Disability weights based on patient-reported data from a multinational injury cohort
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Objective To create patient-based disability weights for individual injury diagnosis codes and nature-of-injury classifications, for use, as an alternative to panel-based weights, in studies on the burden of disease.

Methods Self-reported data based on the EQ-5D standardized measure of health status were collected from 29,770 participants in the Injury-VIBES injury cohort study, which covered Australia, the Netherlands, New Zealand, the United Kingdom of Great Britain and Northern Ireland and the United States of America. The data were combined to calculate new disability weights for each common injury classification and for each type of diagnosis covered by the 10th revision of the International statistical classification of diseases and related health problems. Weights were calculated separately for hospital admissions and presentations confined to emergency departments.

Findings There were 29,770 injury cases with at least one EQ-5D score. The mean age of the participants providing data was 51 years. Most participants were male and almost a third had road traffic injuries. The new disability weights were higher for admitted cases than for cases confined to emergency departments and higher than the corresponding weights used by the Global Burden of Disease 2013 study. Long-term disability was common in most categories of injuries.

Conclusion Injury is often a chronic disorder and burden of disease estimates should reflect this. Application of the new weights to burden studies would substantially increase estimates of disability-adjusted life-years and provide a more accurate reflection of the impact of injuries on peoples’ lives.

Abstracts in العربية, 中文, Français, Русский and Español at the end of each article.

Introduction
If resource allocation and policy for the reduction of the burden of health problems are to be effective, the burden posed by injuries needs to be carefully evaluated. The disability-adjusted life-year (DALY), as used in the Global Burden of Disease (GBD) 1990, 2010 and 2013 studies,1,2 is based on both premature mortality – i.e. years of life lost – and years lived with disability (YLD).3,4 The assignment of disability weights, to represent the decrease in health associated with specific diseases or injuries, is a fundamental step in the estimation of YLD.5,6 Different approaches to estimating disability weights5,6 can lead to substantially different estimates of DALYs and YLD.7,8

In panel-based studies of health burden, a lay description – a vignette – is used to represent the health impact of the condition of interest on a hypothetical affected individual. Health professionals or representatives of the general population then give the health status of that affected individual a score, or panel-based disability weight, that ranges between zero – representing no disability or perfect health – and one – representing disability equivalent to death.5,6 The limitations of such a panel-based approach include the uncertain generalizability of the resultant weights to different geographical and socioeconomic contexts, the difficulty of developing vignettes to represent complex and varied health impacts and the limited focus on the time-course of any disability.4,5

In an alternative to the panel-based approach, self-reported data collected directly from affected individuals, using multi-attribute utility instruments – such as the EQ-5D standardized measures of health status – can be used to derive case-based disability weights.9 An individual’s responses to a standardized set of questions can be used to determine that individual’s generic health state and then the health states of all respondents having a particular health problem can be used to assign a disability weight to that problem. It has been suggested that such case-based disability weights should be used to quantify injury burdens.7,8,9,10 Two studies based on injury cohorts led to case-based weights that were larger than corresponding panel-based estimates, but both studies were limited by small sample sizes.6,7 The GBD 2013 study incorporated case-based weights for some injury groups but was hampered by the limited availability of case-reported data.11 As an adjunct or alternative to the use of panel-based weights in burden of disease studies, we used pooled patient-reported data, from six longitudinal injury-outcome studies, to create case-based weights for individual injury diagnosis codes and established nature-of-injury classifications.

Methods
Setting
Our investigation was based on the Validating and Improving Injury Burden Estimates Study (Injury-VIBES) cohort, which consists of participants’ data from six longitudinal...
studies in five countries (Table 1). The main aim of the Injury-VIBES study is to improve the measurement of non-fatal injury burden through analysis of pooled, de-identified, patient-level data. Our investigation was approved by Monash University’s Human Research Ethics Committee.

Data sets

We investigated persons with injury aged at least 18 years who were included in two Australian registries – that is, the Victorian State Trauma Registry16,17 and the Victorian Orthopaedic Trauma Outcomes Registry15 – in the United Kingdom Burden of Injury Study in the United Kingdom of Great Britain and Northern Ireland,18 the Prospective Outcomes of Injury Study in New Zealand,14 the National Study on Costs and Outcomes of Trauma in the United States of America13 and the Dutch Injury Patient Survey in the Netherlands.12

Injury classifications

When possible, weights were initially calculated for each of the four-character principal diagnosis codes listed in the 10th revision of the *International statistical classification of diseases and related health problems* (ICD-10)19 and then mapped to each of the 47 injury groups used in the GBD 2013 study,1 and each of the 39 EUROCost classification groups20 and each of the European Injury Data Base groupings.21 The ICD-10 codes for the cases from the USA were derived from the ICD-9 codes used in the data set. The Dutch data set only categorized injuries into the European Injury Data Base groupings. Although we could recategorize the Dutch patients into the injury groups used in the GBD 2013 study, we could not use the data from these patients to estimate weights for individual ICD-10 diagnosis codes.

Disability weights

In general, the patients’ responses to the questions in the three-level EQ-5D questionnaire were used to estimate disability weights. The questionnaire is designed to record a respondent’s self-reported health status in terms of five topics: (i) anxiety/depression; (ii) mobility; (iii) pain/discomfort; (iv) self-care; and (v) usual activities. For each of these topics, a respondent is asked if they have no problems, some problems or extreme problems.22 The three-level EQ-5D questionnaire was used for the Australian cases from 2009 onwards and for all the injury cases included in the participating British, Dutch and New Zealand data sets. For all the other cases we considered, the recorded responses to the questions in the 12-item Short Form Health Survey23 had to be translated into EQ-5D responses.24 EQ-5D responses are used to calculate a preference score for each respondent. Such scores can range from −0.59 to 1.00. Negative values and values of zero and one indicate, respectively, respondents who have health states that are worse than death or equivalent to death and respondents who are in perfect health.1 Disability weights were calculated at three time points – that is at three, six and 12 months post-injury – by subtracting the EQ-5D preference scores for respondents with a particular health problem from the age- and sex-specific norms.23

The average EQ-5D differences at each time point were multiplied by a factor corresponding to the length of the period over which the disability weight applied and then these weighted disability averages were summed to provide an annualized or time-averaged disability weight. Thus, the calculated averages at three, six and 12 months were multiplied by 3/12, 3/12 and 6/12, respectively, with the resulting three weighted disability averages then summed together to produce a single disability weight. The nine-month outcomes from the Dutch data set were included in the 12-month estimates. Weights calculated at 12 months post-injury – hereafter called 12-month weights – were assumed to represent both the degree of residual disability at 12 months and the expected lifelong disability.22,24

We compared our new disability weights with the one-year Integration of European Injury Statistics weights25 and the long-term weights – for treated cases when weights for treated and untreated cases were given separately – of the GBD 2013 study.11 The former represent injured cases admitted to hospital while the latter represent cases who warrant “some form of health care in a system with full access to health care”.1,21 We calculated new disability weights separately for cases admitted to hospital and for other cases who only

Table 1. Six data sets used in the estimation of new disability weights for patients with injuries

| Study | Country | Inclusion criteria | Follow-up (months post-injury) | Study period | No. of participants |
|-------|---------|--------------------|-------------------------------|-------------|--------------------|
| DIPS12 | Netherlands | Injury cases who presented to an emergency department | 2.5, 5, 9 and 24 | October 2001 to December 2002 | 8 014 |
| NSCOT13 | United States of America | Cases with at least one injury with an AIS score of > 2 | 3 and 12 | July 2001 to November 2002 | 3 958 |
| POIS14 | New Zealand | Injury cases with ACC entitlement claim | 3, 12 and 24 | December 2007 to June 2009 | 2 856 |
| VOTOR15 | Australia | Injury cases with orthopaedic admission of > 24 hours | 6 and 12 | March 2007 to March 2011 | 15 459 |
| VSTR16,17 | Australia | Injury cases with ISS of > 15 and/or with admission to ICU for > 24 hours and/or requiring urgent surgery | 6, 12 and 24 | March 2007 to March 2011 | 8 213 |
| UKBOIS18 | United Kingdom | Injury cases who presented to emergency department or were admitted to hospital | 1, 4 and 12 | September 2005 to April 2007 | 1 219 |

ACC: Accident Compensation Corporation; AIS, Abbreviated injury scale; DIPS: Dutch Injury-Patient Survey; ICU: intensive care unit; ISS: injury severity score; NSCOT: National Study on Costs and Outcomes of Trauma; POIS: Prospective Outcomes of Injury Study; VOTOR: Victorian Orthopaedic Trauma Outcomes Registry; VSTR: Victorian State Trauma Registry; UKBOIS: United Kingdom Burden of Injury Study.
Table 2. Demographics of the patients from six injury cohorts who had an eligible EQ-5D summary score at three, six and/or 12 months post-injury

| Characteristic                  | DIPS  (n = 2 857) | NSCOT  (n = 3 785) | POIS  (n = 2 831) | VOTOR  (n = 13 005) | VSTR  (n = 6 845) | UKBOIS  (n = 447) | Total  (n = 29 770) |
|--------------------------------|------------------|-------------------|------------------|--------------------|------------------|------------------|-------------------|
| **Mean age in years (SD)**     |                 |                   |                  |                    |                  |                  |                   |
| Male                           | 50.5 (19.9)     | 46.6 (20.0)       | 41.1 (13.0)      | 55.7 (22.6)        | 48.0 (21.2)      | 55.0 (18.5)      | 50.9 (21.5)       |
| Admitted to hospital           | 1 383 (48.4)    | 2 488 (65.7)      | 1 732 (61.2)     | 6 615 (50.9)       | 5 070 (74.1)     | 195 (43.6)       | 17 483 (58.7)     |
| With transport-related injury  | 1 525 (53.4)    | 3 785 (100)       | 699 (24.7)       | 13 005 (100)       | 6 845 (100)      | 198 (44.6)       | 26 057 (87.5)     |
| With fall-related injury       | 789 (28.0)      | 1 716 (45.4)      | 326 (11.5)       | 3 284 (25.8)       | 3 319 (48.7)     | 58 (13.2)        | 9 492 (32.3)      |
| With other injury              | 0 (0.0)         | 1 292 (34.1)      | 695 (24.6)       | 7 623 (59.9)       | 2 108 (31.0)     | 0 (0.0)          | 11 718 (39.8)     |
| **Total**                      | 2 027 (72.0)    | 777 (20.5)        | 1 810 (63.9)     | 1 814 (14.3)       | 1 381 (20.3)     | 305 (86.8)       | 8 191 (27.9)      |

DIPS: Dutch Injury Patient Survey; NSCOT: National Study on Costs and Outcomes of Trauma; POIS: Prospective Outcomes of Injury Study; SD: standard deviation; VOTOR: Victorian Orthopaedic Trauma Outcomes Registry; VSTR: Victorian State Trauma Registry; UKBOIS: United Kingdom Burden of Injury Study.

Results

Across the six data sets and three different time points we investigated, there were 29 770 injury cases with at least one EQ-5D score – 9003, 20 929 and 24 894 responses were recorded at three, six and 12 months post-injury, respectively. The mean age of the respondents was 51 years, most of them were male and almost a third of them had had road traffic injuries. The proportion of the cases from each data set that had been admitted to hospital ranged from 25% to 100% (Table 2). To save space, we have not reported weights for European Injury Data Base groupings but these are available from the corresponding author.

Case-based disability weights

GBD 2013 injury categories

There were insufficient case numbers to calculate new disability weights for admitted cases in 14 of the 40 nature-of-injury categories used in the GBD 2013 study (Table 3). Annualized new weights for the admitted cases sustaining one of the 26 other categories were relatively high for spinal cord injury, femoral fracture, hip fracture, pelvic fracture and lower airway burns, and relatively low for radius/ulna fractures, wrist/hand fractures and superficial injuries. For 22 injury categories, the annualized and 12-month new weights were higher –1.1-fold to 22.2-fold higher – than the corresponding GBD 2013 weights (Table 3). However, the new weights for hospitalized cases of severe traumatic brain injury and spinal cord lesion at neck level were lower than the corresponding GBD 2013 weights (Table 3).

Long-term outcome data for injury cases not admitted to hospital were only available for 16 of the nature-of-injury categories used in the GBD 2013 study (Table 4). The new disability weights for such cases were much lower than the corresponding weights for the admitted cases and several were near zero – indicating that long-term disability is unlikely to occur (Table 4).

EUROCOST injury groups

Annualized new disability weights were calculated for admitted cases sustaining injuries in 31 EUROCOST groups (Table 5). These new weights were lower than the corresponding Integration of European Injury Statistics weights for all but three groups – facial fractures, open facial wounds and spinal cord injuries (Table 5) – and higher than the corresponding new weights for cases not admitted to hospital, several of which were close to – or less than – zero (Table 6).

ICD-10 diagnosis codes

Within the data sets we investigated, there were at least 30 cases admitted to hospital for each of 80 ICD-10 codes (Table 7; available at: http://www.who.int/bulletin/volumes/94/10/16-172155) and at least 30 cases who only presented in an emergency department for each of 16 ICD-10 codes (Table 8; available at: http://www.who.int/bulletin/volumes/94/10/16-172155). The new weights for most intracranial injuries were similar but those for skull fracture codes and concussion were relatively low. The new disability weights for individual ICD-10 codes indicated wide variation in fracture-related disability within body regions. For example, the new weight for lateral malleolus fractures was substantially lower than the new weights for other fractures in the knee or lower leg (Table 7; available at: http://www.who.int/bulletin/volumes/94/10/16-172155).

Discussion

We found differences between our new weights, which were based entirely on case-reported outcomes, and the corresponding GBD 2013 weights, which were based on a combination of panel-based and case-outcome studies. It could be argued that our new weights are not directly comparable with the GBD 2013 weights, due to distinctly different approaches to weight generation, although either set of weights could be used to derive population-based measures of injury burden. The GBD studies primarily relied on the responses of a public panel or panel of experts when faced with a standardized set of brief descriptors. Our new weights are entirely based on case-reported outcomes from cohort studies in high-income countries. The GBD studies, our study and other epidemiological studies designed to generate disability weights have generally not explicitly considered the extent to which factors such as socioeconomic status, access to high-quality care, environmental barriers or resilience, adaptation and the coping strategies of injured individuals can influence the lived experience of injury-related disability.

One argument for the preferential use of panel-based weights is the potential for individuals with chronic conditions to adapt and underestimate disease burden. In general, however, our new weights – like the case-based Integration of European Injury Statistics weights – were substantially higher.
Table 3. New disability weights for each of the injury categories used in the Global Burden of Disease 2013 study, as derived from the responses of patients, from six injury cohorts, who were admitted to hospital

| Injury category                      | \( n^a \) | Mean new weights (95% CI) | Mean GBD 2013 long-term weights (95% CI)c |
|--------------------------------------|----------|---------------------------|------------------------------------------|
|                                      | Annualized | At 12 months post-injury  |                                          |
| Fracture of patella, tibia, fibula or ankle | 3267      | 0.163 (0.154 to 0.171)    | 0.142 (0.132 to 0.152)                    |
| Fracture of hip                       | 2407      | 0.281 (0.268 to 0.294)    | 0.273 (0.259 to 0.287)                    |
| Fracture of radius or ulna            | 2316      | 0.081 (0.071 to 0.091)    | 0.070 (0.059 to 0.081)                    |
| Moderate traumatic brain injury       | 2310      | 0.197 (0.185 to 0.210)    | 0.186 (0.172 to 0.200)                    |
| Fracture of vertebral column          | 1550      | 0.184 (0.170 to 0.198)    | 0.168 (0.152 to 0.183)                    |
| Severe chest injury                   | 1382      | 0.180 (0.165 to 0.195)    | 0.162 (0.146 to 0.178)                    |
| Fracture of clavicle, scapula or humerus | 1289 | 0.153 (0.138 to 0.168)    | 0.142 (0.126 to 0.159)                    |
| Fracture of femur                     | 1078      | 0.263 (0.246 to 0.280)    | 0.243 (0.224 to 0.262)                    |
| Fracture of the sternum or ribs       | 1010      | 0.185 (0.166 to 0.203)    | 0.179 (0.158 to 0.199)                    |
| Fracture of pelvis                    | 906       | 0.205 (0.185 to 0.225)    | 0.194 (0.172 to 0.216)                    |
| Severe traumatic brain injury         | 715       | 0.194 (0.172 to 0.217)    | 0.184 (0.160 to 0.208)                    |
| Abdominal or pelvic organ injury      | 668       | 0.182 (0.162 to 0.203)    | 0.161 (0.138 to 0.183)                    |
| Muscle and tendon injuries            | 551       | 0.108 (0.088 to 0.127)    | 0.089 (0.067 to 0.274)                    |
| Fracture of foot bones except ankle   | 477       | 0.179 (0.156 to 0.202)    | 0.168 (0.143 to 0.193)                    |
| Open wounds                           | 258       | 0.133 (0.100 to 0.165)    | 0.110 (0.075 to 0.146)                    |
| Spinal cord lesion at neck level      | 238       | 0.333 (0.287 to 0.379)    | 0.316 (0.265 to 0.366)                    |
| Spinal cord lesion below neck level   | 179       | 0.373 (0.322 to 0.424)    | 0.356 (0.300 to 0.411)                    |
| Minor traumatic brain injury          | 170       | 0.100 (0.062 to 0.138)    | 0.068 (0.029 to 0.106)                    |
| Fracture of wrist and other distal part of hand | 153 | 0.085 (0.052 to 0.117)    | 0.070 (0.034 to 0.106)                    |
| Fracture of skull                     | 150       | 0.158 (0.117 to 0.199)    | 0.143 (0.097 to 0.187)                    |
| Fracture of face bone                 | 135       | 0.150 (0.104 to 0.196)    | 0.140 (0.087 to 0.194)                    |
| Superficial injury                    | 117       | 0.100 (0.053 to 0.148)    | 0.076 (0.024 to 0.128)                    |
| Dislocation of shoulder               | 109       | 0.136 (0.087 to 0.184)    | 0.110 (0.059 to 0.160)                    |
| Dislocation of hip                    | 55        | 0.188 (0.105 to 0.270)    | 0.171 (0.067 to 0.274)                    |
| Burn covering ≥ 20% TBSA              | 55        | 0.176 (0.100 to 0.251)    | 0.156 (0.077 to 0.234)                    |
| Burn covering < 20% TBSA or unspecified | 54 | 0.131 (0.048 to 0.214)    | 0.110 (0.021 to 0.198)                    |
| Lower airway burns                    | 34        | 0.222 (0.105 to 0.339)    | 0.243 (0.099 to 0.386)                    |
| Nerve injury                          | 31        | 0.215 (0.140 to 0.326)    | 0.191 (0.078 to 0.305)                    |
| Amputation of fingers, excluding thumb | 22     | STS                        | STS                                      |
| Eye injuries                          | 18        | STS                        | STS                                      |
| Amputation of one lower limb          | 13        | STS                        | STS                                      |
| Dislocation of knee                   | 12        | STS                        | STS                                      |
| Amputation of toes                    | 10        | STS                        | STS                                      |
| Crush injury                          | 10        | STS                        | STS                                      |
| Poisoning                             | 7         | STS                        | STS                                      |
| Amputation of one upper limb          | 6         | STS                        | STS                                      |
| Amputation of both upper limbs        | 4         | STS                        | STS                                      |
| Amputation of thumb                   | 1         | STS                        | STS                                      |
| Amputation of both lower limbs        | 0         | STS                        | STS                                      |
| Drowning or non-fatul submersion      | 0         | STS                        | STS                                      |

CI: confidence interval; GBD: Global Burden of Disease; NA: not available; STS: sample too small; TBSA: total body surface area.

*a As used in the Global Burden of Disease 2013 study.

*b Numbers of cases, from six injury cohorts, used in the estimation of the new weights.

*c As reported in the Global Burden of Disease 2013 study.

*d For untreated cases only.

*e Short-term weight shown because specific long-term weight unavailable.

*f For treated cases only.

than the largely panel-based GBD 2013 weights. This difference was especially marked for the more common categories of injury such as fractures and dislocations. In a previous study, estimates of injury burden based on data collected
New disability weights for injury burden studies

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Table 4. New disability weights for each of the injury categories used in the Global Burden of Disease 2013 study, as derived from the responses of patients, from six injury cohorts, who presented at emergency department but were not admitted to hospital

| Injury categorya | n\(^b\) | Mean new weights (95% CI) Annualized | Mean new weights (95% CI) At 12 months post-injury | Mean GBD 2013 long-term weights (95% CI)c |
|------------------|--------|--------------------------------------|-----------------------------------------------------|-------------------------------------------|
| Muscle and tendon injuries | 951 | 0.093 (0.081 to 0.104) | 0.071 (0.058 to 0.084) | 0.008 (0.003 to 0.015) |
| Superficial injury | 226 | 0.056 (0.031 to 0.081) | 0.035 (0.007 to 0.062) | NA |
| Fracture of patella, tibia, fibula or ankle | 157 | 0.063 (0.035 to 0.091) | 0.015 (−0.015 to 0.045) | 0.055 (0.036 to 0.081) |
| Open wounds | 149 | −0.023 (−0.046 to −0.001) | −0.043 (−0.068 to −0.018) | 0.006 (0.002 to 0.012) |
| Fracture of foot bones except ankle | 147 | 0.043 (0.014 to 0.073) | 0.016 (−0.016 to 0.048) | 0.026 (0.015 to 0.042) |
| Fracture of wrist and other distal part of hand | 142 | 0.035 (0.004 to 0.065) | 0.005 (−0.030 to 0.040) | 0.014 (0.007 to 0.025) |
| Fracture of clavicle, scapula or humerus | 139 | 0.023 (−0.004 to 0.050) | −0.009 (−0.038 to 0.020) | 0.035 (0.021 to 0.053) |
| Fracture of radius or ulna | 132 | 0.048 (0.022 to 0.074) | 0.021 (−0.010 to 0.052) | 0.043 (0.028 to 0.064) |
| Fracture of the sternum or ribs | 68 | −0.015 (−0.065 to 0.035) | −0.028 (−0.081 to 0.025) | 0.103 (0.068 to 0.145) |
| Moderate traumatic brain injury | 125 | −0.009 (−0.073 to 0.055) | −0.036 (−0.100 to 0.029) | 0.231 (0.156 to 0.324) |
| Minor traumatic brain injury | 61 | 0.032 (−0.016 to 0.079) | 0.011 (−0.043 to 0.064) | 0.094 (0.063 to 0.133) |
| Dislocation of shoulder | 60 | 0.046 (0.006 to 0.085) | 0.017 (−0.026 to 0.060) | 0.062 (0.041 to 0.088) |
| Fracture of femur | 42 | −0.001 (−0.046 to 0.044) | −0.052 (−0.096 to −0.009) | 0.042 (0.027 to 0.063) |
| Fracture of face bone | 36 | −0.057 (−0.096 to −0.018) | −0.076 (−0.116 to −0.036) | 0.067 (0.044 to 0.097) |
| Dislocation of knee | 35 | 0.101 (0.052 to 0.149) | 0.057 (0.006 to 0.109) | 0.113 (0.075 to 0.160) |
| Fracture of vertebral column | 31 | 0.135 (0.069 to 0.201) | 0.113 (0.038 to 0.187) | 0.111 (0.075 to 0.156) |
| Abdominal or pelvic organ injury | 29 | STS | STS | NA |
| Burn covering <20% TBSA or unspecified | 29 | STS | STS | 0.016 (0.008 to 0.028) |
| Fracture of pelvis | 25 | STS | STS | 0.182 (0.123 to 0.253) |
| Eye injuries | 24 | STS | STS | 0.054 (0.035 to 0.081) |
| Fracture of hip | 19 | STS | STS | 0.058 (0.038 to 0.084) |
| Poisoning | 14 | STS | STS | 0.163 (0.109 to 0.227) |
| Crush injury | 12 | STS | STS | 0.132 (0.089 to 0.189) |
| Dislocation of hip | 10 | STS | STS | 0.016 (0.008 to 0.028) |
| Amputation of fingers, excluding thumb | 4 | STS | STS | 0.005 (0.002 to 0.010) |
| Fracture of skull | 3 | STS | STS | 0.071 (0.048 to 0.100) |
| Nerve injury | 3 | STS | STS | 0.113 (0.076 to 0.157) |
| Spinal cord lesion at neck level | 3 | STS | STS | 0.589 (0.415 to 0.748) |
| Burn covering ≥20% TBSA | 0 | STS | STS | 0.135 (0.092 to 0.190) |
| Lower airway burns | 0 | STS | STS | 0.376 (0.240 to 0.524) |
| Spinal cord lesion below neck level | 0 | STS | STS | 0.296 (0.198 to 0.414) |
| Severe traumatic brain injury | 0 | STS | STS | 0.637 (0.462 to 0.789) |
| Severe chest injury | 0 | STS | STS | 0.047 (0.030 to 0.070) |
| Amputation of thumb | 0 | STS | STS | 0.011 (0.005 to 0.021) |
| Amputation of one upper limb | 0 | STS | STS | 0.039 (0.024 to 0.059) |
| Amputation of both upper limbs | 0 | STS | STS | 0.123 (0.081 to 0.176) |
| Amputation of toes | 0 | STS | STS | 0.006 (0.002 to 0.012) |
| Amputation of one lower limb | 0 | STS | STS | 0.039 (0.023 to 0.059) |
| Amputation of both lower limbs | 0 | STS | STS | 0.088 (0.057 to 0.124) |
| Drowning or non-fatal submersion | 0 | STS | STS | 0.247 (0.164 to 0.341) |

CI: confidence interval; GBD: Global Burden of Disease; NA: not available; STS: sample too small; TBSA: total body surface area.

a As used in the global burden of disease 2013 study.
b Numbers of cases, from six injury cohorts, used in the estimation of the new weights.
c As reported in the global burden of disease 2013 study.
d Short-term weight shown because long-term specific weight unavailable.
e For untreated cases only.
f For treated cases only.

vignette to convey the variability in disability within injuries adequately. This could explain why our new weights for severe traumatic brain injury and spinal cord lesion at neck level are substantially lower than the corresponding GBD 2013 weights. A perceived benefit of the case-based approach is the capacity to evaluate variation in disability within an injury group.

An argument for favouring estimates of disease burdens based on the perceptions of the general public over those based on the responses of the diseased has been that people living...
with a disease may have difficulty in placing their experiences in the context of other diseases.26–28 Our new weights were based on the measurement of case-reported outcomes using validated multi-attribute utility instruments. Such instruments use population preferences to create norms for health states rather than for specific conditions. Their use helps to place the experience of people living with injury into a wide context. Our new weights reflect the deviation of actual patient function from population-based norms.

The panel-based approach requires a brief lay description of what living with a particular condition is like for a typical case. The description of a typical injury case is difficult because of the potential variation in the severity of the injury and in the injury’s impact on the injured person’s life. In the GBD 2013 study, the lay description of a spinal cord lesion below neck level, as used in the GBD 2010 study, was revised to include “and no urine and bowel control”. This revision led to a sixfold increase in the corresponding disability weight – from 0.047 to 0.296.11 In the case-based approach, the problems associated with the variable scope and specificity of lay descriptions are avoided.

Table 5. New disability weights for the nature-of-injury groups used by EUROCAST, as derived from the responses of patients, from six injury cohorts, who were admitted to hospital

| Nature-of-injury group | New weights | EUROCAST weightsb |
|-----------------------|-------------|--------------------|
|                       | n           | Mean (95% CI)      | n |
|                       | Annualized | At 12 months post-injury | |
| Other skull – brain injury | 3173 | 0.195 (0.184 to 0.206) | 0.184 (0.172 to 0.192) | 570 |
| Fracture of knee/lower leg | 2442 | 0.188 (0.178 to 0.199) | 0.172 (0.160 to 0.184) | 628 |
| Fracture of hip | 2407 | 0.281 (0.268 to 0.294) | 0.273 (0.259 to 0.287) | 1364 |
| Internal organ injury | 2066 | 0.182 (0.169 to 0.194) | 0.162 (0.149 to 0.175) | 295 |
| Fracture of wrist | 1622 | 0.059 (0.059 to 0.082) | 0.062 (0.049 to 0.075) | 75 |
| Fracture/dislocation/strain/sprain of vertebrae/spine | 1593 | 0.187 (0.173 to 0.201) | 0.170 (0.155 to 0.186) | 329 |
| Fracture of ankle | 1195 | 0.150 (0.135 to 0.164) | 0.128 (0.112 to 0.144) | 483 |
| Fracture of rib/sternum | 1010 | 0.185 (0.166 to 0.203) | 0.179 (0.158 to 0.199) | 116 |
| Fracture of elbow/forearm | 910 | 0.116 (0.100 to 0.132) | 0.099 (0.082 to 0.117) | 313 |
| Fracture of pelvis | 906 | 0.205 (0.185 to 0.225) | 0.194 (0.172 to 0.216) | 207 |
| Fracture of upper arm | 677 | 0.172 (0.150 to 0.193) | 0.164 (0.140 to 0.188) | 483 |
| Fracture of femur shaft | 648 | 0.261 (0.239 to 0.283) | 0.234 (0.210 to 0.257) | 357 |
| Fracture of foot/toes | 477 | 0.179 (0.156 to 0.202) | 0.168 (0.143 to 0.193) | 87 |
| Fracture of clavicle/scapula | 453 | 0.123 (0.100 to 0.145) | 0.107 (0.082 to 0.132) | 233 |
| Spinal cord injury | 419 | 0.350 (0.316 to 0.384) | 0.333 (0.296 to 0.370) | 160 |
| Other injury | 387 | 0.196 (0.168 to 0.223) | 0.171 (0.141 to 0.201) | 313 |
| Complex soft tissue injury of lower extremities | 358 | 0.090 (0.067 to 0.113) | 0.058 (0.034 to 0.082) | 292 |
| Concussion | 170 | 0.100 (0.062 to 0.138) | 0.068 (0.029 to 0.106) | 606 |
| Burns | 143 | 0.170 (0.120 to 0.220) | 0.159 (0.103 to 0.215) | 62 |
| Fracture of facial bones | 141 | 0.147 (0.101 to 0.192) | 0.136 (0.084 to 0.189) | 168 |
| Dislocation/strain/sprain of shoulder/elbow | 140 | 0.119 (0.077 to 0.161) | 0.095 (0.049 to 0.140) | 23 |
| Open wounds | 134 | 0.091 (0.052 to 0.129) | 0.076 (0.033 to 0.118) | 146 |
| Complex soft tissue injury of upper extremity | 123 | 0.103 (0.059 to 0.148) | 0.099 (0.047 to 0.151) | 99 |
| Superficial injury, including contusions | 117 | 0.100 (0.053 to 0.148) | 0.076 (0.024 to 0.128) | 856 |
| Dislocation/sprain of knee | 86 | 0.131 (0.089 to 0.173) | 0.106 (0.058 to 0.155) | 2 |
| Fracture hand/fingers | 78 | 0.044 (0.009 to 0.079) | 0.031 (−0.013 to 0.076) | 107 |
| Dislocation/sprain of ankle/foot | 69 | 0.200 (0.149 to 0.251) | 0.183 (0.123 to 0.244) | 37 |
| Open wound face | 59 | 0.236 (0.154 to 0.318) | 0.215 (0.122 to 0.308) | 131 |
| Dislocation/sprain of hip | 58 | 0.189 (0.111 to 0.269) | 0.170 (0.072 to 0.268) | 176 |
| Open wound head | 39 | 0.092 (0.006 to 0.178) | 0.037 (−0.053 to 0.127) | 171 |
| Dislocation/sprain of wrist/hand/fingers | 18 | STS | STS | 19 |
| Eye injury | 18 | STS | STS | 31 |
| Whiplash, neck sprain, distortion of cervical spine | 15 | STS | STS | 12 |
| Foreign body | 7 | STS | STS | 59 |
| Poisoning | 7 | STS | STS | 129 |

CI: confidence interval; STS: sample too small.
a As used by EUROCAST.21
b Time-weighted Integration of European Injury Statistics weights for 12 months post-injury.21
The results of our analysis indicated that all categories of injury treated via hospital admission – and most categories of injury treated only in emergency departments – were associated with persistent measurable disability. They also provided evidence of long-term disability for several injury groups where specific long-term weights were not provided by the GBD 2013 study. Similarly, where the GBD 2013 study provided long-term weights only for so-called untreated cases – for example for cases of fracture of the femur, radius or ulna – the corresponding new weights were relatively high, even though the new weights were based on cases recruited directly from health-care services in high-income countries that presumably, had access to relatively well resourced treatment.

Many EUROCAST and GBD injury groups combine several types of injury. The combination of several conditions into a single group – for which a single weight is estimated – is not problematic if the outcomes of the combined conditions are similar. Injuries of a single nature from a single body region, such as fractures within the shoulder, are often bundled together in this manner. However, our new disability weights for individual ICD-10 diagnosis codes (Table 7 and Table 8; available at: http://www.who.int/bulletin/volumes/94/10/16-172155) indicate considerable heterogeneity in disability experienced by patients with fractures in the same body region or even the same bone. For example, the new weights indicate that clavicle fractures have a much lower disability weight than

Table 6. **New disability weights for the nature-of-injury groups used by EUROCAST, as derived from the responses of patients, from six injury cohorts, who presented at emergency department but were not admitted to hospital**

| Nature-of-injury group* | n   | Mean new weights (95%CI)          |           |           |
|-------------------------|-----|----------------------------------|-----------|-----------|
|                         |     | Annualized                      | At 12 months post-injury |
| Fracture/dislocation/strain/sprain of vertebrae/spine | 270 | 0.127 (0.105 to 0.150)          | 0.112 (0.086 to 0.138) |
| Dislocation/strain/sprain of knee | 241 | 0.093 (0.073 to 0.114)          | 0.062 (0.039 to 0.085) |
| Superficial injury, including contusions | 228 | 0.056 (0.031 to 0.081)          | 0.034 (0.007 to 0.062) |
| Dislocation/strain/sprain of ankle/foot | 169 | 0.070 (0.045 to 0.096)          | 0.045 (0.016 to 0.074) |
| Fracture of foot/ toes | 147 | 0.043 (0.014 to 0.073)          | 0.016 (−0.016 to 0.048) |
| Fracture of wrist | 131 | 0.053 (0.025 to 0.082)          | 0.021 (−0.014 to 0.056) |
| Dislocation/strain/sprain of shoulder/elbow | 119 | 0.075 (0.047 to 0.103)          | 0.054 (0.024 to 0.084) |
| Open wounds | 114 | −0.015 (−0.041 to 0.011)        | −0.032 (−0.062 to −0.002) |
| Complex soft tissue injury of lower extremities | 106 | 0.043 (0.012 to 0.074)          | 0.003 (−0.034 to 0.039) |
| Fracture ankle | 91 | 0.077 (0.035 to 0.119)          | 0.034 (−0.013 to 0.080) |
| Complex soft tissue injury of upper extremity | 88 | 0.072 (0.031 to 0.113)          | 0.062 (0.011 to 0.113) |
| Fracture of hand/fingers | 83 | 0.037 (−0.004 to 0.078)         | 0.020 (−0.027 to 0.067) |
| Dislocation/strain/sprain of wrist/hand/fingers | 82 | 0.044 (0.003 to 0.085)          | 0.010 (−0.036 to 0.056) |
| Other injury | 69 | 0.035 (−0.006 to 0.076)         | 0.013 (−0.036 to 0.062) |
| Fracture of rib/sternum | 68 | −0.015 (−0.065 to 0.035)        | −0.028 (−0.081 to 0.025) |
| Other skull – brain injury | 67 | −0.006 (−0.067 to 0.054)        | −0.032 (−0.094 to 0.030) |
| Fracture of knee/lower leg | 66 | 0.045 (0.012 to 0.074)          | −0.011 (−0.044 to 0.023) |
| Fracture of clavicle/scapula | 63 | −0.003 (−0.036 to 0.030)        | −0.029 (−0.063 to 0.004) |
| Fracture of elbow/forearm | 62 | 0.020 (−0.016 to 0.057)         | −0.014 (−0.053 to 0.025) |
| Concussion | 61 | 0.032 (−0.016 to 0.079)         | 0.011 (−0.043 to 0.064) |
| Fracture of upper arm | 50 | 0.081 (0.033 to 0.129)          | 0.036 (−0.014 to 0.086) |
| Whiplash, neck sprain, distortion of cervical spine | 41 | 0.111 (0.048 to 0.174)          | 0.093 (0.020 to 0.165) |
| Fracture of facial bones | 36 | −0.057 (−0.096 to −0.018)       | −0.076 (−0.116 to −0.036) |
| Internal organ injury | 29 | STS                              | STS        |
| Burns | 29 | STS                              | STS        |
| Fracture of pelvis | 25 | STS                              | STS        |
| Eye injury | 24 | STS                              | STS        |
| Dislocation/strain/sprain of hip | 24 | STS                              | STS        |
| Open wound on head | 23 | STS                              | STS        |
| Fracture of hip | 19 | STS                              | STS        |
| Open wound on face | 15 | STS                              | STS        |
| Poisoning | 14 | STS                              | STS        |
| Foreign body | 10 | STS                              | STS        |
| Fracture of femur shaft | 4 | STS                              | STS        |
| Spinal cord injury | 3 | STS                              | STS        |

CI: confidence interval; STS: sample too small.

* As used by EUROCAST.
fractures of the humerus or scapula and that fractures of the distal radius are less disabling than fractures of the proximal radius.

A major strength of our analysis was the large sample size – from multiple studies and health jurisdictions – which allowed weights to be estimated, for most commonly used injury classifications, for both hospital admissions and cases who were only treated in emergency departments. However, our analysis did have several limitations. The accuracy of the coding of injury diagnoses cannot be guaranteed, especially for cases attending emergency departments – whose injuries may not have been recorded by a trained coder. Disability weights for some categories of injury were based on relatively small numbers of cases. We therefore provided 95% confidence intervals to indicate the precision of each weight estimate. Inconsistencies and errors in documentation from the GBD 2013 study sometimes made it difficult to map ICD-10 codes to the relevant GBD 2013 injury group. The six data sets we employed differed in terms of follow-up rates and availability of EQ-5D data for each time point post-injury. Responder bias may have affected the British and Dutch data sets, which showed higher losses to follow-up than the other data sets. For some data sets, there was no collection of EQ-5D scores and we needed to estimate such scores from the responses to questions in the 12-item Short Form Health Survey.

For consistency and comparability, we mapped the principal diagnosis of each case to the EUROCOST and GBD 2013 injury groups. We did not take into account additional injury diagnoses even though disability at 12 months post-injury is known to increase with the number of injuries affecting the patient. Future evaluation of injury weights should consider multiple injuries. Our method ignored recovery within three months and the data sets we used predominantly included cases of falls and road trauma. Penetrating injuries were underrepresented.

Our weights were also calculated using data from adult cases only. While the GBD studies do cover all age groups, the vignettes used in these studies have not accounted for differences between children and adults and the GBD weights have simply been assumed to be applicable to all ages. It is plausible that there are differences in the recovery trajectories of children and adults, although the magnitude of these differences is not yet known. Like the GBD 2013 weights, our new weights do not explicitly consider the presence of comorbidity. However, the new weights are calculated from responses to a multi-attribute utility instrument that included age-specific population preferences – and age is a partial proxy for comorbidity.

Our new weights were based entirely on data collected in high-income countries and it remains unclear if they could and should be applied to cases in low- and middle-income countries. Finally, we considered any disability reported 12 months post-injury to be persistent. While some studies on injuries have shown little or no improvement after more than 12 months, others have shown such late improvement as well as nonlinear recovery trajectories.

In conclusion, new case-based disability weights have been estimated for individual injury-related ICD-10 diagnosis codes and commonly used injury groups. In general, these weights were higher than the corresponding largely panel-based weights that have been estimated previously. Long-term disability was evident in all categories of injuries admitted to hospital. The findings indicate that injury is often a chronic disorder and burden of disease estimates should reflect this. The impact of applying the new disability weights to DALY calculations will depend on the injury incidence profile of the population studied. A similar case-based approach could be used to determine disability weights for other conditions.

Funding: The National Health and Medical Research Council of Australia supported this work (APP1021861). BJG was supported by a Career Development Fellowship from the same Research Council (APP1048731). The Prospective Outcomes of Injury Study was funded by the Health Research Council of New Zealand and the Accident Compensation Corporation. The Victorian State Trauma Registry is funded by the Department of Health and Human Services and the Transport Accident Commission (TAC). The Victorian Orthopaedic Trauma Outcomes Registry is funded by the TAC via the Institute for Safety, Compensation and Recovery Research. The Dutch Injury Inpatient Survey was funded by the Consumer and Safety Institute and the Ministry of Health, Netherlands. The United Kingdom Burden of Injury study was funded by the Policy Research Programme in the Department of Health and the National Study on Costs and Outcomes of Trauma study was funded by the National Center for Injury Prevention and Control of the Centers for Disease Control and the National Institutes of Health.

Competing interests: None declared.
Based on a multinational injury cohort study, patient-reported EQ-5D scores were collected for 29,770 trauma cases, of which 6,908 were hospitalizations and 22,862 were treated in emergency departments only. New disability weights were calculated for each of the 10 EQ-5D dimensions separately for hospitalized cases and those treated in emergency departments only. Trauma cases were more frequent among men and about one-third of the cases involved road accidents.

Conclusions: New disability weights for injury burden studies were developed based on patient-reported EQ-5D scores from a multinational trauma cohort study. The new weights are higher than those used in the Global Burden of Disease Study and provide a more precise reflection of the impact of trauma on the lives of people.
Resumen

Pesos de discapacidad según datos registrados de los pacientes en una cohorte internacional de lesiones

Objetivo Crear pesos de discapacidad basados en pacientes con el fin de establecer códigos de diagnóstico de lesiones individuales y clasificaciones según la naturaleza de la lesión, para su uso en estudios sobre la carga de morbilidad, como alternativa a los pesos basados en panales.

Métodos Se recopiló información autopresentada según la medida estandarizada EQ-5D del estado de salud de 29 770 participantes en el estudio de cohorte de lesiones Injury-VIBES, que abarcó Australia, los Países Bajos, Irlanda del Norte, Nueva Zelanda, el Reino Unido de Gran Bretaña y los Estados Unidos de América. Se combinaron los datos para calcular nuevos pesos de discapacidad para cada clasificación de lesión común y para cada tipo de diagnóstico cubierto por la décima revisión de la Clasificación Estadística Internacional de Enfermedades y Problemas Relacionados con la Salud. Se calcularon los pesos de forma separada para determinar los ingresos hospitalarios y las visitas limitadas a los servicios de urgencias.

Resultados Hubo 29 770 casos de lesiones con al menos una puntuación EQ-5D. La edad media de los participantes que ofrecieron información fue de 51 años. La mayoría de los participantes eran de sexo masculino y casi un tercio de sufrió lesiones por accidentes de tráfico. Los nuevos pesos de discapacidad fueron superiores en los casos de ingresos que en los limitados a los servicios de urgencias y mayores que los pesos correspondientes utilizados por el estudio de Carga Mundial de Morbilidad de 2013. La discapacidad a largo plazo fue común en la mayoría de las categorías de lesiones.

Conclusion Una lesión suele ser un trastorno crónico y las estimaciones de la carga de morbilidad reflejan este hecho. La aplicación de los nuevos pesos a los estudios de carga podría aumentar sustancialmente la estimación de los años de vida ajustados por discapacidad, así como ofrecer un reflejo más preciso sobre el efecto de las lesiones en la vida de las personas.

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### Table 7. New disability weights for the primary diagnosis codes of the International Statistical Classification of Diseases (ICD), as derived from the responses of patients, from six injury cohorts, who were admitted to hospital

| Body region, code | Diagnosis | \( n \) | Mean new weights (95%CI) |
|-------------------|-----------|--------|-------------------------|
| **Head**          |           |        |                         |
| S02.1             | Fracture of base of skull  | 92     | 0.149 (0.100 to 0.197)  | 0.139 (0.085 to 0.194) |
| S02.4             | Fracture of malar and maxillary bones | 49 | 0.195 (0.119 to 0.270)  | 0.182 (0.095 to 0.270) |
| S06.0             | Concussion | 108    | 0.147 (0.100 to 0.193)  | 0.121 (0.072 to 0.169) |
| S06.1             | Traumatic cerebral oedema | 79 | 0.276 (0.197 to 0.354)  | 0.257 (0.177 to 0.338) |
| S06.2             | Diffuse brain injury | 466    | 0.205 (0.177 to 0.234)  | 0.197 (0.166 to 0.227) |
| S06.3             | Focal brain injury | 483    | 0.169 (0.143 to 0.194)  | 0.158 (0.131 to 0.186) |
| S06.4             | Epidural haemorrhage | 281    | 0.185 (0.153 to 0.217)  | 0.161 (0.127 to 0.196) |
| S06.5             | Traumatic subdural haemorrhage | 783 | 0.210 (0.187 to 0.234)  | 0.203 (0.178 to 0.227) |
| S06.6             | Traumatic subarachnoid haemorrhage | 597 | 0.214 (0.188 to 0.241)  | 0.206 (0.177 to 0.234) |
| S06.8             | Other intracranial injuries | 249 | 0.174 (0.139 to 0.209)  | 0.160 (0.122 to 0.197) |
| S09.9             | Unspecified injury of head | 59 | 0.239 (0.165 to 0.313)  | 0.212 (0.128 to 0.297) |
| **Neck**          |           |        |                         |
| S12.0             | Fracture of first cervical vertebra | 49 | 0.129 (0.054 to 0.205)  | 0.104 (0.025 to 0.183) |
| S12.1             | Fracture of second cervical vertebra | 179 | 0.183 (0.137 to 0.230)  | 0.186 (0.132 to 0.241) |
| S12.2             | Fracture of other cervical vertebra | 319 | 0.146 (0.117 to 0.175)  | 0.133 (0.101 to 0.166) |
| S14.0             | Concussion and oedema of cervical spinal cord | 36 | 0.235 (0.128 to 0.342)  | 0.241 (0.112 to 0.370) |
| S14.1             | Other and unspecified injuries of cervical spinal cord | 199 | 0.347 (0.297 to 0.396)  | 0.324 (0.270 to 0.378) |
| **Thorax**        |           |        |                         |
| S22.0             | Fracture thoracic vertebra | 351 | 0.207 (0.176 to 0.238)  | 0.194 (0.161 to 0.228) |
| S22.4             | Multiple fractures of ribs | 866 | 0.187 (0.167 to 0.207)  | 0.183 (0.160 to 0.205) |
| S22.5             | Flail chest | 61 | 0.211 (0.132 to 0.290)  | 0.180 (0.098 to 0.262) |
| S24.1             | Other and unspecified injuries of thoracic spinal cord | 106 | 0.435 (0.367 to 0.502)  | 0.403 (0.331 to 0.475) |
| S26.8             | Other injuries of heart | 96 | 0.142 (0.099 to 0.184)  | 0.127 (0.075 to 0.179) |
| S27.0             | Traumatic pneumothorax | 416 | 0.164 (0.137 to 0.192)  | 0.154 (0.124 to 0.183) |
| S27.1             | Traumatic haemothorax | 63 | 0.143 (0.083 to 0.202)  | 0.108 (0.044 to 0.172) |
| S27.2             | Traumatic haemopneumothorax | 167 | 0.155 (0.113 to 0.196)  | 0.130 (0.087 to 0.172) |
| S27.3             | Other injuries of lung | 488 | 0.205 (0.179 to 0.231)  | 0.182 (0.155 to 0.209) |
| S27.8             | Injury of other unspecified intrathoracic organs | 91 | 0.247 (0.176 to 0.318)  | 0.220 (0.149 to 0.290) |
| **Abdomen/lower back/lumbar spine/pelvis** | | | |
| S32.0             | Fracture of lumbar vertebra | 383 | 0.207 (0.178 to 0.237)  | 0.187 (0.156 to 0.219) |
| S32.1             | Fracture of sacrum | 175 | 0.191 (0.150 to 0.232)  | 0.171 (0.128 to 0.214) |
| S32.3             | Fracture of ilium | 60 | 0.249 (0.170 to 0.327)  | 0.234 (0.140 to 0.327) |
| S32.4             | Fracture of acetabulum | 213 | 0.242 (0.200 to 0.284)  | 0.233 (0.186 to 0.279) |
| S32.5             | Fracture of pubis | 525 | 0.179 (0.154 to 0.205)  | 0.171 (0.143 to 0.199) |
| S32.8             | Fracture of other or unspecified lumbar spine or pelvis | 78 | 0.266 (0.187 to 0.345)  | 0.241 (0.162 to 0.320) |
| S34.1             | Other injury of lumbar spinal cord | 51 | 0.316 (0.221 to 0.411)  | 0.328 (0.216 to 0.440) |
| S36.0             | Injury of spleen | 173 | 0.175 (0.136 to 0.213)  | 0.154 (0.111 to 0.197) |
| S36.1             | Injury of liver or gall bladder | 107 | 0.159 (0.110 to 0.208)  | 0.142 (0.088 to 0.197) |
| S36.4             | Injury of small intestine | 56 | 0.239 (0.141 to 0.338)  | 0.217 (0.112 to 0.323) |
| S36.5             | Injury of colon | 46 | 0.210 (0.125 to 0.295)  | 0.177 (0.085 to 0.268) |
| S36.8             | Injury of other intra-abdominal organ | 112 | 0.182 (0.132 to 0.232)  | 0.181 (0.121 to 0.242) |
| S37.0             | Injury of kidney | 44 | 0.205 (0.123 to 0.287)  | 0.200 (0.105 to 0.295) |
| **Shoulder and upper arm** | | | |
| S42.0             | Fracture of clavicle | 307 | 0.103 (0.073 to 0.132)  | 0.092 (0.063 to 0.122) |
| S42.1             | Fracture of scapula | 102 | 0.150 (0.100 to 0.199)  | 0.127 (0.073 to 0.181) |
| S42.2             | Fracture of upper end of humerus | 511 | 0.178 (0.153 to 0.203)  | 0.175 (0.147 to 0.203) |

(continues...
| Body region, code | Diagnosis                                      | n  | Mean new weights (95% CI) | Annualized | At 12 months post-injury |
|-------------------|------------------------------------------------|----|--------------------------|------------|--------------------------|
| **Elbow and forearm** |                                               |    |                          |            |                          |
| S42.3             | Fracture of shaft of humerus                   | 146| 0.160 (0.113 to 0.207)   | 0.141 (0.090 to 0.192) |                          |
| S42.4             | Fracture of lower end of humerus               | 141| 0.158 (0.113 to 0.203)   | 0.151 (0.100 to 0.203) |                          |
| S43.0             | Dislocation of shoulder                        | 50 | 0.158 (0.079 to 0.238)   | 0.137 (0.055 to 0.218) |                          |
| S43.1             | Dislocation of acromioclavicular joint         | 37 | 0.154 (0.066 to 0.243)   | 0.140 (0.053 to 0.227) |                          |
| S52.0             | Fracture upper end of ulna                     | 252| 0.103 (0.073 to 0.132)   | 0.082 (0.050 to 0.114) |                          |
| S52.1             | Fracture upper end of radius                   | 161| 0.128 (0.091 to 0.165)   | 0.107 (0.067 to 0.147) |                          |
| S52.2             | Fracture shaft of ulna                         | 60 | 0.100 (0.048 to 0.152)   | 0.084 (0.027 to 0.142) |                          |
| S52.3             | Fracture shaft of radius                       | 63 | 0.073 (0.023 to 0.123)   | 0.027 (−0.023 to 0.077) |                          |
| S52.4             | Fracture of shafts of both radius and ulna     | 92 | 0.132 (0.075 to 0.190)   | 0.131 (0.065 to 0.197) |                          |
| S52.5             | Fracture lower end of radius                   | 1339| 0.061 (0.048 to 0.074)   | 0.053 (0.038 to 0.067) |                          |
| S52.6             | Fracture lower ends of both radius and ulna    | 208| 0.110 (0.077 to 0.144)   | 0.107 (0.068 to 0.145) |                          |
| S52.8             | Fracture other parts of forearm                | 93 | 0.087 (0.039 to 0.135)   | 0.083 (0.028 to 0.139) |                          |
| **Wrist and hand** |                                               |    |                          |            |                          |
| S62.0             | Fracture of scaphoid bone                      | 38 | 0.152 (0.065 to 0.239)   | 0.156 (0.061 to 0.250) |                          |
| **Hip and thigh** |                                               |    |                          |            |                          |
| S72.0             | Fracture neck of femur                         | 1315| 0.267 (0.249 to 0.285)   | 0.260 (0.241 to 0.280) |                          |
| S72.1             | Perrotrochanteric fracture                     | 829| 0.307 (0.284 to 0.330)   | 0.301 (0.277 to 0.326) |                          |
| S72.2             | Subtrochanteric fracture                       | 187| 0.279 (0.232 to 0.326)   | 0.267 (0.217 to 0.318) |                          |
| S72.3             | Fracture shaft of femur                        | 533| 0.266 (0.243 to 0.290)   | 0.240 (0.214 to 0.266) |                          |
| S72.4             | Fracture lower end of femur                    | 370| 0.292 (0.261 to 0.322)   | 0.293 (0.258 to 0.328) |                          |
| S72.9             | Fracture of femur, part unspecified            | 51 | 0.232 (0.151 to 0.313)   | 0.202 (0.114 to 0.290) |                          |
| S76.1             | Injury of quadriceps muscle and tendon         | 50 | 0.065 (0.008 to 0.121)   | 0.024 (−0.033 to 0.081) |                          |
| **Knee and lower leg** |                                           |    |                          |            |                          |
| S82.0             | Fracture of patella                            | 237| 0.160 (0.127 to 0.192)   | 0.136 (0.099 to 0.172) |                          |
| S82.1             | Fracture of upper end of tibia                 | 379| 0.185 (0.158 to 0.211)   | 0.178 (0.148 to 0.209) |                          |
| S82.2             | Fracture of shaft of tibia                     | 535| 0.224 (0.201 to 0.247)   | 0.204 (0.178 to 0.230) |                          |
| S82.3             | Fracture of lower end of tibia                 | 252| 0.216 (0.182 to 0.251)   | 0.193 (0.155 to 0.232) |                          |
| S82.4             | Fracture of fibula alone                       | 106| 0.187 (0.137 to 0.237)   | 0.192 (0.132 to 0.251) |                          |
| S82.5             | Fracture of medial malleolus                   | 208| 0.197 (0.161 to 0.232)   | 0.165 (0.128 to 0.201) |                          |
| S82.6             | Fracture of lateral malleolus                  | 654| 0.108 (0.089 to 0.127)   | 0.095 (0.074 to 0.116) |                          |
| S82.8             | Fracture of other parts of lower leg           | 721| 0.118 (0.101 to 0.136)   | 0.098 (0.079 to 0.118) |                          |
| S83.5             | Sprain/strain of posterior/anterior cruciate ligament | 47 | 0.122 (0.069 to 0.176)   | 0.094 (0.032 to 0.157) |                          |
| S86.0             | Injury of Achilles tendon                      | 177| 0.054 (0.027 to 0.081)   | 0.030 (0.002 to 0.058) |                          |
| **Ankle and foot** |                                               |    |                          |            |                          |
| S92.0             | Fracture of calcaneus                          | 147| 0.223 (0.182 to 0.265)   | 0.217 (0.171 to 0.263) |                          |
| S92.1             | Fracture of talus                              | 41 | 0.193 (0.127 to 0.259)   | 0.167 (0.089 to 0.245) |                          |
| S92.2             | Fracture of other tarsal bone                  | 38 | 0.166 (0.096 to 0.236)   | 0.154 (0.080 to 0.227) |                          |
| S92.3             | Fracture of metatarsal bone                    | 132| 0.177 (0.129 to 0.225)   | 0.173 (0.121 to 0.225) |                          |
| S92.4             | Fracture of great toe                          | 57 | 0.091 (0.037 to 0.144)   | 0.094 (0.030 to 0.157) |                          |
| S92.5             | Fracture of other toe                          | 38 | 0.163 (0.050 to 0.275)   | 0.140 (0.023 to 0.258) |                          |
| S93.3             | Dislocation of other and unspecified part of foot | 32 | 0.277 (0.191 to 0.362)   | 0.252 (0.143 to 0.361) |                          |
| **Multiple body regions** |                                           |    |                          |            |                          |
| T02.3             | Fracture of multiple regions of one lower limb | 34 | 0.150 (0.081 to 0.219)   | 0.095 (0.022 to 0.168) |                          |

CI: confidence interval.
* As used in the 10th revision of the International statistical classification of diseases and related health problems.20
Table 8. **New disability weights for the primary diagnosis codes of the International Statistical Classification of Diseases (ICD), as derived from the responses of patients, from six injury cohorts, who presented at emergency departments but were not admitted to hospital**

| Body region, code * | Diagnosis                                                                 | n   | Mean new weights (95%CI)                                                                 |
|---------------------|---------------------------------------------------------------------------|-----|-----------------------------------------------------------------------------------------|
|                     |                                                                           |     | Annualized                                                                              | At 12 months post-injury |
| Head                |                                                                           |     |                                                                                         |                           |
| S06.0               | Concussion                                                                | 30  | 0.070 (0.005 to 0.134)                                                                  | 0.041 (−0.043 to 0.124)   |
| Neck                |                                                                           |     |                                                                                         |                           |
| S13.4               | Sprain and strain of cervical spine                                       | 41  | 0.111 (0.048 to 0.174)                                                                  | 0.093 (0.020 to 0.165)    |
| Abdomen/lower back/ lumbar spine/pelvis |                                                                           |     |                                                                                         |                           |
| S33.5               | Spain and strain of lumbar spine                                          | 163 | 0.109 (0.083 to 0.136)                                                                  | 0.097 (0.066 to 0.128)    |
| S33.0               | Traumatic rupture of lumbar intervertebral disc                           | 40  | 0.174 (0.094 to 0.254)                                                                  | 0.147 (0.063 to 0.232)    |
| Shoulder and upper arm |                                                                           |     |                                                                                         |                           |
| S43.7               | Sprain/strain of other and unspecified parts of shoulder                  | 39  | 0.126 (0.072 to 0.181)                                                                  | 0.114 (0.061 to 0.168)    |
| S46.0               | Injury of muscle(s)/tendon(s) of the rotator cuff of shoulder             | 35  | 0.157 (0.091 to 0.223)                                                                  | 0.166 (0.085 to 0.248)    |
| Elbow and forearm   |                                                                           |     |                                                                                         |                           |
| S52.6               | Fracture lower ends of both radius and ulna                              | 37  | 0.059 (0.013 to 0.104)                                                                  | 0.030 (−0.020 to 0.080)   |
| S52.5               | Fracture lower end of radius                                             | 35  | 0.085 (0.027 to 0.144)                                                                  | 0.072 (−0.010 to 0.154)   |
| Wrist and hand      |                                                                           |     |                                                                                         |                           |
| S62.3               | Fracture of other metacarpal bone                                         | 35  | 0.071 (−0.005 to 0.148)                                                                 | 0.064 (−0.024 to 0.152)   |
| Knee and lower leg  |                                                                           |     |                                                                                         |                           |
| S83.2               | Tear of meniscus                                                          | 79  | 0.088 (0.052 to 0.124)                                                                  | 0.051 (0.013 to 0.089)    |
| S82.6               | Fracture of lateral malleolus                                             | 60  | 0.074 (0.025 to 0.122)                                                                  | 0.044 (−0.007 to 0.094)   |
| S86.0               | Injury of Achilles tendon                                                 | 55  | 0.081 (0.037 to 0.126)                                                                  | 0.039 (−0.014 to 0.091)   |
| S83.6               | Sprain/strain of other and unspecified parts of knee                      | 33  | 0.052 (−0.015 to 0.119)                                                                 | 0.023 (−0.052 to 0.099)   |
| Ankle and foot      |                                                                           |     |                                                                                         |                           |
| S93.4               | Sprain and strain of ankle                                                | 114 | 0.065 (0.034 to 0.097)                                                                  | 0.041 (0.005 to 0.076)    |
| S92.3               | Fracture of other tarsal bone                                             | 42  | 0.075 (0.017 to 0.134)                                                                  | 0.042 (−0.021 to 0.105)   |
| S92.2               | Fracture of metatarsal bone                                               | 31  | 0.062 (−0.008 to 0.131)                                                                 | 0.042 (−0.042 to 0.126)   |

CI: confidence interval.

* As used in the 10th revision of the International statistical classification of diseases and related health problems.20