International Classification of Diseases 10th edition-based disability adjusted life years for measuring of burden of specific injury

Yu Jin Kim[1], Sang Do Shin[1,2], Hye Sook Park[3], Kyoung Jun Song[2],
Jin Sung Cho[4], Seung Chul Lee[5], Sung Chun Kim[6], Ju Ok Park[7],
Ki Ok Ahn[8], Yu Mi Park[9]

[1]Department of Emergency Medicine, Seoul National University College of Medicine, Seoul, Korea
[2]Department of Emergency Medicine, Seoul National University Hospital, Seoul, Korea
[3]Department of Preventive Medicine, Ewha Womans University College of Medicine, Seoul, Korea
[4]Department of Emergency Medicine, Gachon University Gil Hospital, Incheon, Korea
[5]Department of Emergency Medicine, Dongguk University Ilsan Hospital, Goyang, Korea
[6]Department of Emergency Medicine, Gyeongsang National University Hospital, Jinju, Korea
[7]Department of Emergency Medicine, Hallym University College of Medicine, Dongtan, Korea
[8]Laboratory of Emergency Medical Services, Seoul National University Hospital Biomedical Research Institue, Seoul, Korea
[9]Hallym University School of Public Health, Chuncheon, Korea

Objective We aimed to develop an International Classification of Diseases (ICD) 10th edition injury code-based disability-adjusted life year (DALY) to measure the burden of specific injuries.

Methods Three independent panels used novel methods to score disability weights (DWs) of 130 indicator codes sampled from 1,284 ICD injury codes. The DWs were interpolated into the remaining injury codes (n=1,154) to estimate DWs for all ICD injury codes. The reliability of the estimated DWs was evaluated using the test-retest method. We calculated ICD-DALYs for individual injury episodes using the DWs from the Korean National Hospital Discharge Injury Survey (HDIS, n=23,160 of 2004) database and compared them with DALY based on a global burden of disease study (GBD-DALY) regarding validation, correlation, and agreement for 32 injury categories.

Results Using 130 ICD 10th edition injury indicator codes, three panels determined the DWs using the highest reliability (person trade-off 1, Spearman r=0.724, 0.788, and 0.875 for the three panel groups). The test-retest results for the reliability were excellent (Spearman r=0.932) (P<0.001). The HDIS database revealed injury burden (years) as follows: GBD-DALY (138,548), GBD-years of life disabled (130,481), and GBD-years of life lost (8,117) versus ICD-DALY (262,246), ICD-years of life disabled (255,710), and ICD-years of life lost (6,537), respectively. Spearman's correlation coefficient of the DALYs between the two methods was 0.759 (P<0.001), and the Bland-Altman test displayed an acceptable agreement, with exception of two categories among 32 injury groups.

Conclusion The ICD-DALY was developed to calculate the burden of injury for all injury codes and was validated with the GBD-DALY. The ICD-DALY was higher than the GBD-DALY but showed acceptable agreement.

Keywords Disability adjusted life year; Wounds and injuries; International Classification of Diseases

Capsule Summary
What is already known The disability-adjusted life years measures the burden of disease adjusting for mortality and disability using 33 injury categories but is too crude. **What is new in the current study** This study shows that International Classification of Disease 10th edition-based injury codes can be reliably used to estimate disability-adjusted life years for injuries.

INTRODUCTION

Injury is the leading cause of death among children and young people, and it is the leading cause of years of potential life lost in most countries.[1] Injury may also result in disability, which diminishes the subject's quality of life.[2] The disability-adjusted life year (DALY) was created to measure the burden of disease after adjusting for both mortality and disability, and is a useful method for health policy decision-making.[3-6] The DALY has been used to evaluate the global burden of disease (GBD) for major diseases, including injury.[7-10] However, injury is not a single disease entity but a group of very complex processes consisting of multiple injury mechanisms and natures of injury. Previous GBD studies have categorized injury into 32 distinct injury groups.[11] Although the burden of injury may be measured using these simple categories, the GBD of injury may be too crude to reveal the burden of each specific injury. For example, the GBD group classified the burden of poisoning as a single category. However, poisoning involves various materials, ranging from mild substances (i.e., sedatives) to extremely fatal substances (i.e., paraquat).[12] A more specific method for measuring the disability associated with specific injuries would allow researchers and administrators in more precisely assessing subject disability in large databases. The International Classification of Diseases (ICD) includes all injuries, injury subgroups, and adverse effects. The study hypothesis is that developing a method to measure the disability of each injury diagnostic code (ICD 10th edition S/T codes) would allow the calculation of the entire burden of specific injuries. The objectives of the current study were to develop an ICD 10th edition-based disability-adjusted life year (DALY) (ICD-DALY) for injury and to test its reliability and validity.

METHODS

This study was supported by the Ministry of Health, Welfare, and Family Affairs of Republic of the Korea in 2008 (Health Promotion Fund A0104208A00). The Seoul National University Hospital institutional review board approved the study with waiver of informed consent because the study did not require the enrollment of human participants. Patient records/information were anonymized and de-identified prior to analysis. The study flow diagram is presented in Fig. 1.

Determining the disability weight for injury codes

To determine the disability weight (DW) for each injury S/T code (n = 1,284 codes), we randomly sampled 10% (n = 130 codes) of the ICD 10th edition (ICD-10) injury codes from an existing injury database (National Injury Database, NIDB) using a stratified random sampling. The NIDB (n = 29,285,528) included total injury data for all patients who had utilized medical services between 2001 and 2003 in Korea; 93.7% for outpatients, 6.0% for hospital admissions, and 0.3% for death after treatment.[13] Using the NIDB, we calculated the admission rate ratio (ARR) as the number of deaths and hospital admissions associated with a specific ICD injury code over the total number of patients corresponding to the same ICD injury code. Stratified by the ARR distribution per 10 percentiles, we randomly sampled the indicator injury codes in even order (n = 130) (Appendix 1). As the ARR reflects morbidity and mortality associated with specific injury codes, the 10th percentile of the ARR represents a stratum for which no valid parameter exists.

The DW for each injury code was determined using the same method applied by the GBD research group.[11] We established three panel groups, each composed of six experts (five emergency and trauma care physicians and one preventive medicine physician) and one trained coordinator. There was no panel turnover and there were no panel dropouts during the one full-day survey workshop for DW measurement. Each panel group was assigned to separate rooms to avoid any bias. The 130 indicator injury codes were randomly assigned to one of the three groups. An ad-
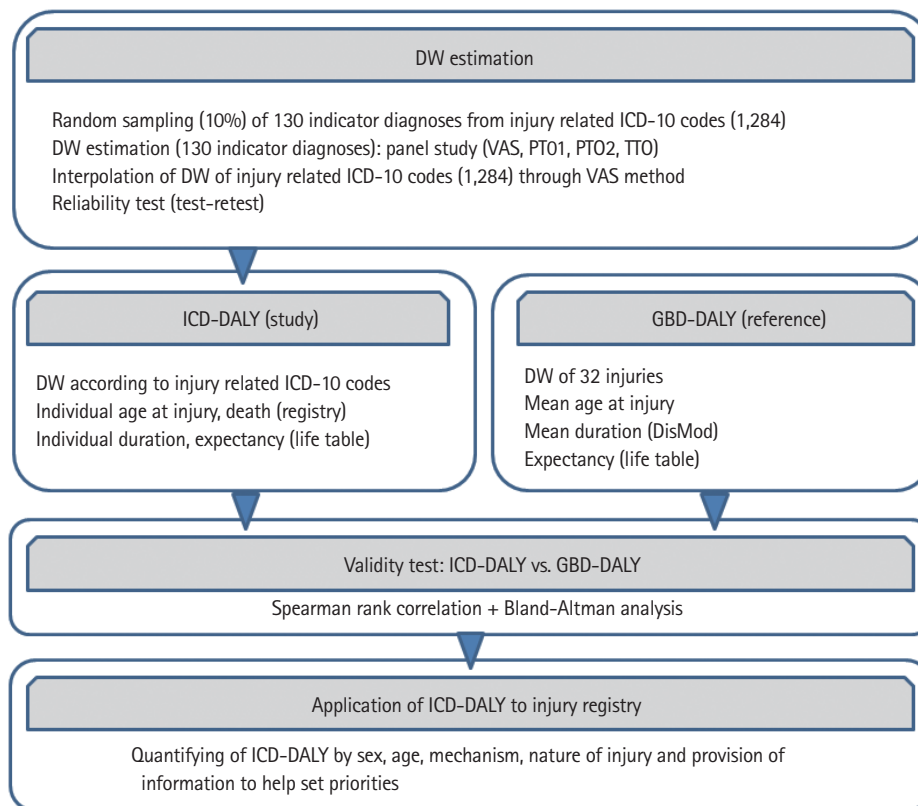
Fig. 1. Study flow diagram. DW, disability weight; ICD-10, International Classification of Diseases 10th edition; VAS, visual analogue scale; PTO1, person trade-off 1; PTO2, person trade-off 2; TTO, time trade-off; DALY, disability-adjusted life years; GBD, Global Burden of Disease Study.

ditional 16 codes were shared by the groups to calculate the level of agreement between the groups via correlation analysis. Ideally, all three panels should evaluate all 130 indicator diagnoses independently. However, cost and time limitations existed. Therefore, we assigned a fixed number of codes (16 common codes and 38 different codes) per panel with the assumption that approximately 10 minutes were required to determine the DW of each injury code. We benchmarked this method on the basis of previous studies.[14,15] To determine the DW, we utilized four separate methods, as follows: visual analogue scale (VAS), person trade-off 1 (PTO1), person trade-off 2 (PTO2), and time trade-off (TTO). These were used to determine the DW in prior studies.[16,17] For example, in the VAS method, one panel member discloses their VAS result regarding a specific code to the other members in their group and explains their reasoning. After discussion, each panel reconsiders the VAS for each injury code and documents the score on a designed questionnaire. This process was performed and repeated for all injury codes (54 codes) assigned to each panel. The median value for every code assessed using each method was calculated and considered to be the DW score. After calculating the DW score, we selected the most reliable of the

four methods (VAS, PTO1, PTO2, or TTO) by calculating Spearman's correlation for the 16 common codes assigned to the three panel groups.

Upon determining the DW for each indicator injury code (n = 130), we estimated the DW for the remaining injury codes using the interpolation method.[18] Each panel scored the DW for the remaining 1,154 S/T codes (i.e., 385 codes for each of the three panel groups). The panels referenced the DW values of the 130 indicator injury codes. For this procedure, the panels used the VAS method, as it required the least amount of time to generate an agreement. After scoring the DW for all injury codes, the median VAS among the panels was calculated to determine the DW for each injury code. Finally, we estimated the DWs for all 1,284 ICD-10 injury codes.

To determine the reliability of the DW of each code, we used the test-retest method for the 16 common indicator injury codes. Two months after completing the initial panel study, we repeated the same panel study using the same procedural methods for VAS, PTO1, PTO2, and TTO. Pearson's correlation analysis was used to assess the reliability of the test-retest method.

Calculating the ICD-DALY using the estimated DW of injury codes

To calculate the DALY, we used the same formula, which has been proposed in several previous studies.[2,3] The ICD-DALY was calculated using the same formula as the conventional DALY (GBD-DALY), but the specific DW of the ICD codes and assumptions regarding duration of morbidity and life expectancy differed. We considered the discount rate ($\gamma = 0.03$), age weight parameter ($\beta = 0.04$), modulation factor ($K = 0$ or 1) according to age weight, and constant ($C = 0.1658$) to calculate the DALY for each injury episode. The estimated life expectancy ("L" in years of life lost [YLL]) or duration of morbidity due to a specific injury ("L" in years of life disabled [YLD]) was calculated from the age at the time of the injury event to the life expectancy, based on the life tables of the National Statistical Office of Korea. According to previous GBD studies, the cure rate of injury was 0% for the YLD measurement, and we surrogated the remaining life expectancy for morbidity due to a specific injury.[19,20] A comparison of essential variables of the ICD-DALY and GBD-DALY calculations are shown in Appendix 2.

Validation of the ICD-DALY

To validate the ICD-DALY, we compared it with the conventional GBD-DALY. We assessed and compared both DALY results (ICD-DALY vs. GBD-DALY) using a pre-existing injury database, the Korean National Hospital Discharge Injury Survey. The Hospital Discharge Injury Survey (HDIS) is a nationwide, stratified sampled, and abstract survey data from 170 general hospitals with more than 100 beds in Korea since 2004 by Korea Centers for Disease Control and Prevention, including all patients with diagnosis code (ICD S or T codes) at discharge hospital. We recategorized 1,284 injury-related ICD codes into 32 categories using the "GBD 2000 nature of injury categories and ICD codes" (http://www.who.int/healthinfo/statistics/bod_injuries.pdf). We calculated the GBD-DALY by using the mean age of injury event, mean duration of injury prevalence (YLD) or mean life expectancy (YLL) using DisMod II (http://www.who.int/healthinfo/global_burden_disease/tools_software/en/). The DisMod II is a software tool that can be used to verify the consistency of estimates of incidence, prevalence, duration, and case fatality for diseases. We estimated the incidence and case fatality for 32 categories of injury, by sex and age group, and replaced the remission rate with 0%, as previously reported.[21,22] We calculated the ICD-DALY using individual age at the time of injury, individual age at death, and the estimated life expectancy based on the life tables of the National Statistical Office of Korea and ICD-10 code–based DW. Spearman's rank correlation test and the Bland-Altman test for agreement were used to compare 32 injury categories between ICD-DALY and GBD-DALY.

RESULTS

DW estimations and the calculation of the ICD-DALY

We sampled 130 indicator ICD-10 injury codes based on the distribution of the ARR of each ICD-10 code in the NIDB. Appendix 1 lists the 130 selected indicator ICD-10 injury codes. Table 1 displays the distribution injury codes according to the ARR. The 130 codes were distributed similarly according to the strata of the ARR percentile. Table 2 displays Spearman's rank correlation coefficients among the panel groups for each of the four methods (i.e., VAS, PTO1, PTO2, and TTO). The PTO1 method demonstrated the highest correlation coefficient among the three panel groups (0.788, 0.685, and 0.875). Fig. 2 shows the distribution of the median DWs for the 16 common indicator injury codes derived from a panel study applying four different methods. The values derived using the VAS and PTO1 methods were distributed evenly throughout the total range of 0.0 to 1.0, while the values derived using the PTO2 and TTO methods were densely concentrated below 0.2. Therefore, we selected the DW for 160 indicator ICD in-

Table 1. Indicator injury ICD-10 codes sampled from total injury ICD-10 codes using the admission rate ratio

Admission rate ratio	Injury ICD-10 codes, total	Indicator injury ICD-10 codes sampled
Total	1,284 (100.0)	130 (100.0)
0.00–0.05	181 (14.1)	18 (13.8)
0.05–0.15	295 (23.0)	30 (23.1)
0.15–0.25	208 (16.2)	21 (16.2)
0.25–0.35	146 (11.4)	15 (11.5)
0.35–0.45	113 (8.8)	11 (8.5)
0.45–0.55	108 (8.4)	11 (8.5)
0.55–0.65	73 (5.7)	7 (5.4)
0.65–0.75	75 (5.8)	8 (6.2)
0.75–0.85	47 (3.7)	5 (3.8)
0.85–0.95	32 (2.5)	3 (2.3)
0.95–1.00	6 (0.5)	1 (0.8)

Values are presented as number (%).
ICD-10, International Classification of Diseases 10th edition.

Table 2. Spearman rank correlation coefficients between two panels according to valuation methods

Valuation method	Panel 1–2	Panel 2–3	Panel 1–3
VAS	0.686 (P = 0.003)	0.708 (P = 0.002)	0.690 (P = 0.003)
PTO1	0.788 (P = 0.003)	0.685 (P = 0.003)	0.875 (P = 0.001)
PTO2	0.549 (P = 0.028)	0.685 (P = 0.003)	0.754 (P = 0.007)
TTO	0.403 (P = 0.014)	0.510 (P = 0.052)	0.723 (P = 0.023)

VAS, visual analogue scale; PTO1, person trade-off 1; PTO2, person trade-off 2; TTO, time trade-off.

jury codes derived using the PTO1 method, which was considered the most reliable and discriminative method for determining DW. We determined the DW of the remaining ICD-10 injury codes using the interpolation method. Fig. 3 shows the markedly high correlation between the VAS- and PTO1-based DWs for the 130 indicator ICD-10 injury codes ($\rho = 0.721$, $P < 0.001$). Using the VAS-based interpolation method, we calculated the median values of the DWs for each ICD-10 code. Appendix 3 displays the DWs of all injury codes.

We performed a test-retest study on the 16 common indicator ICD-10 injury codes. Pearson's correlation coefficient and Spearman's rank correlation coefficient between the test-retest of DW valuation via the PTO1 method were 0.932 ($P < 0.001$) and 0.740 ($P < 0.001$), respectively, thereby demonstrating good reliability (Table 3). Pearson's correlation coefficients between the test-retest re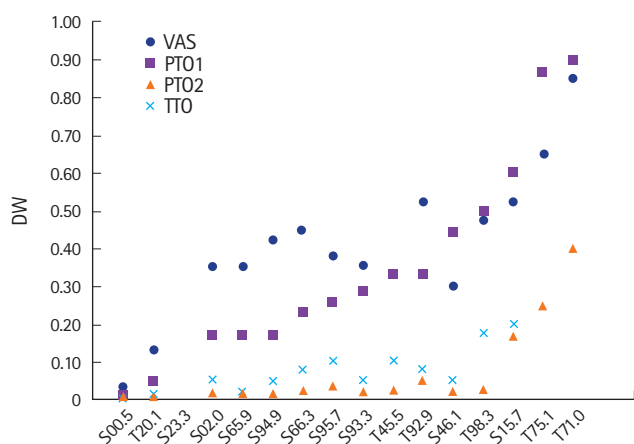sults of the 5 panelists participating in the study were as follows: 0.728, 0.852, 0.891, 0.937, and 0.962 (all $P < 0.001$). The formula was completed to calculate the ICD-DALY using estimated DWs and variables in an existing injury database.

Validation of the ICD-DALY

Most codes in the HDIS (n = 23,160, collected in 2004, male subjects 61.5%, adults (15 to 64 years old) 77.3% and elderly (≥ 65 years old) 17.9% were automatically converted into 32 nature of injury categories using the GBD-DALY method, including 271 codes by manual conversion by the investigators (conversion rate 1,166/1,284 = 91%). However, 118 codes were not reclassified into 32 injury categories due to: extremely rare nature of the injury, non-traumatic injury, post-injury complication, environmental injury, or side effects of medical treatment. The excluded codes are displayed in Appendix 4.

Table 4 displays the GBD-DALY and ICD-DALY results according to 32 categories derived from the HDIS database. The GBD-DALY, GBD-YLD, and GBD-YLL were 138,548, 130,481, and 8,117 years, respectively. The ICD-DALY, ICD-YLD, and ICD-YLL were 262,246, 255,710, and 6,537 years, respectively. The mean YLD/YLL proportions were 16.1 for the GBD-DALY and 39.1 for the ICD-DALY.

Fig. 4 shows the comparison between the ICD-DALY and the GBD-DALY based on 32 nature of injury categories. The injury distribution differed between the GBD-DALY and the ICD-DALY (e.g., intracranial injuries > sprains > fracture-face bones > open wound > fracture-patella, tibia, or fibula > poisoning for GBD-DA-

Fig. 2. Distributions of median disability weight (DW) calculated by each panel method. VAS, visual analogue scale; PTO1, person trade-off 1; PTO2, person trade-off 2; TTO, time trade-off.

Fig. 3. Correlation between person trade-off 1 (PTO1)-based and visual analogue scale (VAS)-based disability weights (DWs) for 130 indicator codes.

Table 3. Test-retest results of 16 common indicator ICD-10 injury codes using person trade-off 1 (median)

ICD-10 code	Test	Retest
S00.5	0.005	0.004
S02.0	0.200	0.167
S15.7	0.375	0.375
S23.3	0.074	0.034
S46.1	0.167	0.200
S65.9	0.167	0.153
S66.3	0.167	0.167
S93.3	0.167	0.153
S94.9	0.167	0.138
S95.7	0.231	0.167
T20.1	0.029	0.015
T45.5	0.200	0.130
T71.0	0.714	0.714
T75.1	0.800	0.833
T92.9	0.310	0.091
T98.3	0.444	0.167

Pearson correlation coefficient = 0.932 ($P < 0.001$); Spearman correlation coefficients = 0.740 ($P < 0.001$).
ICD-10, International Classification of Diseases 10th edition.

Table 4. Comparison of GBD-DALY and ICD-DALY according to 32 nature of injury categories

Nature of injury category	GBD–YLD (a)	GBD– YLL (b)	(a)/(b)	GBD– DALY	ICD–YLD (c)	ICD– YLL (d)	(c)/(d)	ICD– DALY
Fracture-skull	3,990	603	6.6	4,593	6,530	361	18.1	6,891
Fracture-face bones	11,367	281	40.5	11,647	10,854	63	172.3	10,917
Fracture-vertebral column	5,151	190	27.1	5,342	10,797	108	100.0	10,905
Fracture-rib or sternum	2,955	341	8.7	3,296	6,974	215	32.4	7,189
Fracture-pelvis	1,901	180	10.6	2,081	4,174	112	37.3	4,286
Fracture-clavicle, scapula, or humerus	3,579	199	18.0	3,778	8,149	55	148.2	8,204
Fracture-radius or ulna	3,929	40	98.2	3,970	8,451	17	497.1	8,469
Fracture-hand bones	1,987	10	198.7	1,997	4,873	3	1,624.3	4,876
Fracture-femur	4,577	280	16.3	4,857	6,824	159	42.9	6,983
Fracture-patella, tibia, or fibula	8,158	126	64.7	8,284	13,213	54	244.7	13,267
Fracture-ankle	1,101	0	NA	1,101	2,096	0	NA	2,096
Fracture-foot bones	1,112	0	NA	1,112	4,734	0	NA	4,734
Injured spinal cord	3,658	72	50.8	3,730	2,519	36	70.0	2,555
Dislocations-shoulder, elbow, or hip	302	27	11.2	329	1,123	7	160.4	1,130
Dislocations-other dislocation	4,923	49	100.5	4,972	21,551	22	979.6	21,573
Sprains	18,812	299	62.9	19,111	42,943	30	1,431.4	42,973
Intracranial injuries	24,177	2,342	10.3	26,519	36,465	2,252	16.2	38,716
Internal injuries	3,285	1,259	2.6	4,543	16,176	1,373	11.8	17,549
Open wound	8,808	459	19.2	9,267	13,157	89	147.8	13,246
Injury to eyes	2,558	57	44.9	2,615	5,194	12	432.8	5,206
Amputations-thumb	240	0	NA	240	780	0	NA	780
Amputations-finger	615	0	NA	615	3,021	0	NA	3,021
Amputations-arm	328	0	NA	328	486	0	NA	486
Amputations-toe	10	0	NA	10	46	0	NA	46
Amputations-foot	18	0	NA	18	37	0	NA	37
Amputations-leg	157	0	NA	157	224	0	NA	224
Crushing	1,867	41	45.5	1,908	3,683	43	85.7	3,725
Burns-less than 20%	17	167	0.1	184	3,243	37	87.6	3,279
Burns-20% to 60%	3,887	251	15.5	4,137	5,482	113	48.5	5,594
Burns-greater than 60%	164	183	0.9	348	1,506	615	2.4	2,122
Injured nerves	613	22	27.9	635	3,100	7	442.9	3,107
Poisoning	6,186	641	9.7	6,826	7,301	755	9.7	8,063
Total	130,431	8,117	16.1	138,548	255,710	6,537	39.1	262,246

GBD, Global Burden of Disease Study; DALY, disability-adjusted life year; ICD, International Classification of Diseases 10th edition; YLD, years of life disabled; YLL, years of life lost; NA, not applicable.

LY and sprains > intracranial injuries > dislocation-other dislocation > internal injuries > fracture-patella, tibia, or fibula > open wound for ICD-DALY). The ICD-DALY data exceeded the GBD-DALY results in most injury categories. The ICD-DALY results displayed an increased burden compared with the GBD-DALY results by 18-fold, for the burns less than 20% category, and by 6-fold, for the burns greater than 60% category. Meanwhile, the ICD-DALY was lower for the fracture-face bones and spinal cord injury categories compared with the GBD-DALY.

We observed a high correlation between the GBD-DALY and ICD-DALY. Spearman's rank correlation coefficients for YLL, YLD, and DALY were 0.988 (P < 0.001), 0.738 (P < 0.001), and 0.759 (P < 0.001), respectively (Fig. 5A–C). To test the agreement be-

tween the two methods, we analyzed the results using the Bland-Altman test (Fig. 5D). Two categories were in disagreement, thereby demonstrating the limits of the agreement range (e.g., dislocation-other dislocation and sprains).

DISCUSSION

We developed the ICD-DALY in the current study, which represents the first attempt to describe an injury measurement for specific injury codes regarding the GBD. Most GBD studies have focused on the community-based burden of disease.[2,3,15,18] The GBD-DALY has potential for comparing the burden of disease but not individuals with specific injuries. However, the current study

Fig. 4. Comparison of global burden of disease (GBD)–disability-adjusted life year (DALY) and International Classification of Disease 10th edition (ICD)–DALY by 32 injury nature categories.
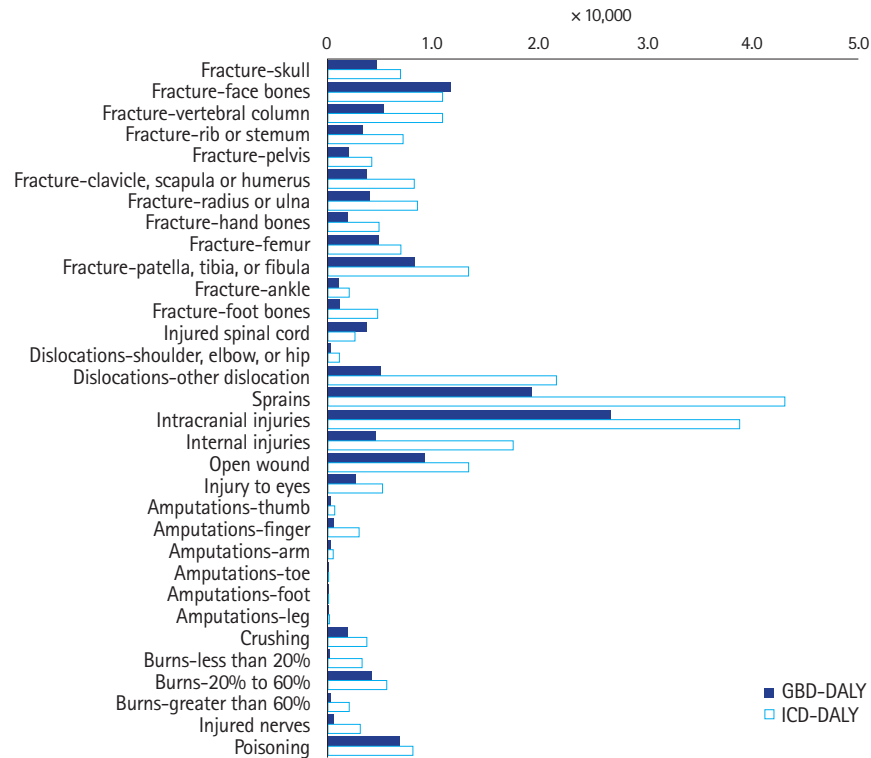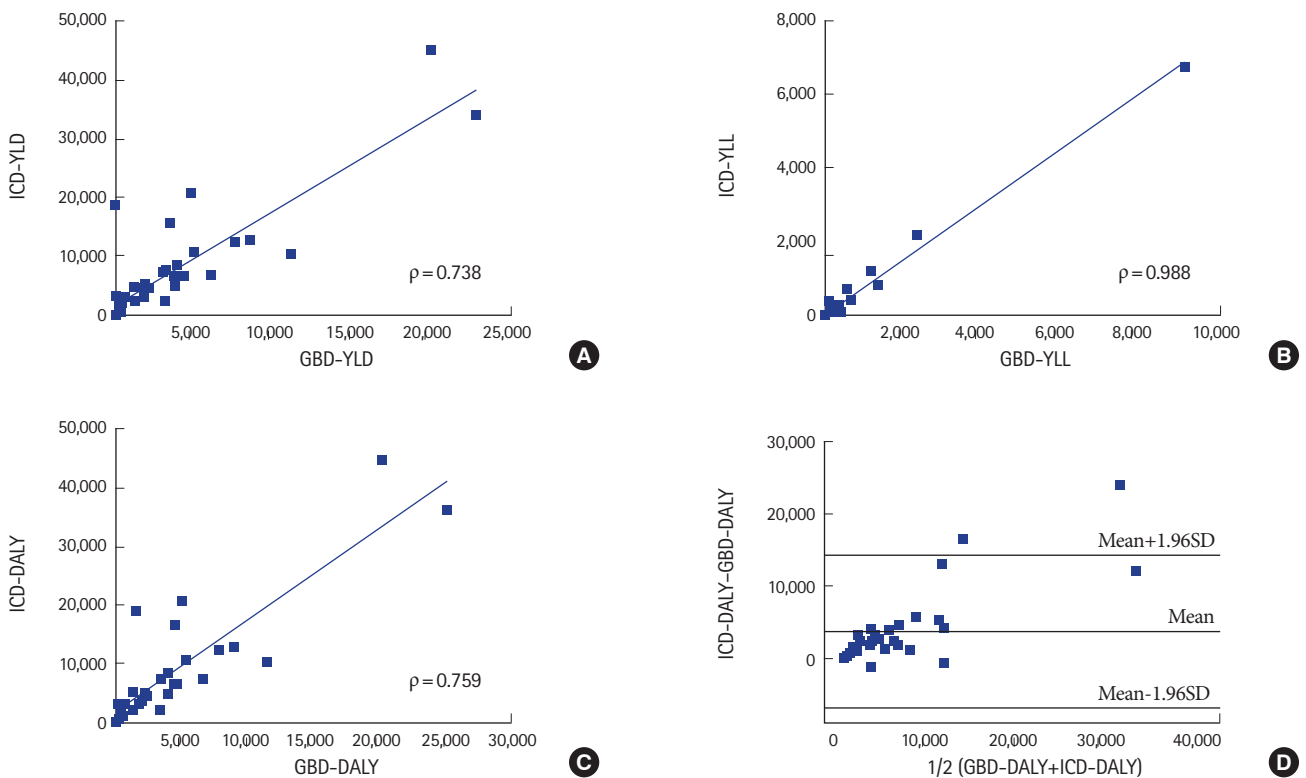

Fig. 5. Comparison of global burden of disease (GBD)–disability-adjusted life year (DALY) and International Classification of Disease 10th edition (ICD)–DALY. (A) Comparison for years of life disabled (YLD), (B) comparison for years of life lost (YLL), (C) comparison for DALY, and (D) Bland-Altman plot. SD, standard deviation.

focused on individual data with specific individual injury diagnosis codes. In many countries, injury surveillance and nation-wide injury datasets exist, which include exact diagnosis codes and injury mechanisms. Most injury datasets include subject age, diagnosis, time of injury, and mortality outcome. These variables are included for analyzing risk factors, developing injury prevention strategies, and evaluating the effect of such interventions. Using this tool and these three variables, the ICD-DALY can be calculated for every injured individual.

The current technique described in our study is a cost-saving method designed for calculating the burden of injury. Resource intensive methods, including the Disability Rating Scale and the Glasgow Outcome Scale, assess the individual disability of an injured victim, but these tools require follow-up interviews with the subject.[21,22] Although these clinical tools provide a reliable assessment of patient disability, their limitations primarily involve the amount of effort required to perform the calculations. In contrast, the ICD-DALY provides a risk-based DALY, which requires fewer resources and is applicable across large databases. This tool now allows for these new outcome parameters in injury research, incidence, mortality, and DALY per individual patient. Hospital-based injury data are also useful for calculating disability and are comparable with other conditions.[23]

This study used a complex methodology to determine the DW derived from injury diagnostic codes. Injury codes vary in terms of severity, mechanism, and outcome, but an injury group cannot be considered one disease entity. Poisonings display a broad spectrum of severity; therefore, a DW for poisoning must account for specific subcategories. Therefore, the determination of a disability for each individual ICD-10 injury code is ideal, but there are too many injury codes (n = 1,284) to be decided via expert-based consensus (panel study). Therefore, indicator injury codes (n = 130, 10%) based on the strata by morbidity/mortality (like ARR) were chosen. To interpolate the DW using the value of the indicator ICD-10 codes, it is essential to have evenly distributed DW values for all ICD-10 codes. We successfully selected indicator injury codes and then interpolated the corresponding DWs into the remaining ICD-10 injury codes. Previous panel studies have demonstrated varying methodological results.[16,17,24] In accordance with previous studies, the current study demonstrated that the PTO1 method displays the best correlation among panel groups. We accepted the PTO1 method as the ideal tool and used it to determine the DWs for the 130 codes, which were then interpolated in the next step. The PTO1 and VAS methods demonstrated a high correlation for common standard injury codes. We used the VAS method for interpolation to all other codes, which demonstrated a good correlation performance with the PTO1 method. Similarly,

other studies have utilized the VAS method due to this benefit.[15,18] This study tested the reliability of the DW of each code using the test-retest method.[25] We found excellent reliability among the median DWs derived from the PTO1 method.

Validation was performed by comparing the ICD-DALY and GBD-DALY values of 32 nature of injury categories, as a direct comparison for all injury codes was impossible. Both measurements correlated strongly ($\rho = 0.759$, $P < 0.001$), although the ICD-DALY were higher than the GBD-DALY results across most categories. The Bland-Altman test showed an acceptable agreement in most categories, with the exception of two categories. Overall, higher agreements were observed between the ICD-DALY and GBD-DALY results in homogeneous categories with similar anatomic areas, injury depth, and severity. Meanwhile, for the remaining heterogeneous categories with different anatomical injuries, the agreement was poor between ICD-DALY and GBD-DALY (e.g., dislocation-shoulder/elbow/hip, dislocation-other dislocation, sprain, intracranial injury, internal injury, open wound, injury of the eyes, crushing, burns-less than 20%, burns-20% to 60%, burns-greater than 60%, injured nerves and poisoning). We assume that the differences between ICD-DALY and GBD-DALY are more marked in the heterogeneous injury categories because they have an increased variety of ICD injury codes compared with the homogeneous category. The GBD-DALY may have excessively reclassified all injuries into 32 injury categories. For example, neurologic deficits, soft tissue injuries, burns, and poisoning would be overlooked in 32 injury categories despite the wide range of disabilities that these injuries incur. The GBD-YLL and ICD-YLL showed very good agreement but GBD-YLD and ICD-YLD showed poorer agreement (Fig. 5A, B). The YLD can be calculated from death, which is clearly defined, for calculation but YLD might be incorrect due to different DWs of injury categories.

This study has certain limitations. First, the interpolation method may be used to determine the DALY. Only 10% of the indicator injury codes were reviewed by the panel groups, while the other codes were estimated via interpolation. Although we tested the reliability of the DW as an indicator for the ICD code (n = 16), the entire ICD-10 code was not tested for reliability. Second, we calculated DALYs using the maximum DW among the multiple injury codes that were diagnosed during the same episode (multiple injuries). Therefore, the DALYs might be underestimated because the remaining injury-associated disability was not included. For patients with multiple injuries, the DALY would be minimally calculated. Third, our validation method in which two DALY results were compared is limited in terms of the injury codes that were not compared due to the difficulty of re-categorizing the injury codes into 32 injury categories. Finally, the ICD-DALY method was

not validated with clinical disability parameters or the quality-adjusted life year.[26]

To efficiently calculate the burden of injury for individual victims, the ICD-10-based DALY was developed and validated using a nationwide database. We found that this new method was easy and feasible for estimating the disability of each individual injury victim and comparable to the GBD-DALY. The ICD-DALY should be extensively validated to apply it for injury epidemiology and prevention.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

ACKNOWLEDGMENTS

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Appendix 1. One hundred and thirty indicator injury diagnosis

No.	ICD–10	Diagnosis
1	S00.5	Superficial injury of lip and oral cavity
2	S01.3	Open wound of ear
3	S02.0	Fracture of vault of skull
4	S02.4	Fracture of malar and maxillary bones
5	S02.8	Fracture of other skull and facial bones
6	S03.1	Dislocation of septal cartilage of nose
7	S05.0	Injury of conjunctiva and corneal abrasion without mention of foreign body
8	S05.5	Penetrating wound of eyeball with foreign body
9	S05.7	Avulsion of eye
10	S10.9	Superficial injury of neck, part unspecified
11	S14.3	Injury of brachial plexus
12	S14.4	Injury of peripheral nerves of neck
13	S15.7	Injury of multiple blood vessels at neck level
14	S15.9	Injury of unspecified blood vessels at neck level
15	S20.0	Contusion of breast
16	S20.4	Other superficial injuries of back wall of thorax
17	S20.8	Superficial injury of other and unspecified parts of thorax
18	S22.4	Multiple fracture of ribs
19	S22.8	Fracture of other parts of bony thorax
20	S23.3	Sprain and strain of thoracic spine
21	S24.3	Injury of peripheral nerves of thorax
22	S25.1	Injury of innominate or subclavian artery
23	S27.6	Injury of pleura
24	S30.2	Contusion of external genital organs
25	S33.0	Traumatic rupture of lumbar intervertebral disc
26	S34.8	Injury of other and unspecified nerves at abdomen, lower back and pelvis level
27	S38.2	Traumatic amputation of external genital organs
28	S40.7	Multiple superficial injuries of shoulder and upper arm
29	S43.4	Sprain and strain of shoulder joint
30	S46.1	Injury of muscle and tendon of long head of biceps
31	S52.2	Fracture of shaft of ulna
32	S52.5	Fracture of lower end of radius
33	S54.0	Injury of ulnar nerve at forearm level
34	S56.2	Injury of other flexor muscle and tendon at forearm level
35	S57.8	Crushing injury of other parts of forearm
36	S60.0	Contusion of finger(s) without damage to nail
37	S62.0	Fracture of navicular [scaphoid] bone of hand
38	S63.1	Dislocation of finger
39	S63.2	Multiple dislocation of fingers
40	S63.7	Sprain and strain of other and unspecified parts of hand
41	S65.9	Injury of unspecified blood vessel at wrist and hand level
42	S66.3	Injury of extensor muscle and tendon of other finger at wrist and hand level
43	S66.5	Injury of intrinsic muscle and tendon of other finger at wrist and hand level
44	S68.3	Combined traumatic amputation of (part of) finger(s) with other parts of wrist and hand
45	S69.0	Other and unspecified injuries of wrist and hand
46	S69.8	Other specified injuries of wrist and hand
47	S70.0	Contusion of hip
48	S72.9	Fracture of femur, part unspecified
49	S74.0	Injury of sciatic nerve at hip and thigh level
50	S75.2	Injury of greater saphenous vein at hip and thigh level
51	S77.0	Crushing injury of hip

(Continued to the next page)

Appendix 1. Continued

No.	ICD-10	Diagnosis
52	S80.9	Superficial injury of lower leg, unspecified
53	S82.3	Fracture of lower end of tibia
54	S83.2	Tear of meniscus, current
55	S84.0	Injury of tibial nerve at lower leg level
56	S88.9	Traumatic amputation of lower leg, level unspecified
57	S89.9	Unspecified injury of lower leg
58	S92.5	Fracture of other toe
59	S93.3	Dislocation of other and unspecified parts of foot
60	S94.9	Injury of unspecified nerves at ankle and foot level
61	S95.7	Injury of multiple blood vessels at ankle and foot level
62	T01.2	Open wounds involving multiple regions of upper limb(s)
63	T01.6	Open wounds involving multiple regions of upper limb(s) with lower limb(s)
64	T04.3	Crushing injuries involving multiple regions of lower limb(s)
65	T05.6	Traumatic amputation of upper and lower limbs, any combination[any level]
66	T05.9	Multiple traumatic amputations, unspecified
67	T06.3	Injuries of blood vessels involving multiple body regions
68	T09.0	Superficial injury of trunk, level unspecified
69	T09.6	Traumatic amputation of trunk, level unspecified
70	T16.0	Foreign body in ear
71	T17.8	Foreign body in other and multiple parts of respiratory tract
72	T20.1	Burn of first degree of head and neck
73	T21.3	Burn of third degree of trunk
74	T24.3	Burn of third degree of hip and lower limb, except ankle and foot
75	T25.3	Burn of third degree of ankle and foot
76	T25.7	Corrosion of third degree of ankle and foot
77	T26.2	Burn with resulting rupture and destruction of eyeball
78	T26.3	Burn of other parts of eye and adnexa
79	T26.6	Corrosion of cornea and conjunctival sac
80	T26.9	Corrosion of eye and adnexa, part unspecified
81	T27.1	Burn involving larynx and trachea with lung
82	T27.5	Corrosion involving larynx and trachea with lung
83	T29.7	Corrosion of multiple regions, at least one corrosion of third degree mentioned
84	T31.0	Burns involving less than 10% of body surface
85	T31.2	Burns involving 20 to 29% of body surface
86	T33.0	Superficial frostbite of head
87	T33.6	Superficial frostbite of hip and thigh
88	T33.8	Superficial frostbite of ankle and foot
89	T37.1	Antimycobacterial drugs
90	T39.0	Salicylate
91	T40.3	Methadone
92	T41.5	Therapeutic gases
93	T42.2	Succinimide and oxazolidinedione
94	T42.7	Antiepileptic and sedative-hypnotis drugs, unspecified
95	T44.8	Centrally acting and adrenergic-neuron-blocking agents, NEC
96	T45.5	Anticoagulants
97	T46.8	Antivaricose drugs, including sclerosing agents
98	T47.8	Other agents primarily affecting the gastrointestinal system
99	T50.7	Analeptics and opioid receptor antagonists
100	T51.8	Other alcohols
101	T53.0	Carbon tetrachloride
102	T53.3	Tetrachloroethylene

Appendix 1. Continued

No.	ICD-10	Diagnosis
103	T56.0	Lead and its compounds
104	T59.8	Other specified gases, fumes and vapours
105	T60.2	Other insecticides
106	T63.0	Snake venom
107	T63.2	Venom of scorpion
108	T63.9	Toxic effect of contact with unspecified venomous animal
109	T65.9	Toxic effect of unspecified substance
110	T68.0	Hypothermia
111	T71.0	Asphyxiation
112	T73.8	Other effects of deprivation
113	T75.1	Drowning and nonfatal submersion
114	T79.5	Traumatic anuria
115	T80.9	Unspecified complications following infusion, transfusion and therapeutic injection
116	T82.3	Mechanical complication of other vascular grafts
117	T82.9	Unspecified complication of cardiac and vascular prosthetic devices, implants and grafts
118	T83.0	Mechanical complication of urinary (indselling) catheter
119	T83.8	Other complications of genitourinary prosthetic devices, implants and grafts
120	T87.4	Infection of amputation stump
121	T87.6	Other and unspecified complications of amputation stump
122	T90.9	Sequelae of unspecified injury of head
123	T91.9	Sequelae of unspecified injury of neck and trunk
124	T92.9	Sequelae of unspecified injury of upper limb
125	T94.0	Sequelae of injuries involving multiple body regions
126	T95.0	Sequelae of burn, corrosion and frostbite of head and neck
127	T95.1	Sequelae of burn, corrosion and frostbite of trunk
128	T95.9	Sequelae of unspecified burn, corrosion and frostbite
129	T98.1	Sequelae of other and unspecified effects of external causes
130	T98.3	Sequelae of complications of surgical and medical care, NEC

ICD-10, International Classification of Diseases 10th edition; NEC, not elsewhere classified.

Appendix 2. The value estimation methods used in the calculation of GBD-DALY and ICD-DALY

Value	a (YLL)	a (YLD)	L (YLL)	L (YLD)	DW
Definition	Age at death	Age at injury	Life expectancy	Disability duration	Disability weight
GBD-DALY	DisMod II	DisMod II	Cohort absolute life table	DisMod II	32 Injury nature
ICD-DALY	Injury data base	Injury data base	Cohort absolute life table	Cohort absolute life table	1,284 ICD S/T codes

GBD, Global Burden of Disease Study; DALY, disability-adjusted life year; ICD, International Classification of Disease 10th edition; YLL, years of life lost; YLD, years of life disabled; DW, disability weight.

Appendix 3. Disability weight according to injury related ICD-10 codes

ICD-10	DW	ICD-10	DW	ICD-10	DW	ICD-10	DW	ICD-10	DW
S00.0	0.02	S38.3	0.7	S83.7	0.3	T25.4	0.3	T54.2	0.29
S00.1	0.02	S39.0	0.36	S84.0	0.775	T25.5	0.2	T54.3	0.325
S00.2	0.01	S39.6	0.7	S84.1	0.3	T25.6	0.3	T54.9	0.325
S00.3	0.02	S39.7	0.65	S84.2	0.12	T25.7	0.375	T55.0	0.08
S00.4	0.02	S39.8	0.6	S84.7	0.44	T26.0	0.15	T56.0	0.245
S00.5	0.005	S39.9	0.6	S84.8	0.4	T26.1	0.18	T56.1	0.2
S00.7	0.02	S40.0	0.105	S84.9	0.13	T26.2	0.606	T56.2	0.325
S00.8	0.02	S40.7	0.048	S85.0	0.45	T26.3	0.129	T56.3	0.325
S00.9	0.01	S40.8	0.11	S85.1	0.35	T26.4	0.38	T56.4	0.275
S01.0	0.12	S40.9	0.05	S85.2	0.5	T26.5	0.39	T56.5	0.15
S01.1	0.13	S41.0	0.3	S85.3	0.25	T26.6	0.444	T56.6	0.2
S01.2	0.125	S41.1	0.305	S85.4	0.21	T26.7	0.5	T56.8	0.2
S01.3	0.048	S41.7	0.33	S85.5	0.425	T26.8	0.4	T56.9	0.15
S01.4	0.05	S41.8	0.12	S85.7	0.4	T26.9	0.258	T57.0	0.15
S01.5	0.05	S42.0	0.25	S85.8	0.2	T27.0	0.8	T57.1	0.2
S01.7	0.18	S42.1	0.23	S85.9	0.25	T27.1	0.697	T57.2	0.2
S01.8	0.05	S42.2	0.23	S86.0	0.35	T27.2	0.6	T57.3	0.5
S01.9	0.04	S42.3	0.23	S86.1	0.39	T27.3	0.4	T57.8	0.275
S02.0	0.167	S42.4	0.435	S86.2	0.42	T27.4	0.84	T57.9	0.25
S02.1	0.4	S42.7	0.25	S86.3	0.18	T27.5	1	T58.0	0.45
S02.2	0.15	S42.8	0.2	S86.7	0.3	T27.6	0.5	T59.0	0.25
S02.3	0.16	S42.9	0.2	S86.8	0.35	T27.7	0.825	T59.1	0.5
S02.4	0.167	S43.0	0.18	S86.9	0.3	T28.0	0.3	T59.2	0.33
S02.5	0.1	S43.1	0.25	S87.0	0.5	T28.1	0.5	T59.3	0.25
S02.6	0.4	S43.2	0.21	S87.8	0.57	T28.2	0.4	T59.4	0.31
S02.7	0.48	S43.3	0.4	S88.0	0.75	T28.3	0.55	T59.5	0.435
S02.8	0.258	S43.4	0.31	S88.1	0.75	T28.4	0.7	T59.6	0.33
S02.9	0.3	S43.5	0.11	S88.9	0.7	T28.5	0.35	T59.7	0.2
S03.0	0.1	S43.6	0.1	S89.0	0.35	T28.6	0.5	T59.8	0.333
S03.1	0.15	S43.7	0.09	S89.7	0.45	T28.7	0.55	T59.9	0.4
S03.2	0.1	S44.0	0.47	S89.8	0.3	T28.8	0.55	T60.0	0.475
S03.3	0.08	S44.1	0.475	S89.9	0.091	T28.9	0.55	T60.1	0.25
S03.4	0.075	S44.2	0.47	S90.0	0.125	T29.0	0.25	T60.2	0.35
S03.5	0.06	S44.3	0.28	S90.1	0.055	T29.1	0.17	T60.3	0.8
S04.0	0.8	S44.4	0.425	S90.2	0.07	T29.2	0.26	T60.4	0.25
S04.1	0.2	S44.5	0.1	S90.3	0.05	T29.3	0.6	T60.8	0.6
S04.2	0.775	S44.7	0.45	S90.7	0.11	T29.4	0.3	T60.9	0.7
S04.3	0.75	S44.8	0.41	S90.8	0.115	T29.5	0.12	T61.0	0.2
S04.4	0.775	S44.9	0.28	S90.9	0.115	T29.6	0.28	T61.1	0.15
S04.5	0.765	S45.0	0.35	S91.0	0.215	T29.7	0.545	T61.2	0.3
S04.6	0.4	S45.1	0.25	S91.1	0.215	T30.0	0.3	T61.8	0.25
S04.7	0.25	S45.2	0.25	S91.2	0.12	T30.1	0.12	T61.9	0.25
S04.8	0.76	S45.3	0.2	S91.3	0.09	T30.2	0.25	T62.0	0.4
S04.9	0.3	S45.7	0.2	S91.7	0.215	T30.3	0.4	T62.1	0.15
S05.0	0.282	S45.8	0.33	S92.0	0.32	T30.4	0.3	T62.2	0.2
S05.1	0.325	S45.9	0.33	S92.1	0.4	T30.5	0.3	T62.8	0.15
S05.2	0.8	S46.0	0.18	S92.2	0.3	T30.6	0.35	T62.9	0.1
S05.3	0.45	S46.1	0.444	S92.3	0.3	T30.7	0.4	T63.0	0.35
S05.4	0.825	S46.2	0.3	S92.4	0.25	T31.0	0.091	T63.1	0.2
S05.5	0.998	S46.3	0.25	S92.5	0.333	T31.1	0.2	T63.2	0.231
S05.6	0.55	S46.7	0.14	S92.7	0.415	T31.2	0.272	T63.3	0.3

Appendix 3. Continued

ICD-10	DW	ICD-10	DW	ICD-10	DW	ICD-10	DW	ICD-10	DW
S05.7	0.8	S46.8	0.275	S92.9	0.405	T31.3	0.4	T63.4	0.05
S05.8	0.3	S46.9	0.275	S93.0	0.2	T31.4	0.5	T63.5	0.12
S05.9	0.25	S47.0	0.45	S93.1	0.2	T31.5	0.6	T63.6	0.12
S06.0	0.2	S48.0	0.45	S93.2	0.25	T31.6	0.65	T63.8	0.3
S06.1	0.61	S48.1	0.45	S93.3	0.286	T31.7	0.8	T63.9	0.029
S06.2	0.6	S48.9	0.45	S93.4	0.165	T31.8	0.775	T64.0	0.36
S06.3	0.2	S49.0	0.25	S93.5	0.08	T31.9	0.895	T65.0	0.5
S06.4	0.4	S49.7	0.3	S93.6	0.07	T32.0	0.3	T65.1	0.4
S06.5	0.71	S49.8	0.27	S94.0	0.3	T32.1	0.35	T65.2	0.3
S06.6	0.57	S49.9	0.25	S94.1	0.3	T32.2	0.45	T65.3	0.4
S06.7	0.8	S50.0	0.15	S94.2	0.17	T32.3	0.55	T65.4	0.26
S06.8	0.585	S50.1	0.08	S94.3	0.25	T32.4	0.6	T65.5	0.16
S06.9	0.6	S50.7	0.05	S94.7	0.4	T32.5	0.65	T65.6	0.14
S07.0	0.85	S50.8	0.05	S94.8	0.4	T32.6	0.7	T65.8	0.15
S07.1	0.9	S50.9	0.05	S94.9	0.167	T32.7	0.85	T65.9	0.091
S07.8	0.88	S51.0	0.305	S95.0	0.31	T32.8	0.85	T66.0	0.26
S07.9	0.72	S51.7	0.09	S95.1	0.31	T32.9	0.95	T67.0	0.25
S08.0	0.425	S51.8	0.1	S95.2	0.12	T33.0	0.091	T67.1	0.275
S08.1	0.575	S51.9	0.1	S95.7	0.259	T33.1	0.05	T67.2	0.2
S08.8	0.565	S52.0	0.35	S95.8	0.15	T33.2	0.16	T67.3	0.215
S08.9	0.535	S52.1	0.35	S95.9	0.31	T33.3	0.06	T67.4	0.215
S09.0	0.2	S52.2	0.38	S96.0	0.3	T33.4	0.05	T67.5	0.15
S09.1	0.1	S52.3	0.38	S96.1	0.18	T33.5	0.06	T67.6	0.11
S09.2	0.2	S52.4	0.4	S96.2	0.3	T33.6	0.029	T67.7	0.24
S09.7	0.45	S52.5	0.38	S96.7	0.3	T33.7	0.075	T67.8	0.13
S09.8	0.16	S52.6	0.4	S96.8	0.3	T33.8	0.048	T67.9	0.15
S09.9	0.4	S52.7	0.45	S96.9	0.28	T33.9	0.05	T68.0	0.258
S10.0	0.1	S52.8	0.2	S97.0	0.5	T34.0	0.38	T69.0	0.19
S10.1	0.125	S52.9	0.4	S97.1	0.35	T34.1	0.58	T69.1	0.22
S10.7	0.05	S53.0	0.13	S97.8	0.465	T34.2	0.6	T69.8	0.18
S10.8	0.02	S53.1	0.33	S98.0	0.6	T34.3	0.37	T69.9	0.175
S10.9	0.012	S53.2	0.2	S98.1	0.45	T34.4	0.6	T70.0	0.21
S11.0	0.32	S53.3	0.2	S98.2	0.57	T34.5	0.625	T70.1	0.22
S11.1	0.3	S53.4	0.07	S98.3	0.57	T34.6	0.3	T70.2	0.15
S11.2	0.3	S54.0	0.167	S98.4	0.55	T34.7	0.55	T70.3	0.26
S11.7	0.35	S54.1	0.42	S99.0	0.25	T34.8	0.53	T70.4	0.225
S11.8	0.35	S54.2	0.375	S99.7	0.23	T34.9	0.575	T70.8	0.2
S11.9	0.3	S54.3	0.36	S99.8	0.12	T35.0	0.05	T70.9	0.25
S12.0	0.9	S54.7	0.4	S99.9	0.18	T35.1	0.7	T71.0	0.9
S12.1	0.8	S54.8	0.4	T00.0	0.1	T35.2	0.15	T73.0	0.05
S12.2	0.6	S54.9	0.375	T00.1	0.06	T35.3	0.14	T73.1	0.08
S12.7	0.71	S55.0	0.36	T00.2	0.04	T35.4	0.6	T73.2	0.1
S12.8	0.4	S55.1	0.17	T00.3	0.06	T35.5	0.15	T73.3	0.11
S12.9	0.6	S55.2	0.17	T00.6	0.07	T35.6	0.15	T73.8	0.129
S13.0	0.6	S55.7	0.1	T00.8	0.08	T35.7	0.12	T73.9	0.15
S13.1	0.7	S55.8	0.15	T00.9	0.07	T36.0	0.1	T74.0	0.2
S13.2	0.65	S55.9	0.36	T01.0	0.22	T36.1	0.1	T74.1	0.25
S13.3	0.9	S56.0	0.4	T01.1	0.31	T36.2	0.4	T74.2	0.25
S13.4	0.15	S56.1	0.2	T01.2	0.25	T36.3	0.1	T74.3	0.25
S13.5	0.175	S56.2	0.708	T01.3	0.15	T36.4	0.25	T74.8	0.25
S13.6	0.26	S56.3	0.3	T01.6	0.303	T36.5	0.125	T74.9	0.25

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Appendix 3. Continued

ICD–10	DW	ICD–10	DW	ICD–10	DW	ICD–10	DW	ICD–10	DW
S14.0	0.8	S56.4	0.3	T01.8	0.325	T36.6	0.125	T75.0	0.7
S14.1	0.5	S56.5	0.2	T01.9	0.45	T36.7	0.175	T75.1	0.857
S14.2	0.6	S56.7	0.3	T02.0	0.5	T36.8	0.175	T75.2	0.31
S14.3	0.667	S56.8	0.3	T02.1	0.65	T36.9	0.1	T75.3	0.03
S14.4	0.048	S57.0	0.3	T02.2	0.45	T37.0	0.25	T75.4	0.25
S14.5	0.55	S57.8	0.5	T02.3	0.45	T37.1	0.5	T75.8	0.16
S14.6	0.35	S57.9	0.48	T02.4	0.65	T37.2	0.15	T78.0	0.5
S15.0	0.7	S58.0	0.735	T02.5	0.65	T37.3	0.1	T78.1	0.15
S15.1	0.5	S58.1	0.73	T02.6	0.68	T37.4	0.1	T78.2	0.625
S15.2	0.4	S58.9	0.725	T02.7	0.75	T37.5	0.2	T78.3	0.3
S15.3	0.5	S59.0	0.37	T02.8	0.7	T37.8	0.125	T78.4	0.185
S15.7	0.6	S59.7	0.36	T02.9	0.7	T37.9	0.12	T78.8	0.1
S15.8	0.3	S59.8	0.4	T03.0	0.5	T38.0	0.25	T78.9	0.2
S15.9	0.444	S59.9	0.17	T03.1	0.2	T38.1	0.12	T79.0	0.675
S16.0	0.3	S60.0	0.048	T03.2	0.1	T38.2	0.225	T79.1	0.5
S17.0	0.575	S60.1	0.085	T03.3	0.3	T38.3	0.275	T79.2	0.325
S17.8	0.4	S60.2	0.1	T03.4	0.3	T38.4	0.15	T79.3	0.265
S17.9	0.4	S60.7	0.05	T03.8	0.1	T38.5	0.1	T79.4	0.5
S18.0	0.95	S60.8	0.3	T03.9	0.3	T38.6	0.125	T79.5	0.9
S19.0	0.43	S60.9	0.06	T04.0	0.68	T38.7	0.2	T79.6	0.29
S19.7	0.45	S61.0	0.15	T04.1	0.6	T38.8	0.15	T79.7	0.3
S19.8	0.36	S61.1	0.1	T04.2	0.58	T38.9	0.15	T79.8	0.35
S19.9	0.5	S61.7	0.1	T04.3	0.756	T39.0	0.25	T79.9	0.32
S20.0	0.029	S61.8	0.2	T04.4	0.625	T39.1	0.25	T80.0	0.32
S20.1	0.03	S61.9	0.1	T04.7	0.65	T39.2	0.2	T80.1	0.34
S20.2	0.03	S62.0	0.2	T04.8	0.575	T39.3	0.07	T80.2	0.2
S20.3	0.03	S62.1	0.2	T04.9	0.615	T39.4	0.15	T80.3	0.525
S20.4	0.029	S62.2	0.15	T05.0	0.85	T39.8	0.25	T80.4	0.31
S20.7	0.03	S62.3	0.18	T05.1	0.89	T39.9	0.2	T80.5	0.5
S20.8	0.017	S62.4	0.2	T05.2	0.9	T40.0	0.15	T80.6	0.475
S21.0	0.4	S62.5	0.2	T05.3	0.75	T40.1	0.16	T80.8	0.3
S21.1	0.15	S62.6	0.285	T05.4	0.78	T40.2	0.15	T80.9	0.167
S21.2	0.375	S62.7	0.28	T05.5	0.82	T40.3	0.111	T81.0	0.275
S21.7	0.3	S62.8	0.32	T05.6	0.796	T40.4	0.3	T81.1	0.6
S21.8	0.38	S63.0	0.2	T05.8	0.875	T40.5	0.515	T81.2	0.17
S21.9	0.18	S63.1	0.333	T05.9	0.9	T40.6	0.22	T81.3	0.5
S22.0	0.45	S63.2	0.286	T06.0	0.85	T40.7	0.375	T81.4	0.2
S22.1	0.575	S63.3	0.225	T06.1	0.775	T40.8	0.4	T81.5	0.525
S22.2	0.34	S63.4	0.22	T06.2	0.5	T40.9	0.15	T81.6	0.6
S22.3	0.2	S63.5	0.07	T06.3	0.444	T41.0	0.2	T81.7	0.22
S22.4	0.5	S63.6	0.115	T06.4	0.3	T41.1	0.7	T81.8	0.2
S22.5	0.63	S63.7	0.091	T06.5	0.6	T41.2	0.7	T81.9	0.525
S22.8	0.333	S64.0	0.19	T06.8	0.22	T41.3	0.15	T82.0	0.5
S22.9	0.4	S64.1	0.225	T07.0	0.3	T41.4	0.225	T82.1	0.485
S23.0	0.27	S64.2	0.36	T08.0	0.725	T41.5	0.048	T82.2	0.7
S23.1	0.5	S64.3	0.3	T09.0	0.007	T42.0	0.16	T82.3	0.65
S23.2	0.38	S64.4	0.18	T09.1	0.19	T42.1	0.28	T82.4	0.3
S23.3	0.091	S64.7	0.3	T09.2	0.25	T42.2	0.091	T82.5	0.675
S23.4	0.13	S64.8	0.3	T09.3	0.37	T42.3	0.25	T82.6	0.675
S23.5	0.2	S64.9	0.2	T09.4	0.725	T42.4	0.2	T82.7	0.675
S24.0	0.7	S65.0	0.25	T09.5	0.2	T42.5	0.25	T82.8	0.54

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Appendix 3. Continued

ICD-10	DW	ICD-10	DW	ICD-10	DW	ICD-10	DW	ICD-10	DW
S24.1	0.4	S65.1	0.25	T09.6	1	T42.6	0.25	T82.9	0.6
S24.2	0.55	S65.2	0.2	T09.8	0.2	T42.7	0.75	T83.0	0.583
S24.3	0.5	S65.3	0.3	T09.9	0.17	T42.8	0.25	T83.1	0.35
S24.4	0.26	S65.4	0.21	T10.0	0.25	T43.0	0.275	T83.2	0.3
S24.5	0.3	S65.5	0.17	T11.0	0.05	T43.1	0.22	T83.3	0.25
S24.6	0.3	S65.7	0.3	T11.1	0.25	T43.2	0.2	T83.4	0.45
S25.0	0.85	S65.8	0.25	T11.2	0.11	T43.3	0.25	T83.5	0.475
S25.1	0.55	S65.9	0.167	T11.3	0.275	T43.4	0.24	T83.6	0.475
S25.2	0.69	S66.0	0.25	T11.4	0.17	T43.5	0.2	T83.8	0.475
S25.3	0.6	S66.1	0.25	T11.5	0.25	T43.6	0.23	T83.9	0.3
S25.4	0.55	S66.2	0.36	T11.6	0.6	T43.8	0.15	T84.0	0.25
S25.5	0.63	S66.3	0.231	T11.8	0.12	T43.9	0.25	T84.1	0.525
S25.7	0.32	S66.4	0.2	T11.9	0.12	T44.0	0.25	T84.2	0.4
S25.8	0.6	S66.5	0.091	T12.0	0.45	T44.1	0.26	T84.3	0.25
S25.9	0.31	S66.6	0.2	T13.0	0.175	T44.2	0.15	T84.4	0.4
S26.0	0.825	S66.7	0.24	T13.1	0.13	T44.3	0.15	T84.5	0.525
S26.8	0.6	S66.8	0.3	T13.2	0.12	T44.4	0.25	T84.6	0.25
S26.9	0.6	S66.9	0.365	T13.3	0.11	T44.5	0.15	T84.7	0.4
S27.0	0.45	S67.0	0.3	T13.4	0.15	T44.6	0.15	T84.8	0.25
S27.1	0.45	S67.8	0.39	T13.5	0.15	T44.7	0.25	T84.9	0.4
S27.2	0.75	S68.0	0.5	T13.6	0.85	T44.8	0.231	T85.0	0.42
S27.3	0.3	S68.1	0.48	T13.8	0.15	T44.9	0.15	T85.1	0.36
S27.4	0.4	S68.2	0.55	T13.9	0.195	T45.0	0.1	T85.2	0.4
S27.5	0.65	S68.3	0.722	T14.0	0.05	T45.1	0.32	T85.3	0.35
S27.6	0.333	S68.4	0.72	T14.1	0.315	T45.2	0.15	T85.4	0.3
S27.7	0.825	S68.8	0.62	T14.2	0.25	T45.3	0.15	T85.5	0.45
S27.8	0.5	S68.9	0.35	T14.3	0.2	T45.4	0.12	T85.6	0.45
S27.9	0.775	S69.0	0.02	T14.4	0.12	T45.5	0.333	T85.7	0.25
S28.0	0.6	S69.7	0.25	T14.5	0.25	T45.6	0.52	T85.8	0.25
S28.1	0.85	S69.8	0.167	T14.6	0.2	T45.7	0.2	T85.9	0.45
S29.0	0.4	S69.9	0.3	T14.7	0.5	T45.8	0.17	T86.0	0.6
S29.7	0.355	S70.0	0.091	T14.8	0.2	T45.9	0.5	T86.1	0.6
S29.8	0.5	S70.1	0.08	T14.9	0.3	T46.0	0.5	T86.2	0.85
S29.9	0.5	S70.7	0.065	T15.0	0.19	T46.1	0.3	T86.3	0.8
S30.0	0.34	S70.8	0.07	T15.1	0.04	T46.2	0.2	T86.4	0.85
S30.1	0.2	S70.9	0.03	T15.8	0.2	T46.3	0.2	T86.8	0.5
S30.2	0.091	S71.0	0.12	T15.9	0.2	T46.4	0.2	T86.9	0.5
S30.7	0.08	S71.1	0.1	T16.0	0.011	T46.5	0.12	T87.0	0.5
S30.8	0.23	S71.7	0.21	T17.0	0.15	T46.6	0.2	T87.1	0.65
S30.9	0.07	S71.8	0.225	T17.1	0.01	T46.7	0.38	T87.2	0.65
S31.0	0.18	S72.0	0.45	T17.2	0.05	T46.8	0.13	T87.3	0.45
S31.1	0.4	S72.1	0.5	T17.3	0.3	T46.9	0.2	T87.4	0.708
S31.2	0.15	S72.2	0.4	T17.4	0.3	T47.0	0.125	T87.5	0.45
S31.3	0.15	S72.3	0.4	T17.5	0.35	T47.1	0.08	T87.6	0.583
S31.4	0.25	S72.4	0.4	T17.8	0.333	T47.2	0.075	T88.0	0.2
S31.5	0.325	S72.7	0.525	T17.9	0.35	T47.3	0.15	T88.1	0.275
S31.7	0.5	S72.8	0.3	T18.0	0.115	T47.4	0.1	T88.2	0.625
S31.8	0.45	S72.9	0.5	T18.1	0.25	T47.5	0.03	T88.3	0.25
S32.0	0.45	S73.0	0.5	T18.2	0.15	T47.6	0.065	T88.4	0.5
S32.1	0.3	S73.1	0.1	T18.3	0.2	T47.7	0.065	T88.5	0.2
S32.2	0.25	S74.0	0.333	T18.4	0.175	T47.8	0.091	T88.6	0.4
S32.3	0.56	S74.1	0.25	T18.5	0.175	T47.9	0.065	T88.7	0.15

Appendix 3. Continued

ICD-10	DW	ICD-10	DW	ICD-10	DW	ICD-10	DW	ICD-10	DW
S32.4	0.32	S74.2	0.2	T18.8	0.21	T48.0	0.125	T88.8	0.475
S32.5	0.52	S74.7	0.38	T18.9	0.2	T48.1	0.25	T88.9	0.4
S32.7	0.6	S74.8	0.36	T19.0	0.315	T48.2	0.12	T90.0	0.1
S32.8	0.48	S74.9	0.19	T19.1	0.2	T48.3	0.15	T90.1	0.39
S33.0	0.456	S75.0	0.475	T19.2	0.07	T48.4	0.1	T90.2	0.25
S33.1	0.685	S75.1	0.45	T19.3	0.3	T48.5	0.06	T90.3	0.5
S33.2	0.3	S75.2	0.583	T19.8	0.1	T48.6	0.1	T90.4	0.3
S33.3	0.5	S75.7	0.465	T19.9	0.18	T48.7	0.13	T90.5	0.55
S33.4	0.34	S75.8	0.46	T20.0	0.3	T49.0	0.1	T90.8	0.3
S33.5	0.225	S75.9	0.4	T20.1	0.048	T49.1	0.08	T90.9	0.444
S33.6	0.15	S76.0	0.46	T20..2	0.3	T49.2	0.05	T91.0	0.1
S33.7	0.1	S76.1	0.45	T20.3	0.625	T49.3	0.05	T91.1	0.55
S34.0	0.65	S76.2	0.48	T20.4	0.5	T49.4	0.1	T91.2	0.39
S34.1	0.35	S76.3	0.25	T20.5	0.12	T49.5	0.05	T91.3	0.41
S34.2	0.52	S76.4	0.2	T20.6	0.25	T49.6	0.1	T91.4	0.6
S34.3	0.39	S76.7	0.3	T20.7	0.52	T49.7	0.1	T91.5	0.3
S34.4	0.57	S77.0	0.6	T21.0	0.25	T49.8	0.1	T91.8	0.4
S34.5	0.3	S77.1	0.58	T21.1	0.15	T49.9	0.1	T91.9	0.333
S34.6	0.23	S77.2	0.65	T21.2	0.315	T50.0	0.1	T92.0	0.21
S34.8	0.231	S78.0	0.8	T21.3	0.333	T50.1	0.1	T92.1	0.25
S35.0	0.825	S78.1	0.77	T21.4	0.35	T50.2	0.18	T92.2	0.25
S35.1	0.6	S78.9	0.75	T21.5	0.23	T50.3	0.1	T92.3	0.12
S35.2	0.73	S79.0	0.3	T21.6	0.33	T50.4	0.15	T92.4	0.25
S35.3	0.785	S79.7	0.35	T21.7	0.5	T50.5	0.1	T92.5	0.26
S35.4	0.5	S79.8	0.15	T22.0	0.15	T50.6	0.12	T92.6	0.39
S35.5	0.49	S79.9	0.485	T22.1	0.05	T50.7	0.149	T92.8	0.12
S35.7	0.6	S80.0	0.09	T22.2	0.2	T50.8	0.18	T92.9	0.333
S35.8	0.575	S80.1	0.12	T22.3	0.46	T50.9	0.28	T93.0	0.13
S35.9	0.575	S80.7	0.06	T22.4	0.4	T51.0	0.12	T93.1	0.25
S36.0	0.48	S80.8	0.06	T22.5	0.1	T51.1	0.65	T93.2	0.15
S36.1	0.635	S80.9	0.006	T22.6	0.275	T51.2	0.25	T93.3	0.12
S36.2	0.55	S81.0	0.1	T22.7	0.35	T51.3	0.25	T93.4	0.36
S36.3	0.665	S81.7	0.24	T23.0	0.15	T51.8	0.212	T93.5	0.12
S36.4	0.55	S81.8	0.12	T23.1	0.05	T51.9	0.22	T93.6	0.4
S36.5	0.68	S81.9	0.21	T23.2	0.16	T52.0	0.3	T93.8	0.25
S36.6	0.685	S82.0	0.3	T23.3	0.4	T52.1	0.2	T93.9	0.3
S36.7	0.65	S82.1	0.3	T23.4	0.275	T52.2	0.27	T94.0	0.393
S36.8	0.53	S82.2	0.49	T23.5	0.2	T52.3	0.29	T94.1	0.2
S36.9	0.6	S82.3	0.667	T23.6	0.3	T52.4	0.25	T95.0	0.545
S37.0	0.55	S82.4	0.2	T23.7	0.425	T52.8	0.315	T95.1	0.32
S37.1	0.685	S82.5	0.2	T24.0	0.24	T52.9	0.3	T95.2	0.3
S37.2	0.68	S82.6	0.45	T24.1	0.12	T53.0	0.35	T95.3	0.2
S37.3	0.625	S82.7	0.5	T24.2	0.3	T53.1	0.25	T95.4	0.25
S37.4	0.625	S82.8	0.3	T24.3	0.419	T53.2	0.21	T95.8	0.25
S37.5	0.5	S82.9	0.35	T24.4	0.4	T53.3	0.048	T95.9	0.31
S37.6	0.45	S83.0	0.41	T24.5	0.1	T53.4	0.21	T96.0	0.16
S37.7	0.65	S83.1	0.2	T24.6	0.32	T53.5	0.2	T97.0	0.1
S37.8	0.52	S83.2	0.667	T24.7	0.4	T53.6	0.3	T98.0	0.35
S37.9	0.55	S83.3	0.375	T25.0	0.2	T53.7	0.15	T98.1	0.667
S38.0	0.705	S83.4	0.1	T25.1	0.1	T53.9	0.15	T98.2	0.3
S38.1	0.7	S83.5	0.1	T25.2	0.3	T54.0	0.2	T98.3	0.5
S38.2	0.857	S83.6	0.1	T25.3	0.5	T54.1	0.54		

ICD-10, International Classification of Disease 10th edition; DW, disability weight.

Appendix 4. The excluded categories from the comparison with ICD-DALY and GBD-DALY

ICD code	Category or subcategory
T14.2	Fracture of unspecified body region
T14.8	Other injuries of unspecified body region
T14.9	Injury, unspecified
T34.0–T34.9	Frostbite with tissue necrosis
T35.0–T35.7	Frostbite involving multiple body regions and unspecified frostbite
T66	Unspecified effects of radiation
T67.0–T67.9	Effects of heat and light
T68	Hypothermia
T69.0–T69.9	Other effects of reduced temperature
T70.0–T70.9	Effects of air pressure and water pressure
T71	Asphyxiation
T73.0–T73.9	Effects of other deprivation
T74.0–T74.9	Maltreatment syndromes
T75.0–T75.8	Effects of other external causes
T78.0–T78.9	Adverse effects, NEC
T79.0–T79.9	Certain early complications of trauma, NEC
T80.0–T80.9	Complications following infusion, transfusion and therapeutic injection
T81.0–T81.9	Complications of procedures, NEC
T82.0–T82.9	Complications of cardiac and vascular prosthetic devices, implants and grafts
T83.0–T83.9	Complications of genitourinary prosthetic devices, implants and grafts
T84.0–T84.9	Complications of internal orthopaedic prosthetic devices, implants and grafts
T85.0–T85.9	Complications of other internal prosthetic devices, implants and grafts
T86.0–T86.9	Failure and rejection of transplanted organs and tissues
T87.0–T87.6	Complications peculiar to reattachment and amputation
T88.0–T88.9	Other complications of surgical and medical care, NEC
T94.0,T94.1	Sequelae of injuries involving multiple and unspecified body regions
T95.0–T95.9	Sequelae of burns, corrosions and frostbite
T96	Sequelae of poisoning by drugs, medicaments and biological substances
T97	Sequelae of toxic effects of substances chiefly nonmedicinal as to source
T98.0–T98.3	Sequelae of other and unspecified effects of external causes

ICD, International Classification of Disease 10th edition; DALY, disability-adjusted life year; GBD, Global Burden of Disease Study; NEC, not elsewhere classified.