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## Global Burden of Disease disability weights for the US National Electronic Surveillance System – All Injury Program

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### Abstract

**Background:** Measuring the impact of nonfatal injuries and violence is essential for informed public health policymaking and communications. This study aimed to generate new health-related quality of life data for a prominent United States nonfatal injury surveillance source using disability weights derived from general population survey estimates.

**Methods:** Disability weights reflecting severity as measured on a 0 (no disability) to 1 (death) scale, for 47 natures of injury from the Global Burden of Diseases, Risk Factors, and Injuries Study (GBD) were mapped to 492 injury types in the US National Electronic Injury Surveillance System - All Injury Program (NEISS-AIP). The matching of GBD natures of injury to NEISS-AIP injury types was based on the underlying definitions for each injury diagnosis.

**Results:** The average disability value weighted by incidence for all NEISS-AIP types was 0.073 (95% uncertainty interval [UI]: 0.050–0.097), and the range by injured body part and diagnosis was 0.006–0.408. Injuries that impacted large or critical body parts (lower trunk, upper trunk, head, neck) had the highest disability weights. Internal injuries, crushing, burns, nerve damage, and fractures had higher disability weight values than lacerations, avulsions, and contusions. The three most common NEISS-AIP nonfatal injury types during 2015–2020 were poisoning, internal injuries of the head, and face lacerations, with disability weights of 0.163 (0.109–0.227), 0.168 (0.112–0.232), and 0.018 (0.010–0.029), respectively.

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**Contributors:** MM led data analysis and drafted the manuscript. All authors contributed to study design and interpretation of results, edited the manuscript, and approved the final manuscript as submitted. MM is the guarantor. The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

Declarations

**Conflicts of interest:** None.

**Patient consent for publication:** Not applicable.

**Ethics approval:** Not applicable. This study used publicly available data and did not require institutional review board approval (45 CFR §46).

**Conclusion:** Mapping of publicly available disability weights data to a prominent nonfatal injury surveillance source can improve opportunities to measure and communicate the health and economic impact of injuries and violence.

### Keywords

Violence; Accidents; Wounds and injuries; Poisoning; Health status; Quality of life; Health Status Indicators; Quality-Adjusted Life Years; Recovery of function; Injury Severity Score; Trauma Severity Indices

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## Introduction

Comprehensive measurement of health-related quality of life is critical for assessing and communicating the health and economic impact of nonfatal injuries and violence. However, affected individuals, medical professionals, and the general public may have different perceptions of functional losses related to a health incident.<sup>1–3</sup> A direct comparison of health state valuations for a variety of short-term conditions with an explicit timeline as elicited from medical professionals versus general population respondents concluded there was consistency between those groups, while other studies based on health state valuations from injured individuals tend to indicate more impairment compared to valuations from the general public.<sup>3–5</sup> Affected individuals are an important source of health-related quality of life information—some researchers have cogently argued that affected individuals are the most accurate source for this information<sup>2</sup>—but data collection can be prohibitively complex, expensive, and have limited generalizability when affected individuals are questioned about their health states over time.<sup>2 3 6 7</sup> A separate challenge is that combining published estimates of health-related quality of life from different groups of affected individuals can be challenging owing to a wide variety of data collection instruments—a recent systematic review identified 14 different generic instruments used in injury health state valuation studies in the previous decade.<sup>8</sup>

Discussions about from whom to elicit health state valuations are important and ongoing, but high-profile guidance in the United States on this topic is clear: In 1996, the Washington Panel on Cost-effectiveness in Health and Medicine recommended that “for purposes of resource allocation, the relevant preferences are those of the general public.”<sup>9</sup> This was confirmed by the Second Panel in 2016 (“community preferences for health states are the most appropriate source of preferences for reference case analyses”).<sup>10</sup> The Global Burden of Diseases, Injuries, and Risk Factors Study (GBD) has facilitated likely the most comprehensive and accessible elicitation of health state valuations from general population respondents to date.<sup>11 12</sup> GBD health state valuations are publicly available and based on regression modeling of pairwise ranking of multiple health state vignettes (i.e., “which description indicates better health?”) from tens of thousands of general population respondents from multiple countries, yielding scaled disability weights (0=no disability, 1=health loss equivalent to death) for 183 health conditions.

The most detailed US nonfatal injury surveillance data source, the National Electronic Injury Surveillance System - All Injury Program (NEISS-AIP), does not include data collection on health-related quality of life. Linking NEISS-AIP to an existing vetted data source for health

state valuations can improve opportunities to measure and communicate the health and economic impact of injuries and violence. This study aimed to generate new health-related quality of life data for US nonfatal injury surveillance using disability weights calculated from general population surveys.

## Methods

Methods used to generate GBD disability weights are detailed elsewhere.<sup>11 12</sup> Briefly, surveys were fielded using paired comparisons to assess which health states were viewed as more debilitating. A lay description for each health state was developed by experts such that main outcomes, symptoms, and impact on daily activities were clearly explained using non-clinical terminology. Household surveys in 2010 and 2013 were conducted in nine countries (Bangladesh, Indonesia, Peru, Tanzania, United States, Hungary, Italy, Netherlands, Sweden), and a web-based survey included respondents recruited through media campaigns and scientific journal editorials, yielding 60,890 total respondents. Table 1 demonstrates GBD health state descriptions and disability weights for 47 injury types by nature of injury (e.g., dislocation of hip).

NEISS-AIP is a nationally representative probability sample of US hospitals that can provide weighted nationwide estimates of emergency department (ED) visits for injuries.<sup>13</sup> In NEISS-AIP annual records of ED visits from 2015–2020 (unweighted n=2.9 million), there were 492 unique injury types by body part category, body part, and injury diagnosis (e.g., Arm/hand-Wrist-Fracture) based on 26 body parts and 30 diagnoses. NEISS-AIP has a higher number of injury types than GBD due to more specificity by both body part and diagnosis (e.g., thermal versus chemical burns). Some NEISS-AIP body part–diagnosis types were far more common than others—head internal injuries or concussion accounted for 11% of analyzed NEISS-AIP ED visit records and poisoning for 12% of records (data not shown).

Definitions underlying each injury diagnosis, including ICD-9-CM codes where available, from both NEISS-AIP and GBD were used to align the two data sources.<sup>14 15</sup> There were 309 NEISS-AIP injury types with a direct match to a single GBD injury type. A further 183 NEISS-AIP injury types were matched to 2+ GBD injury types; a weighted average of the matching GBD disability weights was generated using each contributing injury type's incidence from GBD 2021 US national estimates for 2015–2020 (Appendix, Table S1, Table S2).<sup>15</sup> When the NEISS-AIP injured body part was “All parts,” the GBD disability weight for “Multiple fractures, dislocations, crashes, wounds, pains, and strains” was used (Table 1). When the NEISS-AIP injured body part was “Unknown/Not stated” but the diagnosis was provided (e.g., fracture), an average of GBD weights by injury diagnosis weighted by US incidence was applied. When the NEISS-AIP injury diagnosis was “Other,” an average of all GBD injury disability weights weighted by incidence was applied. Where possible the GBD disability weights corresponding to a short-term injury (duration less than one year, indicated in Table 1) were selected, to correspond most closely with the scope of injuries reported in NEISS-AIP, though this was not an option in all cases (appendix p 3). A supplemental table (S1) reports all assessed NEISS-AIP injury types, the mapped or calculated mean GBD disability weight, and corresponding 95% uncertainty interval (UI;

reflecting the 2.5<sup>th</sup> and 97.5<sup>th</sup> percentile of the GBD standard simulation process to produce mean estimates from underlying data), and all GBD natures of injury (“n-codes”) used to generate the disability weight.

This study complies with the Guidelines on Accurate and Transparent Health Estimate Reporting (GATHER) recommendations (Table S3).<sup>16</sup>

## Results

Disability weights for NEISS-AIP injury types mapped from GBD ranged from 0.006 to 0.408 for all combinations of injured body part and diagnosis (Figure 1). The average disability value weighted by incidence for all NEISS-AIP types was 0.073 (95% uncertainty interval [UI]: 0.050–0.097) (S1). Only 28 NEISS-AIP injury types had a disability weight greater than 0.200. Diagnoses such as internal injury, crushing, burns, nerve damage, and some fractures had higher disability weights (e.g., Upper Trunk-Internal injury, 0.347 [0.235–0.471]), whereas injuries such as lacerations, avulsions, and contusions typically had lower weights (e.g., Finger-Puncture, 0.006 [0.002–0.012]). Injuries impacting the lower trunk, upper trunk, head, or neck also had higher disability weights (e.g., Lower Trunk-Hemorrhage, 0.324 [0.220–0.442]). Injuries that impacted multiple body parts had higher disability weights, such as burns covering 25–50% of the body or the entire body (0.314 [0.211–0.441]), or multiple fractured body parts (0.258 [0.172–0.356]). The most frequent injury reported in NEISS-AIP during 2015–2020 was poisoning (disability weight: 0.163 [0.109–0.227]), followed by internal injuries to the head (0.168 [0.112–0.232]) and lacerations of the face (0.018 [0.010–0.029]) (Figure 2). Of the top 20 most frequent injury types, 14 were sprains/strains, lacerations, or contusions (disability weight range: 0.006 to 0.025), and Lower Trunk-Fracture had the highest disability weight (0.182 [0.126–0.259]) (Figure 2).

## Discussion

General population valuations of injury health states for NEISS-AIP derived as described here can help to improve opportunities to measure and communicate the impact of nonfatal injuries. Disability weights can be used directly to compute years lived with disability to better understand the population-level health impact of nonfatal injuries, or standard monetary valuations of reduced health-related quality of life can be generated to accompany more common cost values such as medical care and lost employment productivity.<sup>17 18</sup> The use of general population respondents to value health states is consistent with the premise that valuations should reflect a broad social understanding of health impairments.<sup>12</sup>

## Limitations

GBD disability weights depend on the validity of the corresponding health state descriptions, which are brief by design.<sup>6 11 12</sup> However, this means the health state descriptions may not fully reflect the potential variety of experiences among patients with the same condition.<sup>11</sup> Explicit timelines are not attached to many GBD health state descriptions; however, respondents’ valuations appear insensitive to framing in terms of temporary or chronic outcomes.<sup>11</sup> Disability weights presented here address injuries by body

region and nature of injury, rather than mechanism (e.g., gunshot wound). The NEISS-AIP is more detailed than the GBD in terms of injured body region and diagnosis—for this study, 47 natures of injury from GBD were mapped to 492 NEISS-AIP injury types. NEISS-AIP injury types with limited information—such as diagnosis of “Other”—were assigned average disability weight values that may not reflect the nature or severity of the injury in all cases. The NEISS-AIP is based on a sample of US hospitals, relies on resource-intensive manual data abstraction from medical records to identify causal injury mechanism and intent, excludes injuries with only a diagnosis of pain, addresses only ED-treated injuries (and not direct inpatient admissions nor injuries treated in urgent care or doctor’s offices) and does not contain sufficient sample sizes to generate estimates by US state. Given that the GBD health states are designed to be comprehensive of all injuries, not only those presenting to the ED, it is possible that some disability weights may be more or less severe than the injuries documented in NEISS-AIP.

## Conclusions

This study’s mapping of publicly available disability weights to a prominent nonfatal injury surveillance source can improve opportunities to quantify, monitor, and communicate the health and economic impact of injuries and violence.

## Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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## Patient and public involvement:

Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

## Abbreviations:

|                  |                                                                     |
|------------------|---------------------------------------------------------------------|
| <b>GBD</b>       | Global Burden of Disease study                                      |
| <b>NEISS-AIP</b> | National Electronic Injury Surveillance System - All Injury Program |

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**What is already known on this topic**

Comprehensively measuring the impact of nonfatal injuries and violence is essential for informed public health policymaking and communications.

**What this study adds**

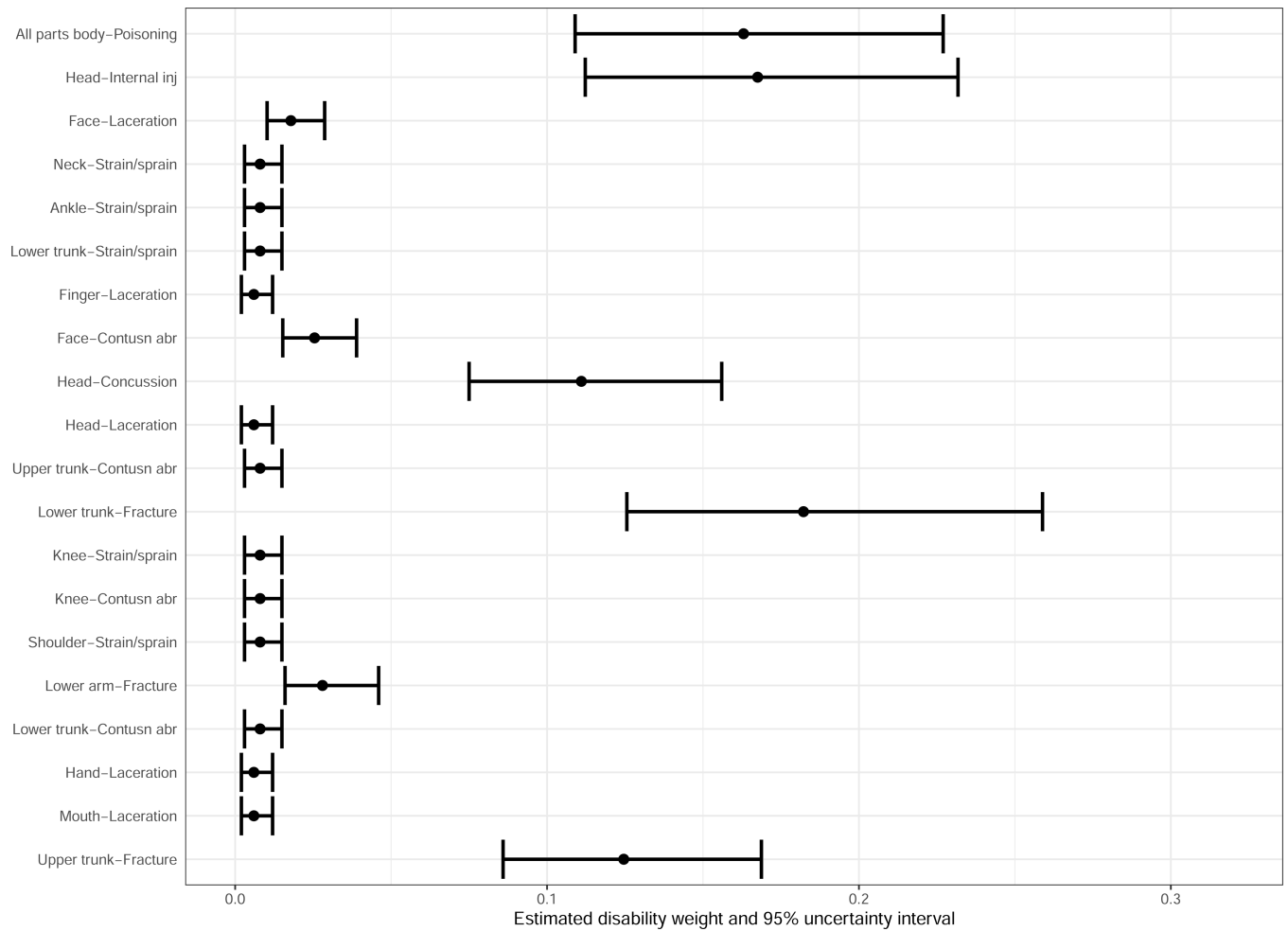
Disability weights from the Global Burden of Disease study, which are derived from general population surveys in multiple countries using plain language health state descriptions, were mapped to a prominent US nonfatal injury surveillance system.

**How might this study affect research, practice, or policy**

Mapping publicly available disability weights data to a prominent nonfatal injury surveillance source can improve opportunities to measure and communicate the health and economic impact of injuries and violence.



**Figure 1.**  
Global Burden of Disease disability weights mapped to NEISS-AIP injuries by body part and diagnosis (n=492)



**Figure 2.**  
Global Burden of Disease disability weights for the 20 most frequent injuries in NEISS-AIP by body part and diagnosis (2015–2020)  
Notes. UI = Uncertainty interval. Y-axis categories are ranked by most (high) to least (low) frequent injury.

**Table 1.**

Global Burden of Disease disability weights and health state descriptions for natures of injury (n=47)

| Nature of injury                                                                                                                  | Disability weight (95% UI) | Surveyed health state description                                                                                                                                                                                       | Health state duration |
|-----------------------------------------------------------------------------------------------------------------------------------|----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| Amputation of lower limbs, bilateral                                                                                              | 0.088<br>(0.057–0.124)     | Has lost part of both legs, leaving pain and tingling in the stumps. The person has two artificial legs that make moving around possible, with extra effort.                                                            | 1+ year               |
| Amputation of upper limbs, bilateral                                                                                              | 0.123<br>(0.081–0.176)     | Has lost part of both arms, leaving pain and tingling in the stumps. The person has two artificial arms that make it possible to do daily activities, with a great deal of extra effort.                                | 1+ year               |
| Amputation of fingers (excluding thumb)                                                                                           | 0.005<br>(0.002–0.010)     | Has lost a finger of one hand. At times there is pain and tingling in the stump.                                                                                                                                        | 1+ year               |
| Amputation of lower limb, unilateral                                                                                              | 0.039<br>(0.023–0.059)     | Has lost part of one leg, leaving pain and tingling in the stump. The person has an artificial leg that helps in moving around.                                                                                         | 1+ year               |
| Amputation of upper limb, unilateral                                                                                              | 0.039<br>(0.024–0.059)     | Has lost one hand and part of the arm, leaving pain and tingling in the stump. The person has an artificial arm that makes it possible to lift objects and do daily activities such as cooking, with some extra effort. | 1+ year               |
| Amputation of thumb                                                                                                               | 0.011<br>(0.005–0.021)     | Has lost one thumb, causing some difficulty in using the hand, pain, and tingling in the stump.                                                                                                                         | 1+ year               |
| Amputation of toe/toes                                                                                                            | 0.006<br>(0.002–0.012)     | Has lost one toe, leaving occasional pain and tingling in the stump.                                                                                                                                                    | 1+ year               |
| Burns, <20% total burned surface area without lower airway burns                                                                  | 0.141<br>(0.094–0.196)     | Has a burn on part of the body. Parts of the burned area are painful, and other parts have lost feeling.                                                                                                                | <1 year               |
| Burns, ≥20% total burned surface area or ≥10% burned surface area if head/neck or hands/wrist involved without lower airway burns | 0.314<br>(0.211–0.441)     | Has a painful burn over a large part of the body. Parts of the burned area have lost feeling, and the person feels anxious and unwell.                                                                                  | <1 year               |
| Lower airway burns                                                                                                                | 0.376<br>(0.240–0.524)     | Has a burn in the throat and lungs, which causes great difficulty breathing and a lot of anxiety.                                                                                                                       | <1 year               |
| Dislocation of hip                                                                                                                | 0.016<br>(0.008–0.028)     | Walks with a limp and feels discomfort when walking.                                                                                                                                                                    | Not specified         |
| Dislocation of knee                                                                                                               | 0.113<br>(0.075–0.160)     | Has a knee out of joint, causing pain and difficulty moving the knee, which sometimes gives way. The person needs crutches for walking and help with self-care such as dressing.                                        | Not specified         |
| Dislocation of shoulder                                                                                                           | 0.062<br>(0.041–0.088)     | Has a shoulder that is out of joint, causing pain and difficulty moving. The person has difficulty with daily activities such as dressing and cooking.                                                                  | Not specified         |
| Muscle and tendon injuries, including sprains and strains, lesser dislocations                                                    | 0.008<br>(0.003–0.015)     | Has a strained muscle that causes pain and swelling.                                                                                                                                                                    | Not specified         |
| Fracture of clavicle, scapula, or humerus                                                                                         | 0.035<br>(0.021–0.053)     | Has a broken shoulder bone, which is painful and swollen. The person cannot use the affected arm and has difficulty with getting dressed.                                                                               | Not specified         |
| Fracture of face bones                                                                                                            | 0.067<br>(0.044–0.097)     | Has a broken cheek bone or a broken nose or chipped teeth, with swelling and severe pain.                                                                                                                               | Not specified         |
| Fracture of foot bones except ankle                                                                                               | 0.026<br>(0.015–0.043)     | Has a broken foot bone, which causes pain, swelling, and difficulty walking.                                                                                                                                            | <1 year               |
| Fracture of hand (wrist and other distal part of hand)                                                                            | 0.010<br>(0.005–0.019)     | Has a broken hand, causing pain and swelling.                                                                                                                                                                           | <1 year               |
| Fracture of hip                                                                                                                   | 0.258<br>(0.172–0.356)     | Has broken a hip and is in pain. The person cannot stand or walk, and needs help washing, dressing, and going to the toilet.                                                                                            | <1 year               |

| Nature of injury                                        | Disability weight (95% UI) | Surveyed health state description                                                                                                                                                         | Health state duration |
|---------------------------------------------------------|----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| Fracture of patella, tibia or fibula, or ankle          | 0.050<br>(0.032–0.075)     | Has a broken shin bone, which causes severe pain, swelling, and difficulty walking.                                                                                                       | <1 year               |
| Fracture of pelvis                                      | 0.279<br>(0.188–0.384)     | Has a broken pelvis bone, with swelling and bruising. The person has severe pain and cannot walk or do daily activities.                                                                  | <1 year               |
| Fracture of radius and/or ulna                          | 0.028<br>(0.016–0.046)     | Has a broken forearm, which causes severe pain, swelling, and limited movement.                                                                                                           | <1 year               |
| Fracture of skull                                       | 0.071<br>(0.048–0.100)     | Has a broken skull but does not have brain damage. The broken area is painful and swollen.                                                                                                | Not specified         |
| Fracture of sternum and/or fracture of one or more ribs | 0.103<br>(0.068–0.145)     | Has a broken rib that causes severe pain in the chest, especially when breathing in. The person has difficulty with daily activities such as dressing.                                    | Not specified         |
| Fracture of vertebral column                            | 0.111<br>(0.075–0.156)     | Has broken back bones and is in pain, but still has full use of arms and legs.                                                                                                            | Not specified         |
| Fracture of femur, other than femoral neck              | 0.111<br>(0.074–0.156)     | Has a broken thigh bone. The person has severe pain and swelling and cannot walk.                                                                                                         | <1 year               |
| Minor TBI                                               | 0.110<br>(0.074–0.158)     | Has headaches, dizziness, nausea, and difficulty concentrating.                                                                                                                           | <1 year               |
| Moderate/severe TBI                                     | 0.214<br>(0.141–0.297)     | Cannot concentrate and has headaches, memory problems, dizziness, and feels angry.                                                                                                        | <1 year               |
| Foreign body in ear                                     | 0.013<br>(0.007–0.024)     | Has an earache that causes some difficulty with daily activities.                                                                                                                         | Not specified         |
| Foreign body in respiratory system                      | 0.408<br>(0.273–0.556)     | Has cough, wheezing, and shortness of breath all the time. The person has great difficulty walking even short distances or climbing any stairs, feels tired when at rest, and is anxious. | Not specified         |
| Foreign body in GI and urogenital system                | 0.114<br>(0.078–0.159)     | Has pain in the belly and feels nauseous. The person has difficulties with daily activities.                                                                                              | Not specified         |
| Spinal cord lesion at neck level                        | 0.589<br>(0.415–0.748)     | Is paralyzed from the neck down, with no feeling or control over any part of the body below the neck, and no urine or bowel control.                                                      | Not specified         |
| Spinal cord lesion below neck level                     | 0.296<br>(0.198–0.414)     | Is paralyzed from the waist down, cannot feel or move the legs, and has difficulties with urine and bowel control. The person uses a wheelchair to move around.                           | Not specified         |
| Drowning and non-fatal submersion                       | 0.247<br>(0.164–0.341)     | Has breathlessness, anxiety, cough, and vomiting.                                                                                                                                         | Not specified         |
| Asphyxiation                                            | 0.247<br>(0.164–0.341)     | Has breathlessness, anxiety, cough, and vomiting.                                                                                                                                         | Not specified         |
| Crush injury                                            | 0.132<br>(0.089–0.189)     | Had part of the body crushed, leaving pain, swelling, tingling and limited feeling in the affected area.                                                                                  | Not specified         |
| Nerve injury                                            | 0.100<br>(0.067–0.140)     | Has a nerve injury, which causes difficulty moving and some loss of feeling in the affected area.                                                                                         | <1 year               |
| Injury to eyes                                          | 0.054<br>(0.035–0.081)     | Has an injury to one eye, which causes pain and difficulty seeing.                                                                                                                        | <1 year               |
| Open wound(s)                                           | 0.006<br>(0.002–0.012)     | Has a cut in the skin, which causes pain and numbness around the cut.                                                                                                                     | <1 year               |
| Poisoning requiring urgent care                         | 0.163<br>(0.109–0.227)     | Has drowsiness, stomach pain, and vomiting.                                                                                                                                               | Not specified         |
| Severe chest injury                                     | 0.369<br>(0.247–0.501)     | Has a serious chest injury, which causes severe pain, shortness of breath, and anxiety.                                                                                                   | <1 year               |
| Internal hemorrhage in abdomen and pelvis               | 0.324<br>(0.220–0.442)     | Has severe pain in the belly and feels nauseous. The person is anxious and unable to carry out daily activities.                                                                          | <1 year               |
| Contusion in any part of the body                       | 0.008<br>(0.003–0.015)     | Has a strained muscle that causes pain and swelling.                                                                                                                                      | Not specified         |

| Nature of injury                                                            | Disability weight<br>(95% UI) | Surveyed health state description                                                                                                 | Health state<br>duration |
|-----------------------------------------------------------------------------|-------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| Effect of different<br>environmental factors                                | 0.049<br>(0.031–0.072)        | Has a chronic disease that requires medication every day and<br>causes some worry but minimal interference with daily activities. | Not specified            |
| Complications following<br>therapeutic procedures                           | 0.133<br>(0.088–0.190)        | Has a high fever and pain, and feels very weak, which causes great<br>difficulty with daily activities.                           | <1 year                  |
| Superficial injury of any part<br>of the body                               | 0.008<br>(0.003–0.015)        | Has a strained muscle that causes pain and swelling.                                                                              | Not specified            |
| Multiple fractures,<br>dislocations, crashes, wounds,<br>pains, and strains | 0.258<br>(0.172–0.356)        | Has broken a hip and is in pain. The person cannot stand or walk,<br>and needs help washing, dressing, and going to the toilet.   | <1 year                  |

Notes. UI = Uncertainty interval. Reproduced from: Global Burden of Disease Collaborative Network. Global Burden of Disease Study 2021 (GBD 2021) Disability Weights. Seattle, United States of America: Institute for Health Metrics and Evaluation (IHME), 2024. “Not specified” indicates no specific time frame attached to the nature of injury and its corresponding disability weight and health state description. Where more than one option was available, the <1 year disability weight and corresponding health state description was chosen. Amputations explicitly have a duration of 1+ year.

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