

Injury-related Health Loss

A report from the New Zealand
Burden of Diseases, Injuries
and Risk Factors Study
2006–2016

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Foreword

We are pleased to present this joint report on *Injury-related Health Loss* from the Ministry of Health and the Accident Compensation Corporation (ACC). Injury is an important cause of premature death and disability in New Zealand, but it can be difficult to quantify the scale of injury-related health loss. This report estimates both the total health loss caused by injury, as well as health loss from specific causes such as transport injuries and falls.

For the first time we have been able to look at injury-related health loss from two perspectives: the external *cause* of the injury (eg, interpersonal violence) and the *nature* of the injury (eg, traumatic brain injury). This approach provides us with a more in-depth understanding of the mechanism of injury, critical for injury prevention, and of the health consequences of injury, important for effective injury management. Age, sex and ethnic disparities are also reported, with a separate section focusing on injury in Māori.

The report also provides important insight into the contribution of different risk factors for injury, such as osteoporosis, alcohol misuse and mental illness. These results re-emphasise the strong association between injury and disease and the need for collaborative efforts to reduce injury-related health loss at a population level.

The injury project demonstrates what can be achieved by linking data and sharing expertise across organisations. Analytical staff from ACC worked with the Health and Disability Intelligence team at the Ministry of Health to enhance the injury component of the New Zealand Burden of Diseases, Injuries and Risks study. The result is a stronger, more comprehensive understanding of injury-related health loss.

The information presented in *Injury-related Health Loss* will be of value to all those working in New Zealand to both prevent injury and to reduce the impact of injury through effective treatment and rehabilitation. We hope you find this report an interesting and informative read.

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Analytical work for the injury project was undertaken by Zhi-ling (Jim) Zhang (ACC), with support from Martin Tobias (Ministry of Health) and Michelle Liu (Ministry of Health). The report was written by Hilary Sharpe (Ministry of Health), with support from the injury project team, including Zhi-ling Zhang, Martin Tobias, Jackie Fawcett (Ministry of Health) and Michelle Liu.

The draft report was peer-reviewed by Margaret Macky (ACC), John Wren (ACC), Hank Weiss (University of Otago) and Sarah Derrett (University of Otago). Many people also contributed to this work, including: Li-cha Yeh, Maria Turley, Kylie Mason (Ministry of Health), Zeeman Van der Merwe and Peter Jensen (ACC).

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Key findings

- Injuries are the third most important cause of health loss in children and young people, and the fifth most important cause of health loss across all age groups.
- Males account for nearly three-quarters of injury-related health loss.
- Over half of all injury-related health loss occurs in those under 35 years old.
- Self-inflicted and transport injuries are the leading causes of injury-related health loss.
- Falls account for more than half of all injury-related health loss in older age groups.
- Māori experience twice the rate of injury-related health loss compared to non-Māori, with health loss from assault four times higher in Māori.
- Self-inflicted injury rates are highest in young people.
- A third of all injury-related health loss results from traumatic brain injury and spinal cord injury, the majority of which is due to transport injuries.
- Alcohol and mental illness each contribute towards a quarter of all injury-related health loss.

Introduction

Injuries have a substantial impact on the health of the population, both as a leading cause of premature death and through disability following an injury. Information on injury-related deaths is well reported in the literature. What is less well understood is the impact of non-fatal injury and the risk factors that contribute to injury.

This report presents the injury-related findings from the New Zealand Burden of Diseases, Injuries and Risk Factors Study 2006-2016 (NZBD). The NZBD aims to quantify the level of health loss, or 'burden', attributable to a comprehensive set of diseases, injuries and their risk factors, using a standardised approach. The impact of injury is quantified in terms of both its fatal burden (impact on premature mortality) and its non-fatal burden (impact on disability), combined in a summary measure, the disability-adjusted life year (DALY). The DALY can be used to compare health loss resulting from a wide range of diseases and injuries, from fatal car crashes in adolescence to falls in the elderly.

The NZBD was carried out by the Health and Disability Intelligence Unit, Ministry of Health, with assistance from the Accident Compensation Corporation (ACC), the Global Burden of Disease team, a project advisory group and more than 30 New Zealand clinical experts. The study incorporates data from a wide range of sources, together with the latest research evidence, to provide a more precise estimate of the burden of diseases, injuries and risk factors in New Zealand.

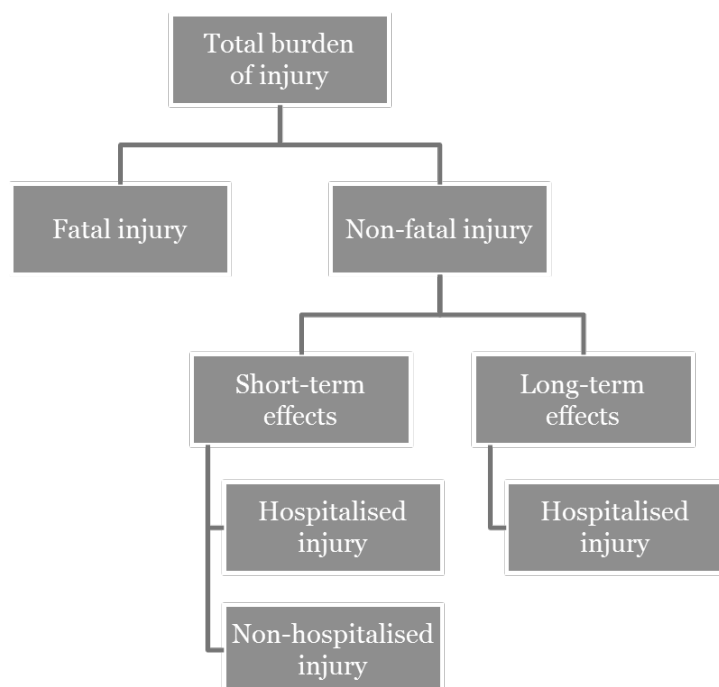
For injuries, additional data and expertise were provided by ACC, enabling a more in-depth look at both injury-related health loss and risk factors for injury. The injury data from the NZBD will help further our understanding of the burden of injury in New Zealand.

Injuries are preventable and so most of the health loss presented in this report is potentially avoidable. The information contained in this report gives an indication of the opportunities and potential scale of health gain achievable through effective, evidence-based injury prevention, treatment and rehabilitation.

Measuring the burden of injury

This report provides a comprehensive overview of the burden of injury using data from a number of sources, including mortality data, hospital discharge data, and ACC claims data for non-hospitalised injury (Table 1). This has allowed us to estimate the level and distribution of health loss resulting from both hospitalised and non-hospitalised injury (see Figure 1).

Figure 1: New Zealand burden of injury model



As well as the short-term effects of injury, we have estimated the longer-term effects of injury in hospitalised cases. This provides a better estimate of the level and duration of disability resulting from injury. However, we have been unable to quantify the long-term effects of non-hospitalised injury. This may have resulted in an underestimation of the total level of disability resulting from injury.

Data were for the 2006 calendar year. The exception was mortality data, where a three-year average was calculated based on data from 2005 to 2007. This reduced the impact of annual fluctuations in the number of deaths in each category.

Reporting of short-stay emergency department events (greater than three hours of treatment) only became compulsory from July 2009, although many DHBs were already reporting this data by 2006. These cases may have been picked up through the ACC claims data, but it is likely that there is an underestimation of non-hospitalised injury. Table 1 summarises the data sources used in this report.

Table 1: Data sources for Injury-related Health Loss

Injury category	Data source	Exclusions*
Fatal injury	NZ Mortality Collection	<ul style="list-style-type: none"> • Sudden unexplained death in infants (SUDI) • Alcohol poisoning • Adverse effects of medical treatment
Non-fatal hospitalised injury	National Minimum Dataset (NMDS)	<ul style="list-style-type: none"> • Readmissions for an identical injury diagnosis within 90 days • Alcohol poisoning • Adverse effects of medical treatment
Non-fatal non-hospitalised injury	ACC claim data 2006	<ul style="list-style-type: none"> • Cases already reported in NMDS • Claims for musculoskeletal disorders, occupational diseases or treatment injury • Claims with only symptoms rather than a diagnosis coded

* Conditions excluded from the injuries category have been included elsewhere in the NZBD report¹.

Injuries are reported from two perspectives: external cause and nature of injury. External causes are classified according to the ICD-10 system and reflect the mechanism of the injury (eg, fall, transport injury). The nature of injury reflects the clinical diagnosis (eg, fracture, dislocation, traumatic brain injury). Looking at injury from both perspectives has enabled us to gain a greater understanding of the impact of injury on the health care system and to identify opportunities for prevention. A list of the external-cause and nature-of-injury codes used in this report is provided in Appendices 1 and 2.

In order to fully quantify the burden of injury in New Zealand it is important to utilise all available patient data, including incomplete records. Where the external cause or nature of injury was unknown, proportional random distribution was used to assign these 'unknown' cases to one of the external-cause or nature-of-injury codes.

For example, for 3741 cases of hospitalised hip fracture with a known external cause, 89% were due to falls, 10% to transport incidents and 1% to mechanical forces. However, there were also 45 hip fractures with an unknown external cause code. These cases were randomly assigned to each of the external cause categories at the same frequency as the known cases: 40 cases assigned to falls (89%), 4 to transport accident (10%) and 1 to mechanical forces (1%).

Quantifying the burden of injury using disability-adjusted life years (DALYs)

The DALY is a summary measure of health loss, combining both fatal and non-fatal health outcomes in a single measure. The DALY sums years lived with disability (YLD) and years lost due to premature death (YLL). So one DALY represents the loss of one year of healthy life. The DALY provides a common metric by which the health impact of different diseases, injuries and risk factors can be compared.

¹ Ministry of Health. 2013. *Health Loss in New Zealand: A report from the New Zealand Burden of Diseases, Injuries and Risk Factors Study, 2006–2016*. Wellington: Ministry of Health.

$$\text{DALYs} = \text{YLD} + \text{YLL}$$

DALY: disability-adjusted life year

YLD: years lived with disability

YLL: years of life lost

Non-fatal burden: years lived with disability (YLD)

In this report, the term 'disability' refers to health states other than full health, which may be short term (eg, superficial injury) or long term (eg, spinal cord injury). The YLD measure combines information on the incidence and duration of injury, together with information on the severity of disability experienced.

Information on the **incidence** of non-fatal injury was obtained from the NMDS hospital admissions data and ACC claims data. **Duration** of injury was determined from international studies, or where this was unavailable, was estimated by a panel of three trauma experts.

Depending on the nature of injury, some injury types are associated with an increased risk of **long-term health effects** (eg, psychiatric disorders and functional impairment resulting from traumatic brain injury). Injuries with long-term health effects were identified through clinical studies, from previous Global Burden of Disease studies and through consultation with clinicians. DisMod II modelling software was used to estimate the **prevalence** of the long-term sequelae of these injuries². Details on the long-term effects of injury included in the NZBD are provided in Appendix 3.

Disability weights are used to estimate the severity of disability associated with each acute injury or long-term sequela, measured on a scale from 0 (perfect health) to 1 (death). Disability weights for injury were obtained from the Global Burden of Disease Study (GBD 2010) or by expert panel consensus where GBD weightings were unavailable.

Individuals may experience more than one disability at the same time, but the total disability experienced is likely to be less than the sum of the individual impacts. Hence an adjustment factor was applied to account for co-morbidity. This adjustment factor increased with age and was greater in Māori to account for greater levels of co-morbidity. Disability weights for individual injuries are provided in Appendix 4.

Adjustment for non-hospitalised cases

Non-hospitalised injury cases are expected to be of lesser severity and shorter duration than hospitalised cases on average. Based on expert clinical advice, an adjustment factor of 0.7 was applied to both the duration of injury and the disability weights for non-hospitalised cases. This meant that non-hospitalised cases were awarded around half the number of YLDs per case as hospitalised cases of the same injury type ($0.7 \times 0.7 = 0.49$).

² Barendregt JJ, van Oortmarssen GJ, Vos T, et al. 2003. A generic model for the assessment of disease epidemiology: the computational basis of DisMod II. *Population Health Metrics* 1: 4.

Fatal burden: years of life lost due to premature death (YLL)

The fatal burden of injury was calculated by measuring the remaining life expectancy at the age of death. The remaining life expectancy was derived from the Global Burden of Disease 2010 standard life table.

Years of life lost (YLL) were then calculated by multiplying the number of deaths from the cause of interest by this remaining life expectancy; hence, a death at a younger age is associated with a greater loss than a death at an older age.

Uncertainty

Estimates from the NZBD are presented in this report without accompanying estimates of uncertainty. Although this helps clarity and readability, it is nevertheless essential that users of this information have an understanding of the uncertainty associated with the estimates and projections. Appendix 5 provides a table of standard errors ('margins of error'), using selected examples only. This information provides a general sense of the uncertainty surrounding estimates and projections at different levels of aggregation within this report. Further information on uncertainty is provided in the NZBD *Ways and Means* report³ and the online Statistical Annexe.

Further information

More detailed methodological information is available in the NZBD *Health Loss in New Zealand* report⁴ and the *Ways and Means* methodology report.

³ Ministry of Health. 2013. *Ways and Means: A report on methodology from the New Zealand Burden of Diseases, Injuries and Risk Factors Study 2006–2016*. Wellington: Ministry of Health.

⁴ Ministry of Health. 2013. *Health Loss in New Zealand: A report from the New Zealand Burden of Diseases, Injuries and Risk Factors Study, 2006–2016*. Wellington: Ministry of Health.

Injury is a leading cause of health loss

Injuries are the fifth leading cause of health loss in New Zealand and the third leading cause of premature mortality

In 2006 over 76,000 years of healthy life were lost due to injury, accounting for 8% of total health loss. This is similar to the level of health loss associated with musculoskeletal disorders (9%) or neurological conditions (7%).

Injuries are a major cause of health loss in children and young people, second only to infant conditions and birth defects in those aged 0–14 years and mental disorders in those aged 15–24 years.

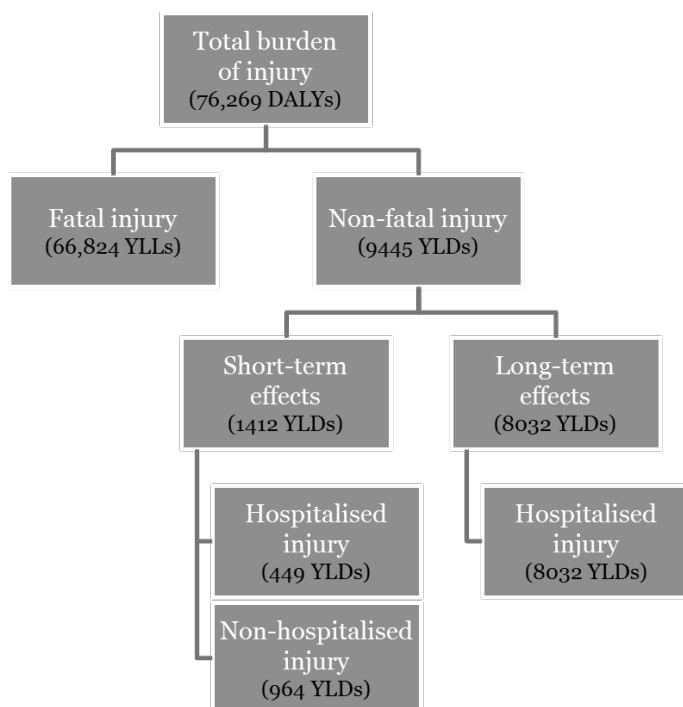
Table 2: Top 10 'broad' causes of health loss in New Zealand, 2006

Condition group	Rank	DALY count	Percentage of total DALYs
Cancers and other neoplasms	1	167,149	18
Vascular and blood disorders	2	166,863	17
Mental disorders	3	106,398	11
Musculoskeletal disorders	4	87,225	9
Injury	5	76,269	8
Neurological conditions	6	65,293	7
Respiratory disorders	7	60,276	6
Infant conditions and birth defects	8	50,338	5
Diabetes and other endocrine disorders	9	38,780	4
Reproductive and gestational disorders	10	33,618	4

Figure 2 summarises the contribution of fatal and non-fatal injury to the total injury-related health loss. A total of 66,824 YLLs were lost through fatal injury as a consequence of 1734 injury-related deaths. Injury is therefore the third leading cause of premature mortality after cancer (153,000 YLLs) and vascular conditions (134,000 YLLs).

Non-fatal injury accounted for 12.4% of the total injury-related health loss (9445 YLDs). The majority of this health loss was due to the long-term effects of serious injury. Only 1412 YLDs were lost due to the short-term effects of injury, 964 of which were due to non-hospitalised injury (Figure 2).

Figure 2: Summary of injury-related health loss from fatal and non-fatal injury, 2006



Almost two-fifths of injury DALYs are due to intentional injury

Injuries can be classified as either intentional or unintentional. Intentional injury includes self-inflicted injury (eg, self-harm) and inter-personal violence (eg, assault). Approximately 30,000 years of healthy life were lost in 2006 due to intentional injury (39% of injury-related health loss).

Most of the health loss from intentional injury was due to premature death (95%). For unintentional injury 83% of health loss was due to premature death, with 8000 DALYs lost as a result of injury-related disability. Males were disproportionately affected by both intentional and unintentional injury. The Standardised Rate Ratio, ie, the ratio of the age-standardised rate of injury DALYs in males compared to females, was 2.8 for both intentional and unintentional injury. This means that males were almost three times as likely to experience health loss from injury as females.

Table 3: The burden of intentional and unintentional injury, by sex, 2006

		Deaths	YLL	YLD	DALYs
Intentional injury	Male	442	20,743	969	21,712
	Female	162	7,576	468	8,044
	Total	604	28,319	1,437	29,756
Unintentional injury	Male	705	27,850	5,491	33,341
	Female	425	10,656	2,516	13,172
	Total	1,130	38,506	8,007	46,513

External causes of injury

Self-inflicted and transport injuries are the leading causes of injury-related health loss in New Zealand

In 2006, over 25,000 years of healthy life were lost as a result of self-inflicted injury (suicide and self-harm), accounting for a third of the injury-related health loss. Transport injuries caused a similar level of health loss (33%), followed by falls (10%) and interpersonal violence (6%).

Table 4: Injury-related health loss, by external cause of injury and sex, 2006

Description	DALY count			Percentage of total		
	Male	Female	Total	Male	Female	Total
Self-inflicted injury	18,919	6,435	25,353	34.4	30.3	33.2
Transport injury	18,133	6,851	24,984	32.9	32.2	32.8
Falls	4,550	2,986	7,536	8.3	14.2	9.9
Interpersonal violence	2,793	1,609	4,403	5.1	7.6	5.8
Mechanical force	2,936	708	3,644	5.3	3.3	4.8
Drowning	2,765	658	3,423	5.0	3.1	4.5
Poisoning	1,797	912	2,709	3.3	4.3	3.6
Fire and thermal causes	906	338	1,243	1.6	1.6	1.6
Animal-related injury	154	136	290	0.3	0.6	0.4
Other unintentional injury	2,100	584	2,684	3.8	2.8	3.5
Total	55,053	21,216	76,269	100	100	100

Males are nearly three times more likely to experience health loss as a result of injury

Males experience a greater level of injury-related health loss, compared to females (SRR = 2.8). This difference is most obvious for mechanical force injuries and drowning, where males experienced four times rate of health-loss compared to females (Table 5).

Table 5: Comparison of age-standardised rates of injury-related health loss, by external cause of injury and sex, 2006

Description	Age-standardised DALY rate (ASR) per 1000		Standardised rate ratio (SRR)
	Male	Female	
Mechanical force	1.37	0.33	4.19
Drowning	1.41	0.35	4.03
Other unintentional injury	1.03	0.26	3.91
Self-inflicted injury	9.55	3.06	3.12
Fire and thermal causes	0.46	0.15	3.00
Transport injury	9.26	3.40	2.73
Poisoning	0.92	0.42	2.22
Falls	1.99	0.95	2.10
Animal-related injury	0.07	0.06	1.10
Interpersonal violence	1.42	0.85	1.67
Total	27.48	9.82	2.80

Most injury-related health loss is due to premature mortality

Premature death, rather than disability, was the predominant cause of injury-related health loss, accounting for 88% of all injury DALYs. This reflects both the fatal nature of many injury types and the disproportionate burden of injury on children and young adults, resulting in a greater number of years of life lost per injury death.

Table 6: Fatal (YLL) and non-fatal (YLD) injury-related health loss by external cause of injury, 2006

Description	YLLs	YLDs	Percentage of health loss due to early mortality (YLL)
Self-inflicted injury	24,775	579	97.7
Transport injury	22,874	2,110	91.6
Falls	4,705	2,831	62.4
Interpersonal violence	3,544	859	80.5
Mechanical force	1,580	2,064	43.4
Drowning	3,361	62	98.2
Poisoning	2,634	75	97.2
Fire and thermal causes	773	470	62.2
Animal-related injury	145	145	49.9
Other unintentional injury	2,434	250	90.7
Total	66,824	9444	87.6

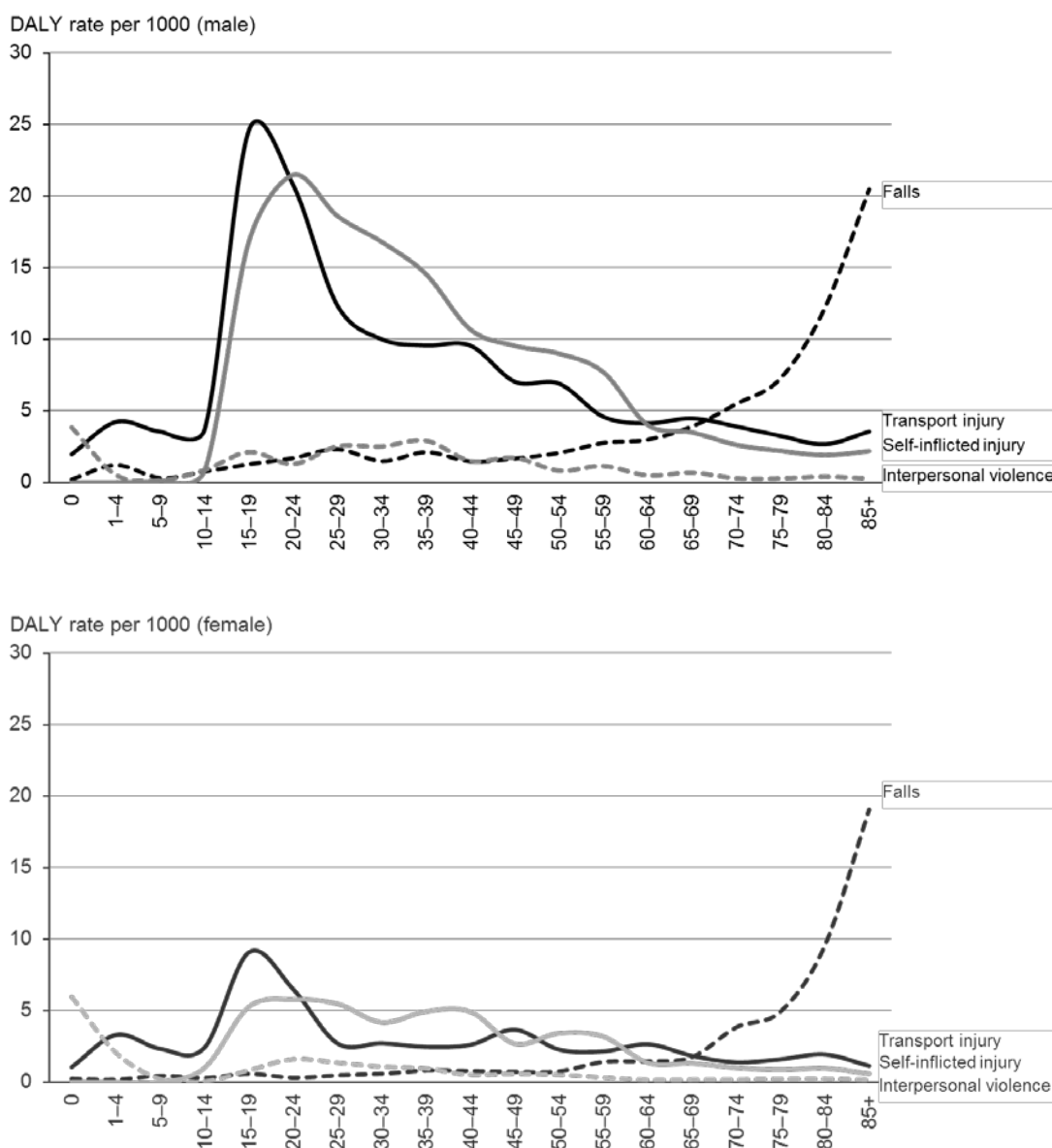
The pattern of injury-related health loss varies with age

Over half of all injury-related health loss (54%) was experienced by those under the age of 35. Injury-related health loss from transport and self-inflicted injuries was greatest in young males aged between 15 and 24 years. These remained the two leading causes of injury-related health loss throughout adulthood until older age, when falls increased in dominance (Figure 3).

In females, health loss from transport injury showed a similar pattern to males, peaking in young females aged 15–19 years. Health loss from self-inflicted injury was much more evenly spread across adulthood, remaining high between the ages of 15 and 44 years. Health loss from falls showed a similar pattern to males, increasing rapidly from the age of 65 (Figure 3).

Health loss from interpersonal violence was greatest in infants under one year, for both males and females.

Figures 3: Major causes of injury-related health loss (>5% of total DALYs), by age group and sex, 2006



Children and young people (0–24 years)

Injuries in children and young people led to the loss of 27,000 years of healthy life

Injuries accounted for 18% of health loss from any cause in children and young people. The majority of this health loss was through early death, with 25,000 years of life lost in those aged under 25 years (Table 7). Injury-related health loss was much higher in young men aged 15–24, where it was responsible for almost two-fifths of health loss from any cause.

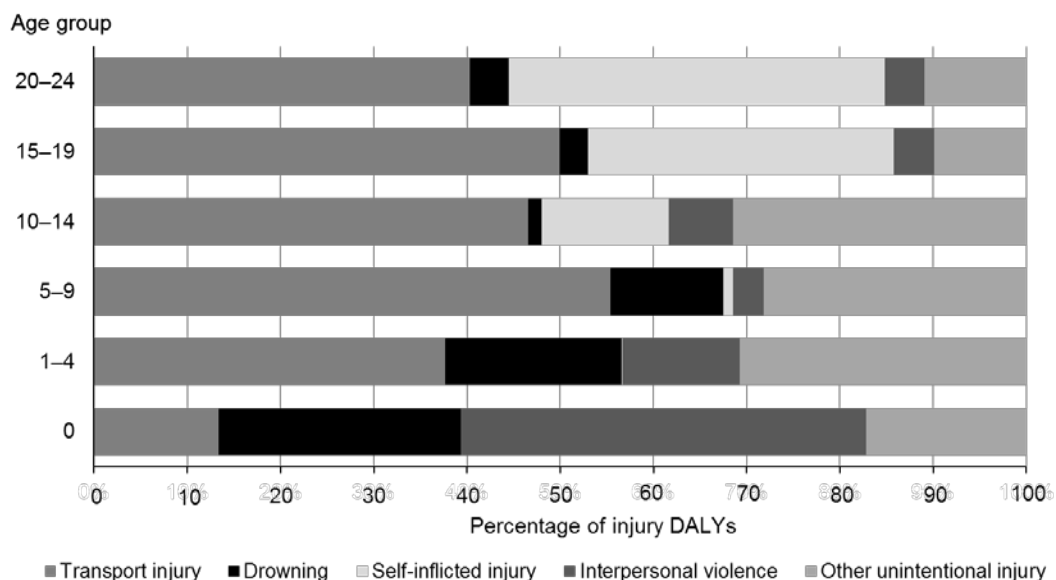
Table 7: Injury-related health loss in children and young people, 2006

Sex	Age group (years)	DALYs	DALY rate per 1000	Injury DALYs as a % of all-cause DALYs
Male	0	332	11.0	1.6
	1–4	1,353	11.7	21.7
	5–9	993	6.7	14.7
	10–14	1,337	8.4	17.5
	15–19	7,960	49.9	39.0
	20–24	7,587	52.0	36.4
Female	0	330	11.4	2.2
	1–4	909	8.2	16.9
	5–9	555	3.9	10.5
	10–14	703	4.7	11.2
	15–19	2,681	17.4	15.8
	20–24	2,260	15.6	12.7
Total		27,000	18.1	18.1

Assault is the leading cause of injury-related health loss in infants

The major causes of injury-related health loss vary depending on the age of the child or young person. Transport injuries were the predominant cause of health loss in children and young people, accounting for 45% of injury-related health loss. In infants, interpersonal violence accounted for over 40% of injury-related health loss. Drowning was an important cause of health loss in children under nine years of age, with self-inflicted injury increasing in importance from the age of 10 (Figure 4).

Figure 4: Predominant causes of injury-related health loss (>5% of total DALYs) in children and young people, by age group, 2006



Young and middle-aged adults (25–64 years)

Self-inflicted injuries are the leading cause of injury-related health loss in young and middle-aged adults

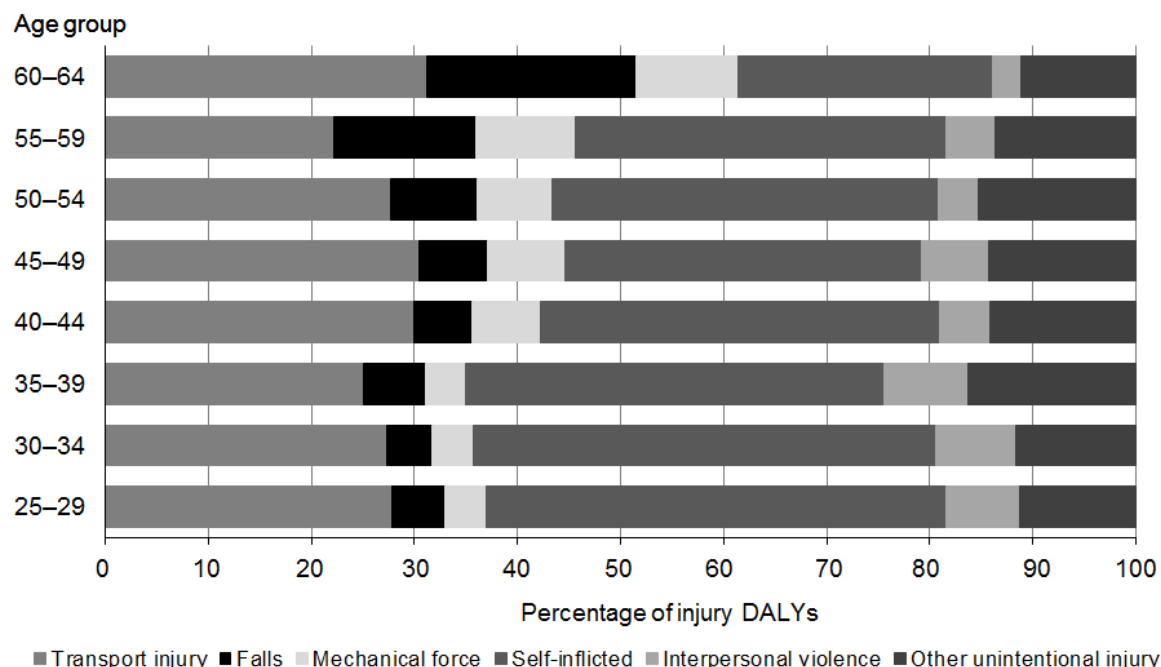
Over 40,000 years of healthy life were lost in 2006 as a result of injury in those aged 25–64 years (Table 8). Injury accounted for 9% of health loss from any cause in this age group. The rate of injury-related health loss was much higher in males aged 25–44 years.

Self-inflicted injury accounted for the greatest proportion of health loss from injury in young and middle-aged adults (39%), followed by transport injuries (28%). Falls accounted for 7% of health loss in young and middle-aged adults, increasing to 20% in those aged 60–64 years (Figure 5).

Table 8: Injury-related health loss in young and middle-aged adults, 2006

Sex	Age group (years)	DALYs	DALY rate per 1000	Percentage of health loss from any cause, attributable to injury
Male	25–34	10,406	39.6	27.5
	35–44	10,106	33.1	20.6
	45–54	7,040	25.2	11.2
	55–64	3,899	18.4	5.1
Female	25–34	2,958	10.4	7.4
	35–44	3,559	10.8	6.1
	45–54	2,567	8.9	4.0
	55–64	1,732	8.0	2.6
Total		42,269	19.4	9.3

Figure 5: Predominant cause (>5% of total DALYs) of injury-related health loss in young and middle-aged adults, by age group, 2006



Older adults (65+)

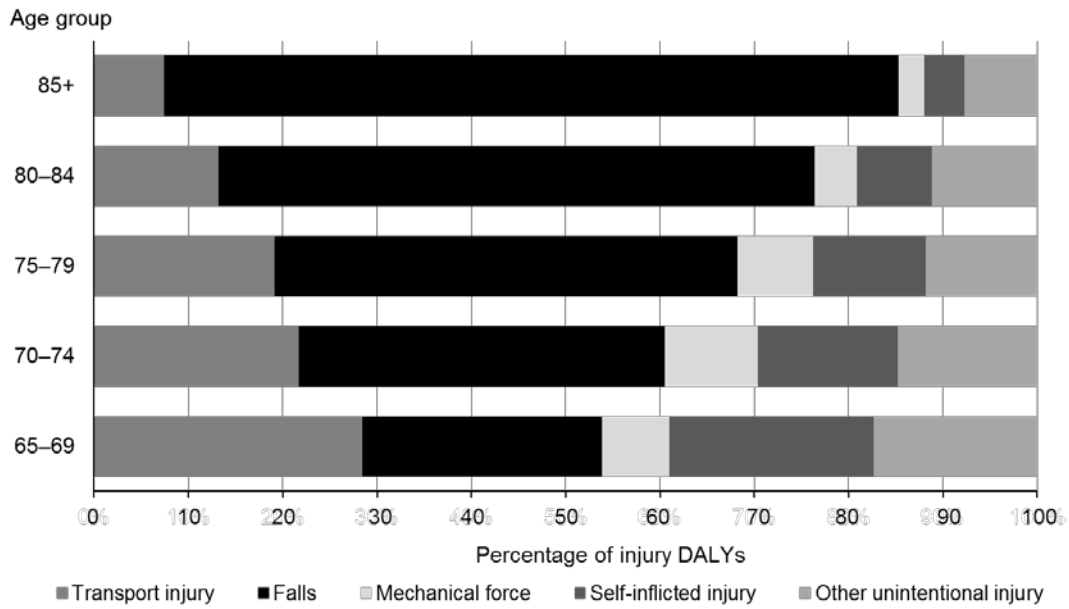
Falls account for the majority of injury-related health loss in older adults

Injuries were responsible for the loss of over 7000 years of healthy life in those aged 65+ (Table 9). However, injury only accounted for 2% of health loss from any cause in this age group. Falls were the leading cause of injury-related health loss in older adults, accounting for half of all injury DALYs in those aged 65+ (Figure 6).

Table 9: Injury-related health loss in older adults, 2006

Sex	Age group (years)	DALYs	DALY rate per 1000	Percentage of health loss from any cause, attributable to injury
Male	65-74	2,149	16.2	2.7
	75+	1,918	20.0	2.1
Female	65-74	950	6.7	1.4
	75+	2,024	14.5	1.8
Total		7,042	13.8	2.0

Figure 6: Predominant cause (>5% of total DALYs) of injury-related health loss in older adults, by age group, 2006



Nature of injury

The following section presents information on the nature of injury (clinical diagnosis), irrespective of intent or external cause. Injuries to the central nervous system (CNS) were the leading cause of injury-related health loss from a nature-of-injury perspective. CNS injuries accounted for nearly a third of all injury-related health loss, followed by internal and crush injuries (16%) and toxic effects (13%).

Table 10: Injury-related health loss, by nature of injury and sex, 2006

Description	DALYs			Percentage of total injury DALYs		
	Male	Female	Total**	Male	Female	Total
Central nervous system (CNS) injury	17,952	6,689	24,641	32.5	31.7	32.3
Internal and crush injury	8,868	3,001	11,868	16.1	14.2	15.6
Toxic effects*	6,770	3,426	10,197	12.3	16.2	13.4
Drowning and immersion injury	3,317	1,117	4,435	6.0	5.3	5.8
Fracture and dislocation	2,088	1,600	3,688	3.8	7.6	4.8
Soft tissue injury and open wound	1,178	485	1,663	2.1	2.3	2.2
Burn injury	1,162	464	1,625	2.1	2.2	2.1
Amputation	551	153	704	1.0	0.7	0.9
Other injury	13,278	4,171	17,449	24.1	19.8	22.9
Total	55,164	21,105	76,269	100.0	100.0	100.0

* Toxic effects include the effects of both intentional and unintentional poisoning.

** Numbers may not total exactly due to rounding.

Table 11 shows the relationship between the external causes of injury and the resulting nature of injury. For transport injury, falls, interpersonal violence and mechanical force injuries, the majority of the resulting health loss was due to CNS injury. For falls, a third of the health loss was from fracture and dislocation.

Over half of the health loss resulting from self-inflicted injury was due to 'other injury'. The majority of these cases had a clinical diagnosis of asphyxiation, as a result of hanging, strangulation or suffocation. Toxic effects (ie, overdose) were responsible for a quarter of the health loss resulting from self-inflicted injuries.

Table 11: Injury-related health loss (DALYs) by nature of injury and external cause, 2006*

Nature of injury	External cause of injury										
	Transport injury	Falls	Mechanical force	Drowning	Poisoning	Fire and thermal causes	Animal-related injury	Other unintentional cause of injury	Self-inflicted injury	Interpersonal violence	Total
Central nervous system injury	15,000	4,100	1,000	100	–	–	100	300	1,900	2,000	24,500
Internal and crush injury	7,900	800	500	–	–	–	100	200	1,400	900	11,800
Toxic effects	100	–	–	–	2,600	400	–	100	6,700	100	10,000
Drowning and immersion injury	600	–	–	3,300	–	–	–	100	500	100	4,600
Fracture and dislocation	500	2,300	200	–	–	–	–	100	100	300	3,500
Soft tissue injury and open wound	200	200	200	–	–	–	–	–	400	600	1,600
Burn injury	200	–	100	–	100	1,000	–	–	200	100	1,700
Amputation	100	–	600	–	–	–	–	–	–	–	700
Other injury	300	200	900	–	–	–	–	1,900	13,900	400	17,600
Total	24,900	7,600	3,500	3,400	2,700	1,400	200	2,700	25,100	4,500	76,000

* Figures have been rounded to the nearest 100 due to small numbers, which may be affected by classification errors.

Central nervous system injury

Injuries to the central nervous system include traumatic brain injury and spinal cord injury. Traumatic brain injury accounted for 28% of injury-related health loss, leading to the loss of nearly 22,000 years of healthy life (Table 12).

Table 12: Health loss from central nervous system injury, 2006

Nature of injury	DALYs	Percentage of all injury DALYs
Traumatic brain injury	21,728	28.5
Spinal cord injury	2,912	3.8
Central nervous system injury	24,641	32.3

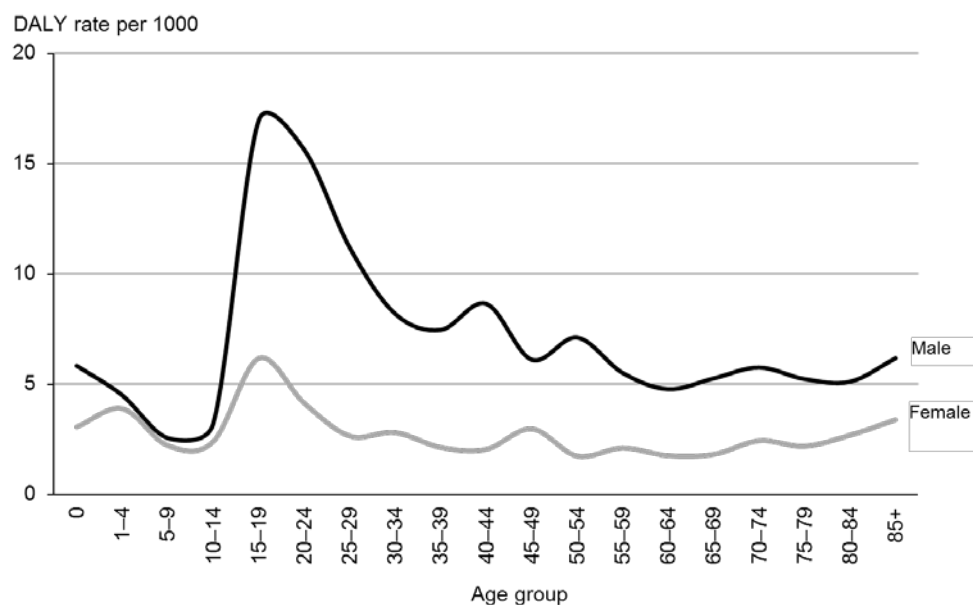
Transport injuries were the predominant external cause of health loss from traumatic brain injury and spinal cord injury, responsible for 62% and 57% of health loss from these injury types, respectively (Table 13). For traumatic brain injury, the remaining health loss was due to falls (16%), interpersonal violence (9%) and self-inflicted injury (8%). For spinal cord injury, falls (22%) and mechanical force (7%) accounted for much of the remaining health loss.

Table 13: External cause of health loss from central nervous system injury, 2006

External cause of injury	Percentage of health loss due to external cause	
	Traumatic brain injury	Spinal cord injury
Transport injury	61.9	56.5
Falls	15.9	22.0
Fire and other thermal causes	0.1	0.0
Drowning	0.2	0.9
Poisoning	0.0	0.6
Animal-related injury	0.3	0.3
Mechanical force	3.9	6.7
Self-inflicted injury	8.0	5.5
Interpersonal violence	9.0	2.6
Other unintentional injury	0.7	4.9
Total	100.0	100.0

Almost three-quarters (72%) of the total health loss from traumatic brain injury occurred in males, leading to the loss of 15,735 DALYs. Young males aged 15–24 experienced the majority of this health loss (Figure 7). Māori experienced over twice the rate of health loss from traumatic brain injury compared to non-Māori, after adjusting for age (SRR males = 2.1, SRR females = 2.5).

Figure 7: Health loss from traumatic brain injury, by age group and sex, 2006



Internal and crush injury

Internal and crush injury accounted for 15.6% of injury-related health loss (Table 14), with internal injury resulting in the loss of 11,500 years of healthy life.

Table 14: Health loss from internal and crush injury, 2006

Nature of injury	DALYs	Percentage of all injury DALYs
Internal injury	11,572	15.2
Crush injury	296	0.4
Total	11,868	15.6

Two-thirds of the health loss from internal and crush injury was due to transport injury, with self-inflicted injury and falls accounting for 12% and 7.5%, respectively (Table 15).

Table 15: External cause of health loss from internal and crush injury, 2006

External cause of injury	Percentage of health loss due to external cause
Transport injury	66.7
Falls	6.7
Fire and other thermal causes	0.0
Drowning	0.3
Poisoning	0.0
Animal-related injury	0.7
Mechanical force	4.2
Self-inflicted injury	12.2
Interpersonal violence	7.5
Other unintentional injury	1.8
Total	100.0

Toxic effects

Toxic effects resulted in the loss of 10,197 years of healthy life, accounting for 13% of injury related health loss (16% in females and 12% in males, Table 10). A quarter of the health loss from toxic effects was as a result of accidental poisoning, with two thirds due to self-inflicted injury (67%, Table 16).

Table 16: External cause of health loss from toxic effects injury, 2006

External cause of injury	Percentage of health loss due to external cause
Transport injury	1.4
Falls	0.1
Fire and other thermal causes	3.6
Drowning	0.2
Poisoning	26.2
Animal-related injury	0.3
Mechanical force	0.0
Self-inflicted injury	67.3
Interpersonal violence	0.5
Other unintentional injury	0.5
Total	100.0

Drowning and immersion injury

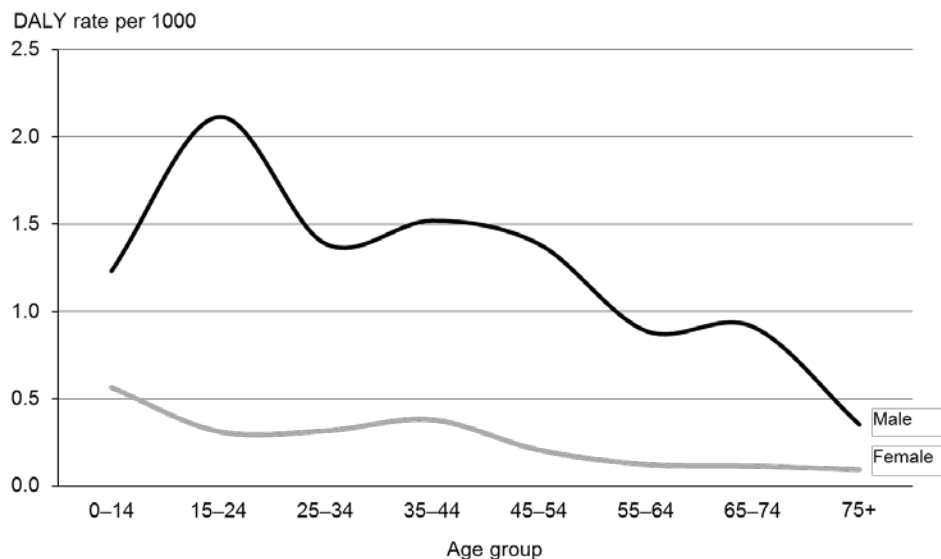
Drowning and immersion injury accounted for 4435 years of healthy life lost, or 6% of the total injury burden (Table 10). Transport injury (eg, a car crashing into a lake) and self-inflicted injury (eg, suicide through drowning) accounted for 13% and 11% of health loss through drowning and immersion injury, respectively (Table 17). Drowning, with no other external cause, accounted for 72% of health loss from immersion injury. These are largely drownings resulting from recreational activity (eg, swimming, fishing, river crossings, etc.).

Table 17: External cause of health loss from immersion injury, 2006

External cause of injury	Percentage of health loss due to external cause
Transport injury	12.5
Falls	0.2
Fire and other thermal causes	0.0
Drowning	72.3
Poisoning	0.1
Animal-related injury	0.0
Mechanical force	0.3
Self-inflicted injury	11.0
Interpersonal violence	1.9
Other unintentional injury	1.7
Total	100.0

Males were three times more likely to suffer health loss through drowning and immersion injury, with Māori males experiencing double the rate of non-Māori males (SRR = 2.1). Health loss from drowning and immersion injury was greatest in the younger age groups, decreasing with age (Figure 8). There was a peak in young males aged 15–24 years, which may in part be associated with self-inflicted drowning.

Figure 8: Health loss from drowning and immersion injury, by age group and sex, 2006



Fracture and dislocation

Fractures and dislocations were responsible for the loss of 3688 years of healthy life and accounted for 5% of the total injury DALY burden (7.6% in females and 3.8% in males, Table 18). Two-thirds of the health loss from fractures and dislocations was due to femoral (hip) fracture.

Table 18: Health loss from fracture and dislocation injury, 2006

Nature of injury	DALYs	Percentage of all injury DALYs
Femoral fracture	2,386	3.13
Maxillofacial fracture	879	1.15
Radius or ulna fracture	85	0.11
Rib or sternum fracture	74	0.10
Skull fracture	51	0.07
Pelvic fracture	48	0.06
Ankle fracture	34	0.04
Patella, tibia or fibula fracture	28	0.04
Clavicle, scapular or humerus fracture	27	0.04
Spinal fracture	24	0.03
Hand bone fracture	22	0.03
Foot bone fracture	17	0.02
Shoulder, elbow or hip dislocation	9	0.01
Other dislocation	5	0.01
Total	3,688	4.84

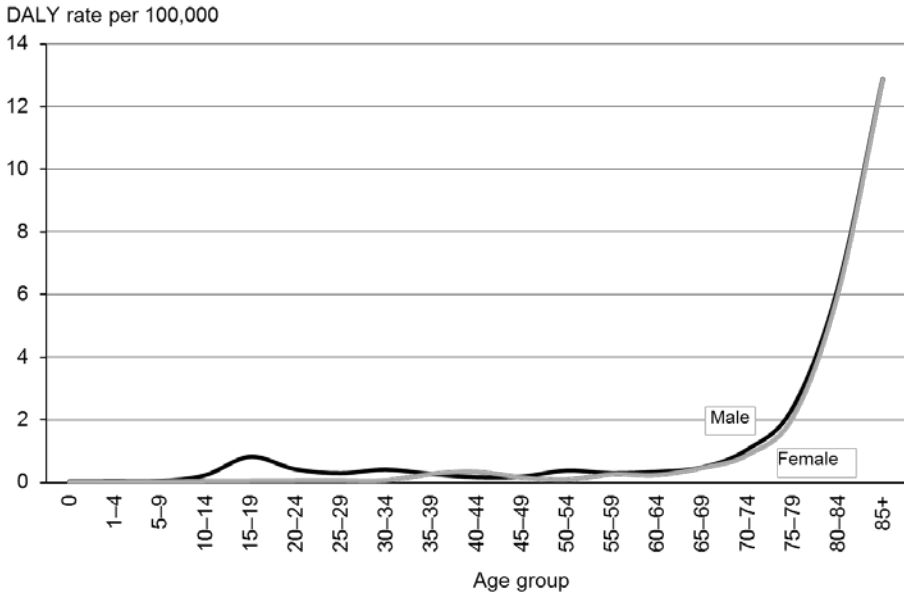
Falls accounted for the majority of health loss from fracture and dislocation (64%), with transportation injury and interpersonal violence responsible for 14% and 9%, respectively (Table 19). For femoral fracture, 77% of health loss was due to falls, with transport injury accounting for 13%.

Table 19: External cause of health loss from fracture and dislocation, 2006

External cause of injury	Percentage of health loss due to external cause	
	Fracture and dislocation	Femoral fracture
Transport injury	13.6	13.2
Falls	63.7	76.9
Fire and thermal causes	0.0	0.0
Drowning	0.2	0.3
Poisoning	0.2	0.2
Animal-related injury	1.0	0.3
Mechanical force	4.8	1.2
Self-inflicted injury	4.0	6.0
Interpersonal violence	9.0	0.2
Other unintentional injury	3.6	1.6
Total	100.0	100.0

The majority of health loss from femoral fracture was experienced by those aged 75+, largely as a result of falls (Figure 9). There was a small increase in health loss from femoral fracture in young males aged 15–19, predominantly due to transport injuries.

Figure 9: Health loss from femoral fracture, by age group and sex, 2006



Soft tissue injury and open wounds

Soft tissue injuries and open wounds resulted in the loss of 1663 DALYs, or 2% of total injury-related health loss. The majority of this health loss was from open wounds (Table 20).

Table 20: Health loss from open wounds and soft tissue injury, 2006

Nature of injury	DALYs	Percentage of all injury DALYs
Open wound	1,431	1.9
Ankle soft tissue injury	57	0.1
Shoulder soft tissue injury	53	0.1
Knee soft tissue injury	36	0.0
Other soft tissue injury	85	0.1
Total	1,663	2.2

Interpersonal violence and self-inflicted injury were the leading causes of health loss from soft tissue injury and open wounds, accounting for 38% and 24% of health loss, respectively (Table 21).

Table 21: External cause of health loss from soft tissue injury and open wounds, 2006

External cause of injury	Percentage of health loss due to external cause
Transport injury	11.5
Falls	11.7
Fire and other thermal causes	0.0
Drowning	0.0
Poisoning	0.0
Animal-related injury	0.8
Mechanical force	12.8
Self-inflicted injury	23.6
Interpersonal violence	37.7
Other unintentional injury	1.9
Total	100.0

Burns

Burn injuries (including smoke inhalation and chemical burns) were responsible for the loss of 1625 years of healthy life, or 2% of injury DALYs (Table 10). Exposure to fire and thermal causes accounted for the majority of health loss from burn injuries (61%), with self-inflicted injury and transport injury responsible for a further 12% and 10%, respectively (Table 22).

Table 22: External cause of health loss from burn injury, 2006

External cause of injury	Percentage of health loss due to external cause
Transport injury	10.4
Falls	1.0
Fire and thermal causes	61.3
Drowning	0.0
Poisoning	3.9
Animal-related injury	0.0
Mechanical force	5.8
Self-inflicted injury	12.0
Interpersonal violence	3.8
Other unintentional injury	1.9
Total	100.0

The impact of injury on Māori

Māori experience twice the rate of injury-related health loss compared to non-Māori

Interpreting the data

Relative inequalities

In this section, the standardised rate ratio (SSR) is the rate of injury-related health loss (either YLL, YLD or DALYs) in Māori divided by the rate in non-Māori, having adjusted for the different population structures of these two groups. For example:

- where the SSR = 1, the rates of injury-related health loss are equal in both populations
- where the SSR = 1.5, the rate of injury-related health loss is 50% greater in Māori
- where the SSR = 0.5, the rate of injury-related health loss is 50% lower in Māori.

Absolute inequalities

The standardised rate difference (SRD) is the age-standardised DALY rate in Māori minus the age-standardised DALY rate in non-Māori. The SRD gives us an indication of the additional health loss experienced by Māori, over and above the rate of health loss in the non-Māori population.

Nearly 20,000 years of healthy life were lost in Māori as a result of injury (12% of health loss from all causes). Māori males experienced the majority of this health loss, with 13,800 DALYs lost compared to 5800 DALYs lost in females.

The rate of injury-related health loss in Māori was double that of non-Māori (standardised rate ratio = 2.0). This level of inequality is similar in both males and females (Table 23).

The standardised rate difference (SRD) gives us an idea of the absolute level of inequality (see box above). Māori experienced an additional 16 DALYs lost per 1000 population over and above the rate of health loss in non-Māori. The absolute level of inequality is greatest in Māori males, who experienced an additional 23 DALYs lost per 1000 population compared to non-Māori males (Table 23).

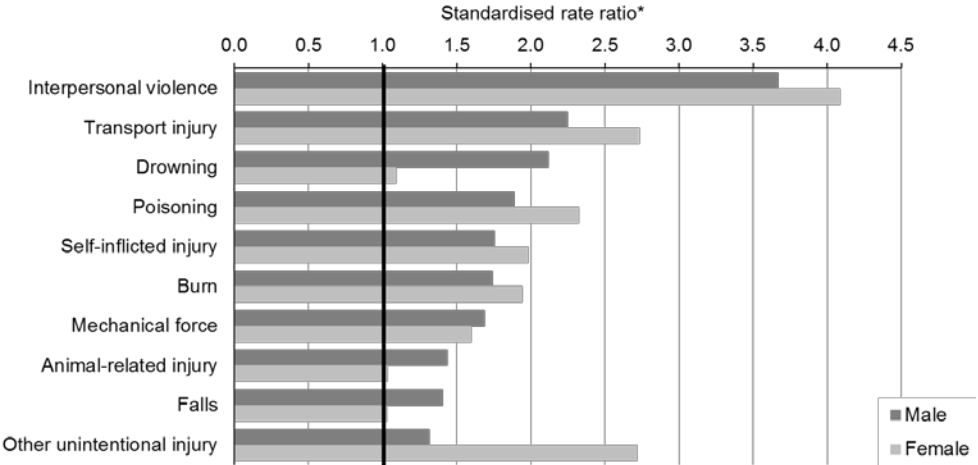
Table 23: Injury-related health loss, by sex and ethnicity, 2006

	DALYs	Age-standardised DALY rate per 1000	Standardised rate ratio	Standardised rate difference per 1000
Māori male	13,788	46.7	2.0	22.9
Non-Māori male	41,265	23.8		
Māori female	5,757	17.8	2.2	9.8
Non-Māori female	15,459	8.0		

Figure 10 shows the relative level of inequality for each external cause of injury experienced by Māori males and females. Differences in the burden of injury in Māori compared to non-Māori were most evident for interpersonal violence and transport injuries. Māori males were also at a greater risk of health loss through drowning compared to non-Māori males (SRR = 2.1), with Māori females at increased risk of poisoning-related health loss (SRR = 2.3).

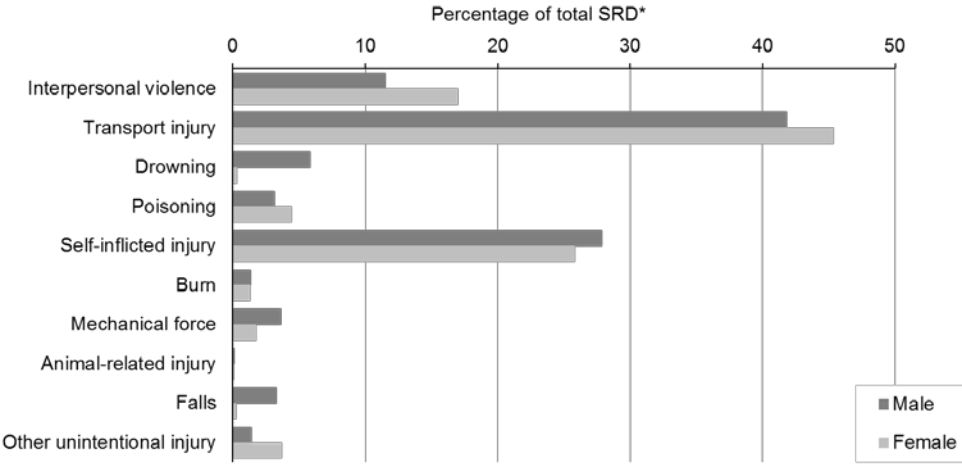
Figure 11 highlights the absolute contribution of external causes of injury to the difference between injury DALY rates in Māori and non-Māori (the SRD). Transport injuries were the leading cause of the observed inequality, responsible for over 40% of the excess injury-related health loss experienced by Māori. Self-inflicted injury was responsible for a quarter of the observed inequality, with interpersonal violence accounting for around 15% of the difference.

Figure 10: Relative inequalities in injury-related health loss in Maori, by external cause of injury, 2006



* An SRR of 1 indicates that Māori experience the same level of injury-related health loss as non-Māori; an SRR of 2 indicates that Māori experience twice the level of injury-related health loss as non-Māori.

Figure 11: Absolute inequalities in injury-related health loss in Maori, by external cause of injury, 2006



* The level of contribution of each external cause of injury to the observed difference in injury-related health loss between Māori and non-Māori.

Health loss from interpersonal violence is four times higher in Māori

Interpersonal violence accounted for a much greater proportion of injury-related health loss in Māori compared to non-Māori. In Māori females, 13% of injury-related health loss was due to interpersonal violence, compared to 6% in non-Māori females (Table 24). Māori experienced four times the health loss from interpersonal violence compared to non-Māori, adjusting for age (female SRR = 4.1, male SRR = 3.7).

Table 24: Health loss from interpersonal violence, by sex and ethnicity, 2006

	DALYs	Percentage of injury DALYs	Age-standardised rate (ASR) per 1000	Standardised rate ratio (SRR)
Māori male	1,084	7.8	3.6	3.7
Non-Māori male	1,709	4.1	1.0	
Māori female	745	12.9	2.2	4.1
Non-Māori female	864	5.6	0.5	

Māori are more than twice as likely to suffer health loss as a result of transport injury

Transport injury was the leading cause of injury-related health loss in Māori, accounting for 38% of the injury burden in Māori males and 41% in Māori females. Māori experienced more than twice the injury-related health loss from transport injury compared to non-Māori (Table 25).

Table 25: Health loss from transport injury, by sex and ethnicity, 2006

	DALYs	Percentage of injury DALYs	Age-standardised rate (ASR) per 1000	Standardised rate ratio (SRR)
Māori male	5,282	38.2	17.3	2.2
Non-Māori male	12,851	31.1	7.7	
Māori female	2,348	40.8	7.0	2.7
Non-Māori female	4,502	29.1	2.6	

Self-inflicted injury is the second leading cause of injury-related health loss in Māori

Self-inflicted injury accounted for 31.5% of the injury-related health loss in Māori males and 28% in Māori females. Māori experienced almost twice the health loss from self-inflicted injury compared to non-Māori (Table 26). The burden of self-inflicted injury was greatest in those aged 20–24 years, with a second peak in Māori males aged 30–34 years (Figure 12).

Table 26: Age-standardised rate of self-inflicted injury, by sex and ethnicity, 2006

	DALYs	Percentage of injury DALYs	Age-standardised rate (ASR) per 1000	Standardised rate ratio (SRR)
Māori male	4,350	31.4	14.9	1.8
Non-Māori male	14,568	35.3	8.5	
Māori female	1,628	28.3	5.1	2.0
Non-Māori female	4,806	31.1	2.6	

Figure 12: Health loss from self-inflicted injury, by age and ethnicity, 2006

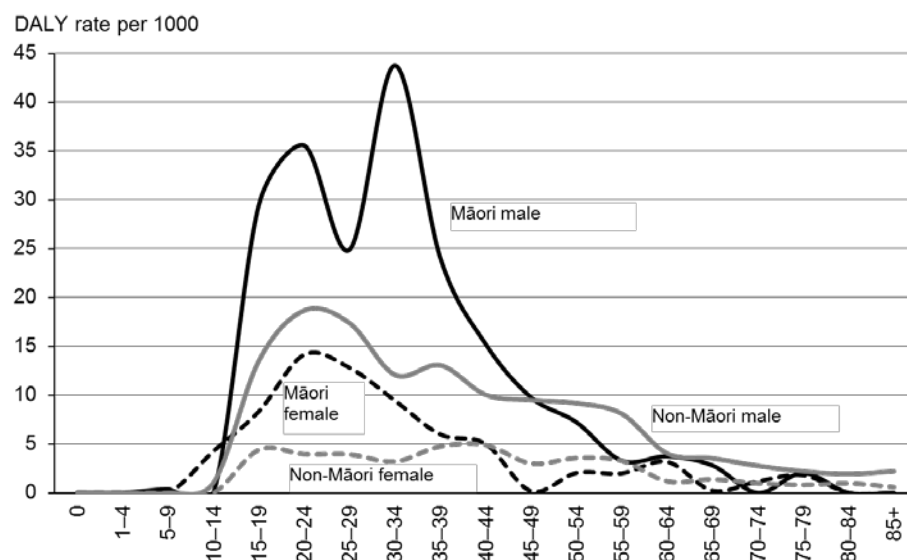


Table 27 compared the age-standardised rate of injury in Māori and non-Māori by nature-of-injury category. For virtually all injury categories the rates of injury were higher in Māori. This difference was most evident for soft tissue injury and open wounds where the SRR for females was 6.4 and 2.8 for males. Māori also experienced higher rates of internal and crush injuries and injuries to the central nervous system.

Table 27: Age-standardised rates of injury, per 1000, by nature of injury, sex and ethnicity, 2006*

Nature of injury	Māori male ASR	Non-Māori male ASR	SRR: males	Māori female ASR	Non-Māori female ASR	SRR: females
Central nervous system injury (CNS)	15.8	7.6	2.1	6.0	2.6	2.4
Internal and crush injury	8.4	3.7	2.3	2.9	1.1	2.6
Toxic effects	4.0	3.2	1.2	2.1	1.4	1.5
Drowning and immersion	2.8	1.5	1.9	0.9	0.5	1.7
Fracture and dislocation	1.0	0.9	1.1	0.6	0.5	1.2
Soft tissue injury and open wound	1.2	0.4	2.8	0.7	0.1	6.4
Burn	1.0	0.5	1.9	0.3	0.2	1.6
Amputation	0.2	0.2	0.9	0.1	0.1	1.3
Other injury	12.4	5.7	2.2	4.4	1.6	2.8

* Caution should be taken when interpreting these figures due to small numbers.

Risk factors for injury

The NZBD includes several risk factors that have well-established causal relationships with injury. They include alcohol, illicit drug use, osteoporosis and mental illness. The NZBD has estimated the risk of injury associated with each of these behaviours or conditions. This information, together with information on the prevalence of each behaviour or condition, has been used to quantify the level of injury-related health loss attributable to each risk factor.

Please note that the risk factors included in this section are not an exhaustive list of the risk factors for injury. Also, the proportion of injury attributable to each risk factor cannot be summed across risk factors because people may be exposed to multiple risk factors. Further methodological information on the calculation of the attributable burden of risk factors for injury is provided in the New Zealand Burden of Disease methodology report.

Alcohol

Estimates of alcohol-attributable injury were obtained from the New Zealand Burden of Alcohol Project.⁵ This includes injuries attributable to 'passive drinking' (eg, assault to an individual by an intoxicated perpetrator).

It was estimated that in 2006 alcohol was responsible for 24% of all injury-related health loss (27% male and 17% female). Alcohol-attributable injury was higher in Māori, accounting for over a third of injury-related health loss in Māori males and 24% in Māori females.

Table 28: Injury-related health loss attributable to alcohol, by sex and ethnicity, 2006*

	Injury-related health loss attributable to alcohol (DALYs)	Percentage of all injury DALYs attributable to alcohol
Māori male	4,685	35.5
Non-Māori male	9,420	24.2
Māori female	1,339	23.9
Non-Māori female	2,141	14.4
Total	17,585	24.2

* Includes intentional and unintentional injury.

Note that these estimates are largely based on data from the early 2000s and current values may be different. Nevertheless, alcohol is clearly an important risk factor for injury across all ages, particularly between the ages of 15 and 44 years (Figure 13). Alcohol accounted for more than a third of the health loss from transport injury in males and over a third of health loss from assaults in both males and females (Figure 14).

⁵ Connor J, Kydd R, Shield K, et al. In press. *Alcohol-attributable burden of disease and injury in New Zealand: 2004 and 2007*. Health Promotion Agency.

Figure 13: Injury-related health loss attributable to alcohol, by age group and sex, 2006

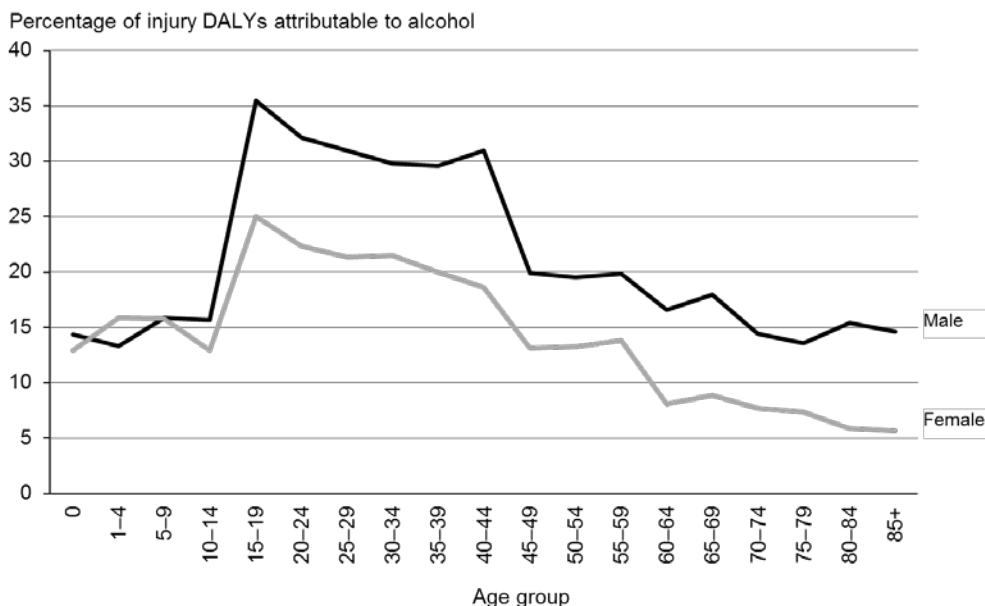
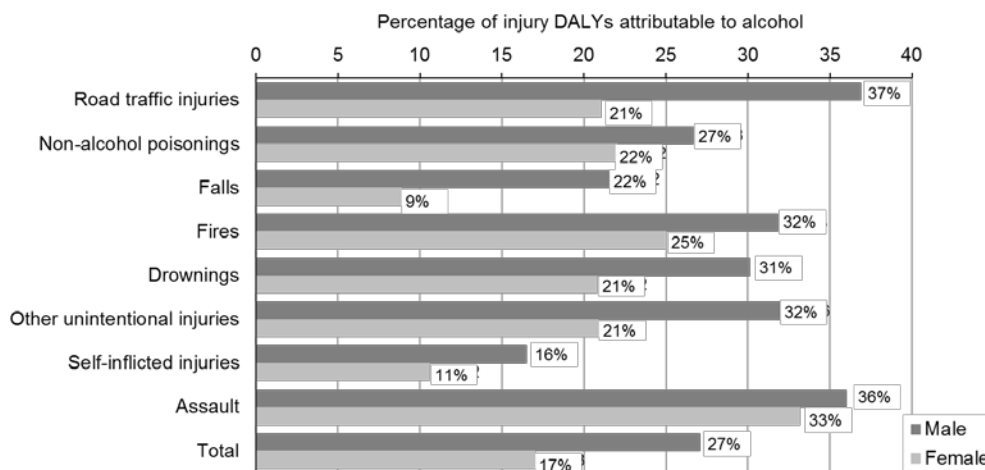


Figure 14: Injury-related health loss attributable to alcohol, by external cause of injury and sex, 2006



Illicit drug use

It is estimated that illicit drug use (which includes the use of multiple drugs concurrently) accounted for 6% of injury-related health loss. This has been calculated by estimating the proportion of self-inflicted injury, poisoning and transport injury that are linked to illicit drug use, based on the published New Zealand literature.

Illicit drug use accounted for a greater proportion of injury-related health loss in males (7%) compared to females (3.9%). The majority of injury-related health loss associated with illicit drug use was due to fatal overdose.

Table 29: Injury-related health loss attributable to illicit drug use, by external cause of injury and sex, 2006*

		Injury-related health loss attributable to illicit drug use (DALYs)	Percentage of injury DALYs attributable to illicit drug use
Self-inflicted injury (fatal)	Male	2,441	13.1
	Female	383	6.3
Poisoning (fatal overdose)	Male	949	52.8
	Female	376	41.2
Transport injury (all injury)	Male	249	1.3
	Female	39	0.5
Total	Male	3,639	7.0
	Female	798	3.9

* Includes intentional and unintentional injury.

Osteoporosis

Osteoporosis, a bone disease resulting from age-related loss of bone mineral density, is a key risk factor for fracture in older people (namely femur, rib, forearm and spinal fracture).

Osteoporosis contributed to 82% of fracture-related health loss in older females and 64% in older males. Osteoporosis was estimated to account for 10% of all injury-related health loss in the over 50s (17.5% in females, 6.1% in males).

Table 30: Injury-related health loss attributable to osteoporosis in those aged 50+, 2006

	Injury-related health loss attributable to osteoporosis (DALYs)	Percentage of fracture DALYs attributable to osteoporosis (50+ age group)	Percentage of all injury DALYs attributable to osteoporosis (50+ age group)
Male	683	64	6.1
Female	1029	82	17.5
Total	1,711	74	10

Mental illness

Injury-related health loss attributable to mental illness was estimated by assessing the impact of depression, bipolar disorders and schizophrenia on self-inflicted injury. Three-quarters of self-inflicted injury was estimated to be associated with mental illness (88% in females and 70% in males). It is estimated that a quarter of all injury related health loss was associated with mental illness (26.4%). The majority of injury related health loss in those with mental illness was due to self-harm and suicide in individuals with depression, accounting for 20% of all injury-related health loss in females and 17% in males.

It is likely that this is an underestimate of the injury burden attributable to mental illness as there is good evidence that mental illness is also a risk factor for unintentional injury. However, we were unable to quantify this relationship.

Table 31: Injury-related health loss attributable to mental illness, by injury category and sex, 2006*

		Injury-related health loss attributable to mental illness (DALYs)	Percentage of self-inflicted injury DALYs attributable to mental illness	Percentage of all injury DALYs attributable to mental illness
Depression	Male	8,703	46.0	16.7
	Female	4,043	62.8	19.8
Bipolar disorder	Male	1,216	6.4	2.3
	Female	1,141	17.7	5.6
Schizophrenia	Male	3,255	17.2	6.2
	Female	461	7.2	2.3
All mental illness	Male	13,174	69.6	25.3
	Female	5,645	87.7	27.6

* Includes intentional and unintentional injury.

International comparison

The Global Burden of Disease Study (GBD) 2010⁶ published its key findings in the *Lancet* in December 2012. The GBD 2010 is a useful tool that enables us to benchmark New Zealand internationally. However, currently comparisons between the NZBD and GBD 2010 are limited by differences in frameworks, classifications, definitions, standards, modelling methods and assumptions, time periods and data sources. In particular, the GBD did not use New Zealand-specific data other than mortality and some risk factor exposure data, but instead largely modelled the New Zealand burden of disease on Australian data. Further information on the comparability of the NZBD and the GBD is provided in *Health Loss in New Zealand – A report from the New Zealand Burden of diseases, Injuries and Risk Factors Study, 2006–2016*.⁷

Table 32: International comparison of injury-related health loss (DALYs), NZBD 2006 and GBD 2010

External cause of injury	NZBD 2006, DALY rate per 100,000	Global Burden of Disease Study 2010, DALY rate per 100,000			
		Australasia	High-income Asia-Pacific	High-income North America	Western Europe
Animal-related injury	7	5	4	5	5
Interpersonal violence	105	81	54	323	71
Drowning	82	65	99	71	43
Falls	180	681	622	414	917
Fire and thermal causes	30	38	51	65	41
Mechanical force	87	53	50	58	47
Transport injury	597	736	546	781	670
Poisoning	65	50	19	150	28
Self-inflicted injury	606	435	804	481	434
Other unintentional injury	64	133	176	128	154
Total	1,823	2,276	2,424	2,475	2,408

Table 32 provides details on the global burden of injury in high-income world regions, taken from GBD 2010.⁸ The corresponding data from the NZBD is also provided, showing broadly similar patterns to the Australasia GBD 2010 figures.

The only major exception is for falls, where the NZBD DALY rate has been estimated to be much lower than the GBD 2010 figures. We have reviewed the NZBD data by running a number of sensitivity analyses and sense checks on our estimates. These have identified that the discrepancy only relates to the YLD estimates, for which the NZBD has good information through ACC claims data. We will continue to review the discrepancy with the falls data both internally and with the GBD 2010 team.

⁶ *The Lancet*. Global Burden of Disease Study 2010. Vol 380 No. 9859 15 December 2012.

⁷ Ministry of Health. 2013. *Health Loss in New Zealand: A report from the New Zealand Burden of Diseases, Injuries and Risk Factors Study, 2006–2016*. Wellington: Ministry of Health.

⁸ Institute of Health Metrics and Evaluation. 2013. *GBD Compare*. <http://viz.healthmetricsandevaluation.org/gbd-compare/> (accessed 10 June 2013).

The GBD 2010 data highlight that the total DALY rate from injury is lower in Australasia than in the other high-income world regions. However, Australasia has the second-highest rate of health loss from road transport injury, behind North America. Rates of interpersonal violence are also higher than in Western Europe and Asia–Pacific, although much lower than in North America.

Conclusions

Injuries were responsible for the loss of an estimated 76,000 years of healthy life in New Zealand in 2006 (8% of total health loss from all causes). Much of this health loss could have been prevented. Injury disproportionately affects children and young people, with a large proportion of injury-related health loss resulting from premature death. Although we can estimate the direct health loss of injury at an individual patient level, we cannot quantify the indirect burden of injury on the families and communities of those who die or are seriously injured.

The data have highlighted the contribution of both transport injury and self-inflicted injury to the total level of injury-related health loss in New Zealand. They account for over two-thirds of the injury burden, and significant health gain could be made by targeting these two causes of injury. In older people falls are the predominant cause of injury-related health loss. This report has shown that falls are responsible for three-quarters of the health loss caused by femoral fracture. The association between falls in older people and a subsequent decline in health is well documented. Our report reiterates the importance of effectively preventing and managing falls-related injury in this vulnerable group.

The report also highlights the importance of traumatic brain injury, accounting for 28% of injury-related health loss. Improved prevention, treatment and rehabilitation for traumatic brain injuries could greatly reduce the impact of injury as a whole on the health of New Zealanders.

Māori experience twice the rate of injury-related health loss compared to non-Māori. In addition to transport injury and self-inflicted injury, interpersonal violence is a substantive cause of injury-related health loss in the Māori population. Māori also experience significantly higher rates of health loss caused by injury to the central nervous system. These injury characteristics of the Māori population need to be considered when developing injury prevention and management strategies.

Finally, the report highlights the significant role alcohol plays in increasing our risk of injury. Alcohol-attributable injuries accounted for around a quarter of injury-related health loss. Mental illness accounted for almost three-quarters of health loss from self-inflicted injury. To reduce the burden of injury on the New Zealand population, these major risk factors need to be effectively addressed.

The data presented in this joint report from the Ministry of Health and the Accident Compensation Corporation will support an increased understanding of the health impact of injury in New Zealand. We hope the report will be of interest to a wide range of professionals working to reduce the incidence and impact of injury.

Glossary

Age standardisation: The statistical adjustment of rates, allowing groups with differing age structures to be fairly compared.

Attributable burden: The proportion of the total burden of a condition caused by exposure to a risk factor.

Burden (of disease or injury): Health loss, measured in DALYs.

Comorbidity: The co-occurrence of two or more conditions in the same individual.

Condition: A disease or injury.

Condition group: A cluster of related diseases or injuries.

Disability: In NZBD, any non-fatal health loss, including symptoms, dysphoric affective states, impairments and functional limitations.

Disability-adjusted life year (DALY): The sum of fatal and non-fatal health losses; see *Years lived with disability* and *Years of life lost*.

Disability weight: See *Health state valuation*.

DisMod II: A public domain software program that allows the descriptive epidemiology of a condition to be estimated.

Fatal burden: Health loss due to premature mortality, measured in YLL.

Health expectancy: The generalisation of life expectancy to include time lived in different health states; if health states are measured using YLD, then the term 'health-adjusted life expectancy' may be used synonymously with health expectancy.

Health loss: Burden, measured in DALYs.

Health state: Sequela or severity level of a condition.

Health state valuation (disability weight): An estimate of the severity of a health state, measured on a 0–1 scale, where 0 represents no health loss and 1 represents complete health loss equivalent to being dead.

Incidence: Occurrence of an event (eg, new cases of a disease or injury occurring in a specified time interval).

Life expectancy: A statistic derived from a life table, indicating how long individuals with certain characteristics (eg, age and sex) are expected to survive on average.

Life table: An actuarial model summarising the survival of a real or synthetic population.

Non-fatal burden: Health loss from disability, measured in YLD.

Population-attributable fraction: The proportion of the total burden of a condition estimated to be causally related to exposure of a population to a risk factor.

Prevalence: The number of persons in a particular health state or with a particular condition at a point in time.

Risk factor: Any entity that increases the probability of the incidence of a condition.

Sequela: Complication of a condition; stage or phase of a condition; level of severity of a condition; health state.

Standard classification: Classification of conditions and condition groups used in the NZBD. Based on the ICD (WHO International Classification of Diseases).

Standardised rate difference (SRD): The difference between rates (eg, of two ethnic groups) standardised for age. Used as a measure of absolute inequality.

Standardised rate ratio (SRR): The ratio of two rates (eg, of two ethnic groups) standardised for age. Used as a measure of relative inequality.

Theoretical minimum risk exposure distribution: The prevalence of a risk factor that would confer minimal risk of the outcome on a population.

Uncertainty: The degree of confidence in an estimate. In NZBD uncertainty is generally measured as the standard error or the 95% confidence interval.

Years lived with disability (YLD): Non-fatal health loss, measured as year equivalents of full health lost because of time lived in states of health less than full health.

Years of life lost (YLL): Fatal health loss, measured by weighting each death according to the age at which it occurred; in NZBD the weights are derived from a standard life table (the GBD Standard Lifetable).

Abbreviations

CNS	central nervous system
DALY	disability-adjusted life year
GBD	Global Burden of Disease
ICD	International Classification of Diseases
LE	life expectancy
NZBD	New Zealand Burden of Diseases, Injuries and Risk Factors Study 2006–2016
SRD	standardised rate difference
SRR	standardised rate ratio
YLD	years lived with disability
YLL	years of life lost

Appendix 1: External cause codes (E-codes)

NZBD code	Description	ICD-10 AM codes	Notes
Q01	Transport injury	V01–V89, V91, V93–V99, Y85.0, Y85.9 including: Road traffic injury V01–V04, V06, V09 (pedestrian) V10–19 (bicyclist) V20–V29, V30–V39, V40–V49, V50–V59, V60–V69, V70–V79 (vehicle occupants) V05, V81 (railway accident) V80, V82, V83, V84, V85, V86, V91, V93, V94, V95–V98 (other transport injury)	Y85.0 and Y85.9 are the sequelae of transport accidents
Q02	Falls	W00–W19 including: W05 (wheelchair), W06 (bed), W07 (chair), W08 (furniture), W09 (playground), W10 (stairs and steps), W11 (ladder), W12 (scaffolding), W13 (building or structure), W14 (tree), W15 (cliff)	
Q03	Fires and thermal causes	X00–X19 including: X00 (uncontrolled fire in building), X02 (controlled fire in building), X04 (flammable material), X10 (hot drink, food, fats and cooking oil), X11 (hot tap-water), X15 (hot household appliances), X17 (engines, machinery and tools)	
Q04	Drowning	W65–W74, V90, V92 including: W67, W68 (swimming pool) W69, W70 (natural water)	V90 (accident to watercraft causing drowning and submersion), V92 (water-related drowning and submersion without accident to watercraft)
Q05	Poisoning	X40–X44, X46–X49 including: X42 (drugs), X46 (solvents), X47 (gas), X48 (pesticides), X49 (unspecified chemicals and noxious substances)	Alcohol-related poisoning (X45) is not included for YLD, as it will be included in a separate project on alcohol-related disorders
Q06	Animal-related injuries	W53–W59, X20–X27, X29	
Q07	Mechanical force	W20–W49 (inanimate mechanical force) including: W32–W34 (firearm) W25–W28, W45–W46 (sharp object) W24, W29–W31 (machinery)	
Q08	Other unintentional injuries	W50–W52, W60–W64, W75–W99, X28, X50, X52–X54	For YLL, W75 (accident suffocation and strangulation in bed) is only classed as an injury for those older than one year old. Those younger than one year are counted as SUDI. However, for YLD, all age ranges should be counted.

NZBD code	Description	ICD-10 AM codes	Notes
Q09	Self-inflicted injuries	X60–X84, Y87.0, Y10–Y34, Y87.2 The following codes of injuries with undetermined intent are included in self-inflicted injuries: Y30, Y21, Y20, Y26–27, Y22–24, Y28, Y17, Y18, Y10–Y16, Y19, Y25, Y29, Y31–33, Y34, Y87.2	
Q10	Interpersonal violence	X85–X99, Y00–Y09, Y35, Y36, Y87.1, Y89.0, Y89.1	Legal intervention and operations of war violence are included in interpersonal violence
	Dump codes for redistribution	U500–U739 (activity E-code), X51 (travel and motion), X58–59 (specified and unspecified other factors), Y86 (sequelae of other accidents), Y899 (sequelae of unspecified external causes), Y920–929 (place E-code), missing data	Treatment-related adverse events (Y40–Y84, Y88) are included in a separate project, rather than injury

Appendix 2: Nature of injury codes (N-codes)

NZBD code	Description	ICD-10 AM codes	Notes
P01	Skull fracture	S02.0, S02.1, S02.7, S02.9, T90.2	In the cases of head injury, traumatic brain injury rather than skull fracture is most pertinent to persisting functional deficit
P02	Maxillofacial fracture	S02.2, S02.3, S02.4, S02.5, S02.6, S02.8 Including: dental injuries (S02.5)	In the cases of head injury, traumatic brain injury rather than skull fracture is most pertinent to persisting functional deficit Supcode N01021 – for ACC dental injury (7 July 2011)
P03	Vertebral fracture	S12.0, S12.1, S12.2, S12.7, S22.0, S22.1, S32.0, S32.7, T91.1, T08 Including: T08 (fracture of spine, level unspecified); linkage to osteoporosis	Spinal fractures here are those without spinal cord injury
P04	Fracture of rib or sternum	S22.2, S22.3, S22.4, S22.5	N0104 excluding S22.8 (fracture of other parts of bony thorax) and S22.9 (fracture of bony thorax, part unspecified)
P05	Fracture of pelvis	S32.1, S32.2, S32.3, S32.4, S32.5, S32.8, T91.2	
P06	Fracture of clavicle, scapula or humerus	S42.0–S42.9	
P07	Fracture of radius or ulna	S52.0–S52.9, T10, T92.1	
P08	Fracture of hand bones	S62, S69.7, T92.2	
P09	Fracture of femur	S72, S79.7, T93.1 including: fracture of neck of femur: S72.0–S72.2 other fracture of femur S72.3–S72.9 T93.1 (sequelae of fracture of femur)	
P10	Fracture of patella, tibia or fibula	S82.0, S82.1, S82.2, S82.3, S82.4, S82.7, S82.9, T12, T93.2 Including: fracture of patella: S82.0 fracture of tibia: S82.1–S82.3, S82.5 fracture of fibula: S82.4, excluding S82.6 (to ankle fracture)	
P11	Fracture of ankle	S82.5, S82.6, S82.8	
P12	Fractures of foot bones	S92	
P30	Other fractures	S12.8, S12.9, T02.3, T02.7, T14.2	Moved to other injury (N1799); eight cases in 2006 (20 April)
P13	Shoulder, elbow or hip dislocation	S43.0, S43.1, S43.2, S43.3, S73.0, S53.0, S53.1	

NZBD code	Description	ICD-10 AM codes	Notes
P14	Other dislocation	S03.0, S03.1, S03.2, S03.3, S13.10–S13.18, S13.2, S13.3, S23.1, S23.2, S33.1, S33.2, S33.3, S63.0, S63.1, S63.2, S83.0, S83.1, S93.0, S93.1, S93.3, T03, T11.2, T13.2, T14.3, T92.3, T93.3, T09.2	Dislocation of knee (S83.0, S83.1) and dislocation of ankle (S93.0, S93.1) are grouped into this category (to be in line with the category in GBD study)
P15	Traumatic brain injury (TBI)	S06, T90.5 (sequelae of intracranial injury) including: 1 minor traumatic brain injury (short and long term): S06.00 S06.01 and S06.02 2 moderate and severe traumatic brain injury (short term); S06.03–S06.05, S06.20–S0628, S06.30–S06.38, S06.4–S06.9, T90.5	
P16	Spinal cord injury	S14.1, S14.7, S24.1, S24.7, S34.1, S34.7, T06.0, T06.1, T91.3, T09.3	The codes that don't indicate persisting damage to spinal cord and are unclear about persisting consequences are excluded: S14.4 (injury of peripheral nerves of neck), S24.3 (injury of peripheral nerves of thorax), S34.6 (injury of peripheral nerves of abdomen, lower back and pelvis), S14.0 (concussion and oedema of cervical spinal cord), S24.0 (concussion and oedema of thoracic spinal cord) and S34.0 (concussion and oedema of lumbar spinal cord)
P17	Peripheral nerve injury	S04, S44, S54, S64, S74, S84, S94, T06.2, T11.3, T13.3, T14.4, S14.2, S14.3, S14.4, S14.5, S14.6, S24.3–S24.6 S34.6, T90.3, T92.4, T93.4 S34.2–S34.5, S34.8, T09.4	
P18	Injury of heart, lung, major vessel, abdominal viscera, pelvic viscera	S25–S27, S35–S37, S39.6, T06.3, T06.5, T91.4, T91.5	Same as internal injury
P19	Shoulder and associated structures injury	S43.4, S43.5, S43.6, S46.0–S46.9, S43.7	
P20	Knee and associated structures injury	S83.2, S83.3, S83.4, S83.5, S83.6	
P21	Ankle and foot-associated structures injury	S86.0, S93.4, S93.2, S96.0–S96.9	
P22	Other soft tissue injury	S16, S034, S035, S13.4, S13.6, S23.3, S23.4, S23.5, S33.5–S33.7, S39.0, S53.2–S53.4, S56.0–S56.8, S63.3–S63.7, S66.0–S66.9, S73.1, S76.0–S76.7, S86.1–S86.9, S93.5, S93.6, T09.5, T11.5, T13.5, T14.5, T14.6	
P23	Eye injury	S05.0–S05.9, T90.4, T15.0–T15.9	
P24	All burn injuries	T20–T30	Chemical burns are expected to be coded in T32, which is not used in ICD 10 AM version
	<20% of TBSA	T31.0, T31.1	TBSA = total body surface area
	20–59% of TBSA	T31.2, T31.3, T31.4, T31.5	
	±60% TBSA	T31.6, T31.7, T31.8, T31.9, T27.0, T27.1	

NZBD code	Description	ICD-10 AM codes	Notes
P25	Poisoning	T52–T65, T97 T51 (toxic effect of alcohol, if also coded as intentional injury) T36–T50, T96 (if also coded as intentional injury)	
P26	Near drowning (immersion)	T75.1	
P31	Thumb amputation	S68.0	
P32	Finger amputation	S68.1, S68.2	
P33	Arm amputation	S48, S58, S68.3, S68.4, S68.8, S68.9, T05.0, T05.1, T05.2, T11.6	
P34	Leg amputation	S78, S88, T05.4, T05.5, T13.6	
P35	Foot amputation	S98.0, S98.3, S98.4, T05.3	
P36	Toe amputation	S98.1, S98.2	
P30	Other amputations	T05.9, S38.2, T05.8, (including amputation of ear, Readcode S822 in ACC claim data)	Other injury
P27	Open wound	S01, S08, S11, S15, S21, S31, S41, S45, S51, S55, S61, S65, S71, S75, S81, S85, S91, S95, T01, T11.1, T11.4, T13.1, T14.1, T90.1 S71.8	
P28	Crush injury	S07, S17, S28.0, S38.0, S38.1, S47, S57, S67, S77, S87, S97, T04, T14.7, T92.6, T93.6, S59.7	
P29	Superficial injury	S00.0–S00.9, S10.0–S10.9, S20.0–S20.8, S30.0–S30.9, S40.0–S40.9, S50.0–S50.9, S60.0–S60.9, S70.0–S70.9, S80.0–S80.9, S90.0–S90.9, T00.2–T00.9, T09.0, T11.0, T13.0, T14.0	
P30	Other injuries	The following codes are based on 2006 data: 1 Other head and neck injury (head S061, S090, S091, S092, S097, S098, S099; neck S130, S140, S198, S199) 2 Thorax abdominal and trunk injury (thorax S228, S229, S240, S290, S298, S299; lumbar disc S330; abdominal injury S397, S398, S399; trunk injury T098, T099) 3 Shoulder hip knee ankle wrist injury (shoulder S498, S499; hip and thigh injury S798, S799; knee injury S837; ankle and foot S998, S999; wrist and hand S698, S699) 4 Other limb injury (forearm S598, S599; lower leg S898, S899; other limb T119, T138, T139) 5 Other fractures (T023, T027, S128, S129, T142) 6 Foreign body (T16, T170, T171, T172, T173, T174, T175, T178, T179, T180, T181, T182, T183, T184, T185, T188, T189, T190, T191, T192) 7 Other physical factors (frostbite T347, T354; heat effects T670, T671, T673, T675, T676; radiation T66; cold effects T68, T691; pressure air and water T700, T701, T702, T703, T708; electricity current T753, T754, T758) 8 Other injury (asphyxiation T71; deprivation T732, T733, T738; abuse T740, T741, T742, T748; early complications T790, T792, T793, T794, T796, T797, T798; others T149, T890)	T780 to T784 – adverse effects of allergic reactions (n = 479 in 2006) excluded T789 (n = 1 in 2006, adverse effect, unspecified) is also excluded

Appendix 3: Long-term effects of injury

Diagnostic group	Description	Percentage of cases who experience long-term effects	Remission (annual proportion)*	Mortality (rate ratio)**	Notes
Skull fracture	Disfigurement, mental health issues	15%	0.01	1.1	
Maxillofacial fracture	Facial deformity, functional problems	15%	0.01	1.1	Note: double vision and other visual impairment and blindness are likely to be with maxillofacial fracture, but are not included as long-term sequelae at this stage.
Femoral fracture	Functional impairments, pain and depression	10%	0	1.5	
Traumatic brain injury	Cognitive/motor deficit, psychiatric disorder, possible life-long disability	23%	0.01	2.5	Based on severity (mild 80%, moderate 15%, severe 5%) of non-fatal hospitalised patients; and percentage of long-term sequelae (10% of mild, 67% of moderate and 100% of severe traumatic brain injury cases), and reports.
Spinal cord injury	Persisting functional impairment, acute and chronic pain, pulmonary complication and depression	100%	0.01	3	
Peripheral nerve injury	Neuropathic pain, hyperalgesia, functional and sensory impairment	20%	0.01	1.05	
Eye injury	Blindness, low vision	10%	0.01	1.25	
Burn injury		28%	0.05	1.2	
Burn injury < 20%	Pain, functional limitations, disfigurement/scalds, psychological disorders, tetanus	10%	0	1.01	
Burn injury 20–60%	As above	100%	0	1.1	
Burn injury > 60%	As above	100%	0	1.1	
Poisoning	Neuropsychological sequelae	5%	0.01	2	
Drowning and immersion injury	Neurological sequelae: hypoxic or anoxic brain injury, vegetative state, pulmonary damage and pneumonia, cardiovascular instability, renal failure, anxiety	15%	0.01	2	

Diagnostic group	Description	Percentage of cases who experience long-term effects	Remission (annual proportion)*	Mortality (rate ratio)**	Notes
Amputated thumb	40% function of the hand, pain, functional and sensory impairment	100%	0	1.05	
Amputated finger	Pain, functional and sensory impairment	100%	0	1.02	
Amputated arm	Phantom limb pain, functional and sensory impairment, post-traumatic stress disorder	100%	0	1.1	
Amputated leg (above knee)	Phantom limb pain, functional and sensory impairment, post-traumatic stress disorder	100%	0	1.2	
Amputated foot (below knee)	Phantom limb pain, functional and sensory impairment, post-traumatic stress disorder	100%	0	1.1	
Amputated toe	Pain, functional and sensory impairment	100%	0	1.05	

* Remission = Proportion of cases that enter remission every year.

** Mortality risk ratio = Increased risk of death associated with the long-term effects of injury, presented as a risk ratio.

Appendix 4: Disability weights for injury

Injury: short-term effects	Disability weight (DW)	Injury: long-term effects	Disability weight (DW)
P01 Skull fracture	0.073	P01 Skull fracture – disfigurement	0.072
P02 Maxillofacial fracture	0.173	P02 Maxillofacial – disfigurement	0.072
P03 Spinal fracture	0.132		
P04 Rib or sternum fracture	0.15		
P05 Pelvic fracture	0.39		
P06 Clavicle, scapular or humerus fracture	0.053		
P07 Radius or ulna fracture	0.065		
P08 Hand bone fracture	0.025		
P09 Femoral fracture	0.308	P09 Femoral – mobility	0.072
P10 Patella, tibia or fibula fracture	0.087		
P11 Ankle fracture	0.087		
P12 Foot bone fracture	0.033		
P13 Shoulder, elbow or hip dislocation	0.08		
P14 Other dislocation	0.08		
P15 TBI	0.235	P15 TBI – motor + cognitive + psychological	0.224
P16 SCI	n/a	P16 SCI – paralysis + pain + pneumonia	0.369
P17 Peripheral nerve injury	0.065	P17 nerve – pain + sensory + motor	0.136
P18 Internal and multiple injury	0.352		
P19 Shoulder soft tissue injury	0.08		
P20 Knee soft tissue injury	0.08		
P21 Ankle soft tissue injury	0.08		
P22 Other soft tissue injury	0.08		
P23 Eye injury	0.079	P23 Eye – vision loss	0.191
P24 Burn	< 20% = 0.096 > 20% = 0.333	P24 Burn – pain + mobility + disfigurement + psych	< 20% = 0.018 > 20% = 0.438 [Weighted mean 0.095]
P25 Poisoning	0.171	P25 Poisoning – motor + cognitive + psychological	0.221
P26 Drowning and immersion injury	0.288	P26 Drowning – motor + cognitive + psychological	0.221
P27 Open wound	0.009		
P28 Crush injury	0.145		
P29 Superficial injury	0.005		

Injury: short-term effects	Disability weight (DW)	Injury: long-term effects	Disability weight (DW)
P30 Other injury	0.129		
		P31 Amputated thumb	0.013
		P32 Amputated finger	0.03
		P33 Amputated arm	0.13
		P34 Amputated leg (AK)	0.164
		P35 Amputated foot (BK)	0.164
		P36 Amputated toe	0.008

Appendix 5: Uncertainty quantification

Overall, about 75% of the input data for the NZBD were considered robust. This includes all mortality (and hence YLL) data and about half the YLD data. YLD data are less robust because there is no one comprehensive and reliable source of data on the incidence, prevalence, severity and duration of all non-fatal health conditions.

The following table provides an estimate of the level of uncertainty that should be applied to the injury data. Low-level analyses, broken down by several factors (eg, sex, age, ethnic group) should be treated with particular caution due to the likely uncertainty in our estimates.

Level	Total population	Population subgroups
All cause	± 1%	± 2–4%
Condition group (eg, injury)	± 4%	± 6–14%
Major specific conditions (eg, traumatic brain injury)	± 7%	± 10–20%
Minor specific conditions (eg, pelvic fracture)	± 15%	± 20–40%