type have the potential to be severe, although no *Intracranial injury* was reported at the time. The *Skull fracture* injury only group contributed a further 2,393 cases. Not surprisingly, patients who sustained an intracranial injury had the lowest predicted probability of survival and lowest observed proportion of patients surviving to discharge when compared to patients who sustained other injury types. This is to be expected since intracranial injuries such as haematomas and haemorrhages are more likely to have fatal consequences than concussions and skull fractures.

The correlation between the mean ICISS and the observed proportion of cases who survived to discharge was relatively poor, particularly for *Fall*-related cases. This poor correlation may, in part, be due to the narrow criteria (i.e any diagnosis of S06) used to select cases for this report, given that ICISS is normally calculated using all injury and poisoning codes. It should also be noted that the predicted probability of survival was generally much lower than the observed survival proportions indicating that this measure (i.e. mean ICISS) tended to significantly overestimate mortality. This reflects the fact that the published set of survival weights used for this report had been calculated on the basis of cases spending at least one night in hospital, while this report retained same-day cases.

In summarising outcomes for all incident TBI cases, it was found that a large proportion of these cases where the patient's only significant head injury was a concussion or a concussion in combination with a skull fracture, were characterised by short lengths of stay in hospital and discharges to the usual place of residence.

Although, most of these cases could be classified as suffering from mild traumatic brain injury, there is evidence that a small proportion of cases such as these can be followed by persisting problems related to a combination of cognitive, behavioural and physical deficits. It has been estimated that 10–15% of all mild traumatic brain injury cases remain symptomatic in the longer term with physicals complaints including headache, cervical pain, vestibular complaints, changes in taste and hearing, difficulty with attention and memory, and irritability, insomnia and sleeping difficulties (Ponsford et al. 2000).

A smaller, but still substantial number of cases had indicators of being more severe. These cases generally included diagnosis codes for diffuse or focal brain injury or brain haemorrhage and were characterised by longer lengths of stay and a much higher likelihood of a fatal outcome than for cases without these types of injuries. Almost 10% of cases admitted with an intracranial injury died in hospital, compared to less than 1% for cases without this type of injury. These cases were also much more likely to be transferred to a nursing home and have persisting serious consequences of TBI. The effects of moderate and severe TBI can be far-reaching and profound. Consequences include neurological impairment, cognitive impairment, personality and behavioural changes and lifestyle consequences such as unemployment and financial hardship (Khan et al. 2003).

Direct costs for hospital care for TBI separations were estimated to be more than $184 million. The highest proportion of costs was for TBI separations resulting from *Transportation* injury (46%, $85.7 million), a major cost and also social impact, particularly for younger people, who are affected more often, and are likely to require after care for ongoing periods. This was followed by Falls (35%, $62.7 million), where the elderly are particularly vulnerable. TBI injury caused by *Assault* was estimated at 9% ($15.7 million) of total direct costs. There were also significant direct costs of close to $8.5 million for hospital care for patients suffering from late effects of TBI.

Episodes of follow-up care accounted for almost 2,100 hospitalisations. These episodes were reported more than 2 times more often for males than for females, and were much more prominent among those aged 75 years and over. Cases in this group were predominantly *Transportation* and *Fall*-related and being predominantly rehabilitation episodes of care had generally long lengths of stay. Not surprisingly, the most common procedures for this group were allied health interventions, with the most common of these being physiotherapy, occupational therapy, social work and speech pathology.

A better understanding of the consequences of TBI can be achieved by following patients and assessing outcomes. The development of data linkage capabilities for hospital data in Australia will enable such work to be undertaken more widely, and this will improve understanding of the consequences of TBI.

Appendix: Data issues

Analysis of multiple head injury codes

For Tables 1 and 2 in section 5 of this report, the head injury combinations were defined in the following manner:

- Intracranial only—at least one diagnosis in range S06.1–S06.9, but no diagnoses in the ranges S06.00–S06.05 or S02.0–S02.9
- Intracranial and skull fracture—at least one diagnosis in the ranges S06.1–S06.9 and S02.0–S02.9, but no diagnosis in the range S06.00–S06.05
- Concussion only—at least one diagnosis in range S06.00–S06.05, but no diagnoses in the ranges S06.1–S06.9 or S02.0–S02.9
- Concussion and skull fracture—at least one diagnosis in the ranges S06.00–S06.05 and S02.0–S02.9, but no diagnosis in the range S06.1–S06.9
- Concussion and intracranial injury—at least one diagnosis in the ranges S06.00–S06.05 and S06.1–S06.9, but no diagnosis in the range S02.1–S02.9
- Concussion and intracranial injury and skull fracture—at least one diagnosis in the ranges S06.00–S06.05 and S06.1–S06.9 and S02.1–S02.9

Table 1 also includes a category for skull fracture only cases —at least one diagnosis in range S02.0–S02.1, S02.7–S02.9, but no diagnosis in the range S06.0–S06.9

For Tables 3 to 20 in Section 5 of this report, the head injury combinations were defined in the following manner:

- Intracranial injury—at least one diagnosis in range S06.1–S06.9
- Concussion injury only—at least one diagnosis in range S06.00–S06.05, but no diagnoses in the ranges S06.1–S06.9 or S02.0–S02.9
- Concussion injury and skull fracture—at least one diagnosis in the ranges S06.00–S06.05 and S02.0–S02.9, but no diagnosis in the range S06.1–S06.9
- Skull fracture without TBI—at least one diagnosis in range S02.0–S02.1, S02.7–S02.9, but no diagnosis in the range S06.0–S06.9

ICISS

The threat-to-life measure ICD-based Injury Severity Score (ICISS) is used throughout this report, particularly in Section 5, as a means of assessing the severity of an injury or set of injuries sustained by each patient. When compared to an observed measure, such as the observed proportion of patients within a predefined group who survived to discharge from hospital, ICISS, in many instances, significantly overestimates mortality.

The main reason for this overestimation is that the survival rate ratios (SRRs) used to calculate ICISS were originally calculated using a subset of records that excluded cases where patients were discharged on the same day as their admission, unless discharge was due to death (Stephenson et al. 2003). Excluding same-day cases not only removes a number of low severity cases from the dataset, and hence results in a higher estimate of the proportion of cases leading to death, than if same-day cases were retained. Additionally, the ICISS method, which utilises all injury diagnoses within a record, often assigns a SRR value of less than 1 to injuries which, on their own, would rarely result in death. These reasons, combined with the application of these SRRs to a set of records in which same-day cases are included, largely explains the observed overestimation of mortality.

The SRRs used in the calculation of ICISS in this report were utilised since firstly, they already appear in a published report (Stephenson et al. 2003), and secondly, New Zealand injury researchers have already used this set of SRRs in a number of published reports. Despite these limitations, ICISS serves the intended function of providing a relative measure of threat to life of various injury diagnoses.

Age adjustment

Most all-age rates have been adjusted for age to allow comparison of injury risk free from the distortion introduced by one population having a different age distribution to another. Direct standardisation was employed, using the Australian population as at 30 June 2001 as a reference population. Where crude rates or age-specific rates are reported, this is noted.

Confidence intervals

Nearly all injury cases are thought to be included in the data reported, representing minimal risk of sampling error. Data are based on the financial year of separation, but choice of this time period is arbitrary. Use of the calendar year would result in different rates, especially where the case numbers are small. The 95% confidence intervals of these rates are based on a Poisson assumption about the number of cases in a time period. Chance variation alone would be expected to lead to a rate outside the 95% confidence interval on 5% of occasions. Confidence intervals were calculated using the methods described by Anderson and Rosenberg (Anderson & Rosenberg 1998). Asymmetrical confidence intervals were calculated for case numbers up to 100. Symmetrical intervals, based on a normal approximation, were calculated where case numbers exceed 100.

Suppression of small cell counts in data tables

In some instances, cell counts in tables that are 4 cases or fewer have been suppressed, as have rates derived from them, to protect confidentiality and because values based on very small numbers are sometimes difficult to interpret.

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List of tables

List of figures

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This report describes hospitalisations for Traumatic Brain Injury (TBI) in Australia for the period 2004-05. TBI, as distinct from head injury, is characterised by an external impact to the head that results in damage to the brain. TBI is defined in this report by the presence in hospital separation records of at least one ICD-10-AM code in the S06 intracranial injury range occurring in at least one of fifty available diagnosis fields. The 22,710 records meeting this criterion were analysed in three groups, according to the prominence of TBI in the record.

Analysis and description of combinations of injury types resulting in TBI admissions to a hospital are reported, including discussion of severity of injury, and cost and burden on the systems for acute care and rehabilitation. About 980 (4.3% of cases) deaths in hospital were reported. Direct costs for hospital care for TBI separations were estimated to be more than $184 million.