# Functioning in victims of non-fatal traffic accident

*Funcionalidade em vítimas não fatais de acidente de trânsito*

Flávia Guimarães Dias Duarte [1*]
Ligia Regina de Oliveira [2]
Francine Nesello Melanda [2]
Franciele Silvia de Carlo [2]

[1] Secretaria Municipal de Saúde, Cuiabá, MT, Brazil
[2] Universidade Federal de Mato Grosso (UFMT), Cuiabá, MT, Brazil

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***Correspondence:** flaviagdd@gmail.com

## Abstract

**Introduction:** Traffic accidents are a problem for the health system and society, evidenced by the high rates of deaths, hospitalizations and care in health services due to serious injuries and disabilities, affecting the functioning and quality of life of individuals. **Objective:** To identify outcome measures in studies on victims of non-fatal traffic accidents, to fulfill the first step in the development of a Core Set of the International Classification of Functioning, Disability and Health (ICF) for victims of non-fatal traffic accidents. **Methods:** A systematic review of published articles was carried out in the electronic databases PubMed/MEDLINE and SciELO, between 2011 and 2022, using terms in English. The search strategy combined terms about the consequences of traffic accidents in adults. The selection of articles was carried out by two independent reviewers, applying the eligibility criteria. **Results:** A total of 626 studies were located in the databases, and 91 articles were included in the review. The consequences observed in the studies were injuries, fractures and trauma. When extracting outcome measures, 780 concepts were identified, linked to a total of 124 ICF categories, in the components: body function (30 categories); body structure (72 categories); activity and participation (20 categories); and environmental factors (two categories). **Conclusion:** This systematic review revealed that the main consequences of non-fatal traffic accidents for victims are in the body structures related to the movement, mobility and stability of joints.

**Keywords:** Disabled people. International Classification of Functioning, Disability and Health. Traffic accidents. Wounds and injuries.

## *Resumo*

***Introdução:*** *Os acidentes de trânsito são um problema para o sistema de saúde e para a sociedade, evidenciado pelas altas taxas de óbito, internações e atendimento nos serviços de saúde em função das lesões graves e incapacidades, repercutindo na funcionalidade e qualidade de vida dos indivíduos.* ***Objetivo:*** *Identificar medidas de desfecho nos estudos sobre vítimas não fatais de acidentes de trânsito, para cumprir a primeira das etapas no desenvolvimento de um* core set *da Classificação Internacional de Funcionalidade, Incapacidade e Saúde (CIF) para vítimas não fatais de acidentes de trânsito.* ***Métodos:*** *Trata-se de uma revisão sistemática cuja busca foi feita nas bases de dados PubMed/MEDLINE e SciELO, entre 2011 e 2022, utilizando termos em inglês. A estratégia de busca combinou termos sobre as consequências dos acidentes de trânsito em adultos. A seleção dos artigos deu-se por dois revisores independentes, aplicando os critérios de elegibilidade.* ***Resultados:*** *Foram localizados 626 estudos nas bases de dados e incluídos, na revisão, 91 artigos. As consequências observadas nos estudos foram lesões, fraturas e traumas. Na extração das medidas de desfecho, 780 conceitos foram identificados, vinculados a um total de 124 categorias da CIF nos componentes: função do corpo (30 categorias); estrutura do corpo (72 categorias); atividade e participação (20 categorias); e fatores ambientais (duas categorias).* ***Conclusão:*** *Esta revisão sistemática revelou que as principais consequências dos acidentes de trânsito para as vítimas não fatais estão nas estruturas do corpo relacionadas ao movimento e à mobilidade e estabilidade das articulações.*


***Palavras-chaves:*** *Pessoas com deficiência. Classificação Internacional de Funcionalidade, Incapacidade e Saúde. Acidentes de trânsito. Ferimentos e lesões.*

## Introduction

Traffic accidents constitute an important public health problem, evidenced by the growing number of hospitalizations, serious injuries, disabilities, increased financial expenses and greater demand for urgent and emergency services, specialized care and rehabilitation, in addition to the biopsychosocial, economic and pension. They mainly affect young adults, male motorcyclists, who are economically active, and cause irreparable individual and collective damage.[1,2] Given the various consequences of traffic accidents, the World Health Organization (WHO) estimates that every year 1.3 million people are killed and tens of millions are injured or disabled as a result of traffic accidents.[3]

The WHO states that there is a large number of people who suffer non-fatal injuries as a result of traffic accidents and who become incapacitated, causing pressure on health services and requiring specialized procedures such as surgeries, admissions to intensive care units, prosthetics, orthoses and other highly complex resources.[3,4] Added to this scenario, disabilities tend to cause a reduction in the individual's ability to carry out routine activities expected in life in society, impacting the functioning and quality of life of individuals.[5]

The International Classification of Functioning, Disability and Health (ICF) was established by the WHO as a classification system that provides a conceptual basis for defining, describing and measuring human functioning, as well as standardizing language and assisting in communication and information exchange. about health and states related to it.[6]

The ICF represents a paradigm shift in thinking about disability and incapacity, moving from the linear biomedical model to the biopsychosocial one, which includes the interactions of health status and contextual factors, constituting an important instrument for assessing living conditions and for the promotion of social inclusion policies.[7] Establishing itself as a multidimensional tool, which allows viewing human health from various aspects and undertaking different approaches, the ICF can still be used in many sectors (health, education, social security, statistics, public policies) and in diverse settings such as clinical practices, teaching and research.[8] In addition to offering a comprehensive and holistic approach to health, it includes the interaction between a person's health condition, environmental and personal factors. When adopted in health services, it enables a more comprehensive understanding of individuals' needs and capabilities, expanding to more personalized and effective care. The ICF's biopsychosocial approach promotes the inclusion of different perspectives in the assessment and treatment process, thus promoting more patient-centered care and considering the complexities of the human experience in relation to health and illness.[9-12]

CAs a way of making the classification more practical, the WHO and ICF (ICF Research Branch) proposed the creation of shorter classification lists, namely the core sets or "main set", "basic set" and "essential items". This is

a basic set of the most relevant ICF codes to describe a given health situation to be used in all individuals, whether in clinical or epidemiological studies.[13] Although some authors disagree with the use of core sets, they have been used in some countries, as mentioned in a study carried out with the WHO Collaborating Center of the Family of International Classifications, which aimed to present a global and updated portrait of the main uses of the ICF over 20 years.[14]

The basic sets began to be produced in 2004 and there are several existing around the world for different health conditions, such as breast cancer, obesity, chronic general pain, neurological conditions, AIDS, and cervical cancer, among others.[13,15-18] To date, however, no core sets have been identified in the national and international literature for classifying functioning and disability in victims of traffic accidents.

The construction of the ICF core sets involves a scientific process based on the proposal of Selb et al.[19] and Bickenbach et al.,[20] consisting of several methods: 1) systematic review of the literature to identify the researchers' perspective on outcome measures related to the investigated object, in this case, traffic accidents; 2) clinical research with individuals to analyze the problems most commonly related to disability and quality of life in victims of traffic accidents using the ICF checklist as an assessment tool; 3) qualitative research using semi-structured interviews to investigate individuals' perception of their health condition; and 4) research with experts (Delphi study) to identify the perception of health professionals about the most relevant functional and environmental factors of victims of traffic accidents.

With the purpose of fulfilling the first of the steps planned for the development of an ICF core set for victims of non-fatal traffic accidents, this work sought to answer the following question: What are the consequences for adult victims of non-fatal traffic accidents in the world? Thus, the systematic review aimed to identify the outcome measures addressed in published studies on victims of non-fatal traffic accidents and to correlate them with the ICF.

## Methods

The systematic review aims to systematize knowledge of a given area of study for its implementation. In this study, the following steps were followed: (1) elaboration of the research question; (2) literature search; (3) selection of articles; (4) data extraction; (5) assessment of methodological quality; (6) data synthesis; (7) assessment of the quality of evidence; and (8) writing and publishing results.[21] A detailed protocol was registered on Prospero (CRD42023452808).

AThe research question covered the four components of the PICO anagram: population (adult victims of traffic accidents around the world); intervention or exposure (traffic accidents); comparison (not applicable); and outcome (consequences such as injuries, injuries, traumas, sequelae, disabilities). Literature searches were carried out in the PubMed (U.S. National Library of Medicine – MEDLINE) and SciELO (Scientific Electronic Library Online) databases, in journals published between 2011 and 2022, without language restrictions.

The following terms were used to identify publications about the consequences of traffic accidents in adults: "traffic accident", "traffic collision", "traffic crashes", "consequences", "injuries", "wounds", "trauma severity indices" , "disabled persons", "sequel", "disabilit", "international classification of functioning". To construct the search strategy, these terms were combined using Boolean operators AND and/or OR according to the rules of each database (Table 1).

**Table 1** - Keywords used to search for articles in electronic databases

| Database | Concept blocks used |
|---|---|
| PubMed/ MEDLINE | (traffic accident*[Title] OR traffic Collision*[Title] OR Traffic Crashes [Title]) AND (consequences[Title/Abstract] OR Injuries[Title/ Abstract] OR Wounds[Title/Abstract] OR "Trauma Severity Indices"[Title/Abstract] OR "Disabled Persons"[Title/Abstract] OR sequel*[Title/Abstract] OR disabilit*[Title/Abstract] OR "international classification of functioning"[Title/Abstract]) |
| SciELO | (ti:(traffic accident* OR traffic collision* OR traffic crashes* OR acidente transito*) AND (consequences OR injuries OR wounds OR "Trauma Severity Indices") OR ("Disabled Persons" OR sequel* OR disabilit*) OR ("international classification of functioning") |

Note: access on 04/19/2023.

The established inclusion criterion was a primary study that presented data on the consequences, injuries, traumas, sequelae or disabilities in adults involved in traffic accidents. The exclusion criteria considered were

articles that did not provide access to the abstract or full text, studies only on mortality, qualitative studies, case studies, clinical trials, methodological studies and instrument validation.

The study selection stage took place through the evaluation of titles and abstracts, carried out by two independent reviewers, applying the defined eligibility criteria. In case of disagreement, a third independent reviewer analyzed it. Agreement between researchers regarding study eligibility was analyzed using the Kappa coefficient: mild (K < 0.4), moderate (K ≤ 0.4 to < 0.8), strong (K ≤ 0.8 to < 1.0) and perfect (K = 1.0).[22]

Assessment of the methodological quality of studies and evidence in a systematic review aims to reduce the presence of bias and the impact on the validity of the study; therefore, the items contained in the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) initiative were used to evaluate the studies. The 22 items in the STROBE checklist establish what should be contained in observational studies for a more complete and accurate description of the research object, with studies that include more than 16 items (75%) of STROBE being included in the review.

To extract the outcome measures, the reviewers independently analyzed the complete articles, identifying the concepts (injuries, injuries, traumas, sequelae or disabilities resulting from traffic accidents) contained in the outcome measures, including all types of measures assessed, such as: wounds, injuries, problems in body structures and functions, traumas, severity indices, disabilities, sequelae, limitations in carrying out any activity expected in daily life, as well as restrictions in participating in society.

After this step, the most relevant significant concepts contained in the outcome measures were linked to the most specific category of the ICF, in accordance with the linking rules proposed by Cieza et al.[23,24] To carry out this stage, two reviewers with experience in using the ICF made the connection; that is, they classified/coded the meaning concepts using the classification codes, and when there was no consensus between the two, a third reviewer classified the concept.

The descriptive analysis of the identified concepts was carried out using absolute and relative frequencies. The degree of agreement between the two professionals who evaluated the summaries and linked the concepts with the ICF was calculated using the simple Kappa coefficient. Those with a percentage frequency equal to or greater than 5% of publications were included in the list of candidate categories of the ICF core set, with the second hierarchical level being considered independent of the possibility of greater detail in connection with the classification.

## Results

The search strategy located 626 studies in the databases searched, 79 of which were removed because of duplication, leaving 547 studies for title and abstract analysis. Subsequently, following the established exclusion criteria, 107 articles were read in full to analyze eligibility. Considering the type of study and research object, 16 were excluded, resulting in 91 studies included in the review. Figure 1 shows the selection process for articles in this review.

Regarding the quality of the studies included in the review, the median percentage was 88.6% (77.3-100). All studies included more than 16 items from the STROBE initiative, and therefore, none were excluded at this stage. The selected articles came from 34 countries, representing five continents, with the majority of studies carried out in Asia (38.2%), Europe (38.2%) and Africa (11.7%). They were published by 65 different journals, with the journals "Traffic Injury Prevention", "Injury", "International Journal of Critical Illness and Injury Science", and "Accident Analysis & Prevention" being responsible for 30.7% of publications.

All articles eligible for the systematic review had observational methods as a study design to describe victims of traffic accidents, 73.6% of which were cross-sectional studies. The number of participants in the surveys ranged from 14 to 653,386, with an average age of 25 to 70.9 years. The main consequences identified in the selected articles were injuries, fractures and trauma to various parts of the body. Table 2 presents the characteristics and outcomes of the studies.

Of the total number of studies, only 15 used standardized instruments. The most used were Injury Severity Score (ISS), in eight studies, and Abbreviated Injury Scale (AIS), in five studies, with the concepts of consequences (injuries, wounds, trauma, sequelae, disabilities) of traffic accidents identified in the measures of outcomes.

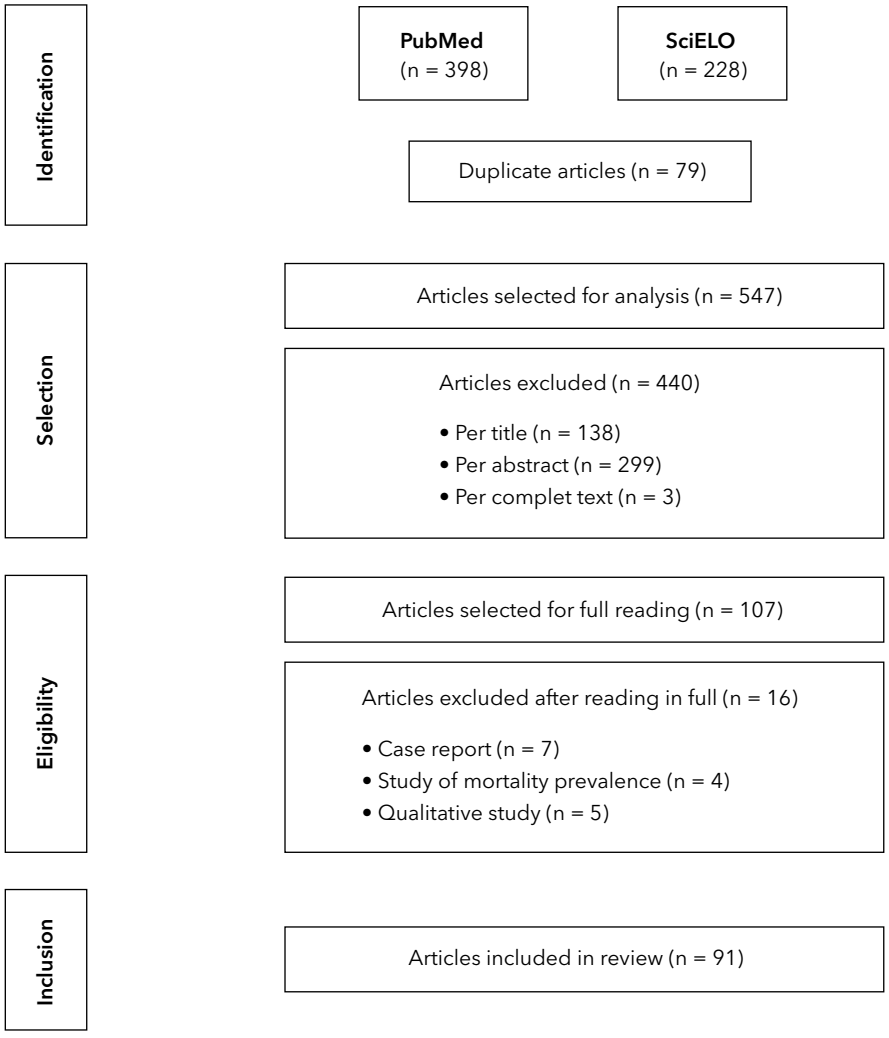


**Figure 1 -** Flowchart for selection of articles studied.

The Kappa coefficient found in the abstract analysis stage showed that there is moderate reliability between observers (K = 0.767; agreement = 89.7%).[22] In the connection stage with the contents of the ICF, the Kappa test showed that there is a disagreement between the observers (K = - 0.050; agreement = 89.2%)..

A total of 780 concepts were extracted from the outcome measures, identified in the 91 selected studies. Of these, 76 concepts (9.9%) were considered not defined by the ICF and 51 (6.6%) as a health condition. The other 653 concepts were linked to a total of 124 different ICF categories. In total, one concept (0.1%) was linked to the first level of the ICF, 453 (69.5%) to second-level categories, 160 (24.5%) to third-level categories and 39 (5.9%) %) to fourth level categories. It is noteworthy that eleven concepts were linked to more than one ICF category. In detailing the number of categories per level in each component of the ICF, we have:

- Body function: one category at the first level of the ICF, 72 at the second level, one at the third level and 11 at the fourth level;

- Body structure: 351 at second level, 157 at third level and 28 at fourth level;

- Activity and participation: 27 at second level, two at third level and none at fourth level;

- Environmental factors: three at second level.

**Table 2** - Main characteristics of eligible studies on the consequences of traffic accidents and quality assessment for the systematic review (n = 91)

| Author, location, and year | N | Outcomes | Study type | Instruments | STROBE |
|---|---|---|---|---|---|
| Adeoye et al.[39] Nigeria, 2014 | 571 | Injury, fracture of limbs, head, soft tissues, spine, burns | Cohort | Questionnaire | 77.3 |
| Agnihotri et al.[40] India, 2013 | 350 | Fracture of the nasal, jaw, orbital, frontal bones | Cross sectional | Questionnaire | 78.2 |
| Airaksinen et al.[41] Finland, 2018 | 574 | Subluxation of the vertebrae, multiple fractures of ribs, lower limbs, exposed in the distal tibia and fibula, vascular injury and thrombosis | Cross-sectional | Questionnaire | 100 |
| Aladelusi et al.[43] Nigeria, 2014 | 201 | Head trauma, injury to the chest, cervical spine, abdomen, fracture of the jaw, skull, eye and chest, multiple facial injuries, lacerations | Prospective cross-sectional | MFISS and ISS | 81.8 |
| Aldwsari, et al.[44] Saudi Arabia, 2018 | 237 | Scalp laceration, fractures of craniofacial and facial bones, brain stem hemorrhage | Cohort study | Questionnaire | 90.9 |
| Ammori et al. [45] Taiwan, 2016 | 85 | Injuries to the head, lower limbs, chest, abdomen, fracture or dislocation of the lower limb | Cohort | ISS and AIS | 100 |
| Arif et al.[46] India, 2019 | 311 | Lower face fractures, intracranial injury, abrasions, lacerations, contusions and extraoral communication | Cross-sectional | Questionnaire | 81.8 |
| Bambach et al.[18] Australia, 2014 | 49.082 | Injuries to chest, lower limbs, head, lungs, rib fractures | Cross-sectional | Questionnaire | 90.9 |
| Barbosa et al.[48] Brazil, 2014 | 210 | Injuries, fractures | Cross-sectional | Questionnaire | 86.4 |
| Brand et al.[49] Germany, 2012 | 4,430 | Injuries to the head, neck, maxillofacial region, abdomen, chest, extremities; trauma to abdomen, upper and lower extremities | Retrospective cross-sectional | AIS, ISS and MAIS | 81.8 |
| Bayan et al.[50] India, 2013 | 212 | Multiple injuries or multiple trauma to the lower limbs, fractures | Cross-sectional | Questionnaire | 77.3 |
| Behzadi et al.[51] Iran, 2020 | 3,277 | Injuries to the lower limbs | Cross-sectional | Questionnaire | 86.4 |
| Bhoi et al.[52] India, 2018 | 359 | Trauma to thead head, skull, face | Cross-sectional | Questionnaire | 95.5 |
| Bener et al.[53] Qatar, 2012 | 1,762 | Injuries to the head, face, neck and spine were most common | Cross-sectional | Questionnaire | 95.5 |
| Brito[54] Brazil, 2011 | 719 | Spinal trauma | Cross-sectional | Standardized form and ICF | 81.8 |
| Candefjord et al.[55] Sweden, 2016 | 119,768 | Chest and head trauma | Cross-sectional | ISS | 95.5 |
| Cardoso et al.[56] Brazil, 2020 | 203 | Fracture-type injuries | Cohort | Questionnaire | 86.4 |
| Cardoso et al.[57] Brazil, 2020 | 203 | Cuts, sprains, lacerations and multiple injuries | Cohort | Questionnaire | 86.4 |
| Chelly et al.[58] Tunisia, 2019 | 694 | Traumatic brain injury | Retrospective cross-sectional | Questionnaire | 86.4 |
| Cheynel et al.[59] France, 2011 | 2,009 | Cranioencephalic, thoracic and abdominopelvic injuries, also to spleen, retroperitoneal organs and liver | Cross-sectional | AIS and ISS | 86.4 |
| Choi et al.[60] Korea, 2016 | 846 | Fractures of the face, nasal bone, zygomatic complex, and blowout and maxillary fractures | Retrospective cross-sectional | AIS, ISS | 90.9 |

**Table 2** - Main characteristics of eligible studies on the consequences of traffic accidents and quality assessment for the systematic review (n = 91) (continued)

| Author, location, and year | N | Outcomes | Study type | Instruments | STROBE |
|---|---|---|---|---|---|
| Copanitsanou et al.[61] Greece, 2018 | 60 | Post-traumatic stress disorder, phobias, fear of driving and walking on the road | Cohort | IES-R, CES-D and SWLQ | 90.9 |
| Daskal et al.[62] Israel, 2018 | 28,635 | Traumatic brain injury; abdominal, chest, pelvis injuries | Cohort | AIS and ISS | 90.9 |
| Duan et al.[63] China, 2020 | 2,741 | Traumatic injury to brain, chest, limbs | Cross-sectional | Questionnaire | 95.5 |
| El-Menyar et al.[64] Qatar, 2016 | 5,118 | Lung contusions, rib fractures, pneumothorax and hemothorax, head injuries | Retrospective cross-sectional | Questionnaire | 86.4 |
| Etehad et al.[65] Iran, 2015 | 1,306 | Polytrauma and trauma to multiple body regions, head and neck injuries | Cross-sectional | Questionnaire | 86.4 |
| Erem et al.[66] Uganda, 2017 | 178 | Traumatic brain injury, extracerebral hemorrhage, cerebral edema, skull fractures, headache, dizziness, convulsions, mental changes | Cross-sectional | Questionnaire | 77.3 |
| Ernstberger et al.[67] Germany, 2015 | 44,503 | Leg, pelvic, upper extremity injuries, head trauma | Prospective cross-sectional | Questionnaire | 100 |
| Fekadu et al.[68] Ethiopia, 2019 | 299 | Post-traumatic stress disorder, alcohol dependence, sleep disorders | Cohort study | PCL, PHQ-2 and AUDIT | 90.9 |
| Fernando et al.[69] Sri Lanka, 2017 | 579 | Soft tissue injury, abrasions, contusions, lacerations and fractures | Retrospective cross-sectional | MLEF | 81.8 |
| Freitas et al.[70] Brazil, 2018 | 439 | Closed fractures, open fractures, dislocations, vascular injuries, sprains and nerve injuries, changes in joint mobility, gait pattern, muscle strength | Cross-sectional | Questionnaire | 77.3 |
| Bilgin et al.[71] Turkey, 2012 | 168 | Injuries to extremities, multiple, head and neck, internal organs, arteries, nerves and fractures | Case-control | MLEF | 81.8 |
| Gomei et al.[72] Japan, 2013 | 115 | Injuries and fractures of the head, chest, extremities, face, abdomen and spine | Retrospective cross-sectional | Questionnaire | 86.4 |
| Gorge et al.[73] Saudi Arabia, 2020 | 1,314 | Serious injuries to the head, neck, thorax, abdomen, pelvis, lower and upper limbs | Cross-sectional | Questionnaire | 95.5 |
| Gupta et al.[74] Cambodia, 2018 | 491 | Serious injuries to the head, neck, thorax, abdomen, pelvis lower and upper limbs Traumatic brain injury, contusions, epidural and subdural hematomas, subarachnoid hemorrhages, skull and facial fractures | Retrospective cross-sectional | Questionnaire | 100 |
| Hadaye et al.[75] India, 2020 | 476 | Lower limbs and head, neck and face, single-site fracture; obstacles on the road, defective roads and poor lighting | Cross-sectional | Questionnaire | 77.3 |
| Helm et al.[76] Germany, 2013 | 479 | Injuries to the skull, face, neck/cervical spine, chest, abdomen, thoracic/lumbar spine, pelvis, upper and lower limbs | Retrospective cross-sectional | Questionnaire | 86.4 |
| Huang et al.[77] China and Germany, 2018 | 43 | Head trauma, brain injuries | Cohort | Questionnaire | 90.9 |
| Inamasu et al.[78] Japan, 2018 | 409 | Traumatic brain injury | Retrospective cross-sectional | Questionnaire | 95.5 |
| Iteke et al.[79] Nigeria, 2011 | 150 | Post-traumatic stress disorder | Case-control | Questionnaire | 86.4 |
| Ito et al.[80] Japan, 2019 | 943 | Serious injuries to the pelvis and extremities, head and neck, abdomen, chest | Cohort | Questionnaire | 100 |

**Table 2** - Main characteristics of eligible studies on the consequences of traffic accidents and quality assessment for the systematic review (n = 91) (continued)

| Author, location, and year | N | Outcomes | Study type | Instruments | STROBE |
|---|---|---|---|---|---|
| Johansson et al.[81] Canada, 2015 | 3,711 | Neck injury, pain in the neck, head and lower back, pain when moving the neck, sleeping problems and reduced ability to move the neck | Cohort | Questionnaire | 100 |
| Jovanovic et al.[82] Serbia, 2011 | 36 | Concurrent eye injuries, eyeball ruptures, adnexal damage | Cross-sectional | Questionnaire | 77.3 |
| Kaiser et al.[83] Czech Republic, 2012 | 326 | Brachial plexus injuries, root avulsion | Retrospective cross-sectional | Questionnaire | 77.3 |
| Karadana et al.[42] Turkey, 2013 | 2,003 | Traumatic brain injury, extremities, chest and abdomen | Prospective cross-sectional | MFISS and ISS | 81.8 |
| Kovačević et al.[84] Croatia, 2020 | 155 | Post-traumatic stress disorder, depression, anxiety | Cohort | Questionnaire | 100 |
| Kovačević et al.[85] Croatia, 2020 | 200 | Multiple injuries, serious injuries to head, face, neck, chest, abdomen, spine, upper and lower extremities, depression, anxiety | Cross-sectional | Questionnaire | 100 |
| Lee et al.[86] Republic of Korea, 2018 | 231 | Injuries to the head, neck, chest, abdomen, upper and lower extremities | Retrospective cross-sectional | Questionnaire | 95.5 |
| Leijdesdorff et al.[87] Netherlands, 2014 | 1,250 | Traumatic brain injury, contusion, skull fractures, hemorrhaging | Retrospective cross-sectional | Questionnaire | 90.9 |
| León et al.[88] Colombia, 2018 | 2,445 | Injuries to head/neck/cervical spine, face, chest/thoracic spine, abdomen/lumbar spine, limbs/pelvis, external areas | Retrospective cross-sectional | Questionnaire | 100 |
| Littleton et al.[89] Australia, 2011 | 95 | Musculoskeletal injuries to neck, chest, upper/lower limbs, back, shoulder | Cohort | Questionnaire | 100 |
| Littleton et al.[90] Australia, 2012 | 193 | Soft tissue injuries, fractures, abrasions and lacerations | Cohort | Questionnaire | 100 |
| Littleton et al.[91] Australia, 2014 | 95/98 | Musculoskeletal injuries, being mild injuries | Case-control | Questionnaire | 100 |
| Littleton et al.[92] Australia, 2014 | 96/98 | Musculoskeletal injuries to the neck, chest, back, lower/upper limbs, shoulder | Case-control | Questionnaire | 100 |
| Mahajan et al.[93] India, 2013 | 401 | Fractures, abdominal injuries, abrasions and bruises, lacerations and open wounds | Cross-sectional | Questionnaire | 77.3 |
| Mahdian et al.[94] Iran, 2015 | 1.723 | Traumatic brain injury, injuries to the head, vertebrae, chest, upper and lower limbs, abdomen | Cross-sectional | Questionnaire | 81.8 |
| Mahdian et al.[95] Iran, 2017 | 962 | Polytrauma, fractures and dislocations of extremities | Retrospective cross-sectional | Questionnaire | 95.5 |
| Mai et al.[96] Vietnam, 2020 | 413 | Problems with mobility, self-care, usual activities and pain/discomfort | Cross-sectional | Questionnaire | 95.5 |
| Majdan et al.[97] Austria, 2013 | 683 | Traumatic brain injury, injuries to the abdomen, extremities, face, head and neck, chest | Cross-sectional | Questionnaire | 100 |
| Malta et al.[98] Brazil, 2016 | 60,202 | Bodily injury, complications, disabilities | Cross-sectional | Questionnaire | 86.4 |
| Meredith et al.[99] Sweden, 2020 | 284 | Fractures of the forearm, clavicle and tibia/fibula, hand, vertebrae and humerus | Case-control | STRADA and SFR | 81.8 |
| Mesquita Filho[100] Brazil, 2016 | 196 | Low elf-esteem and quality of life | Cross-sectional | WHOQOL-BREF | 81.8 |
| Meyyappan et al.[101] India, 2018 | 1,835 | Traumatic brain injury, maxillofacial trauma, soft tissue injuries | Retrospective case-control | Questionnaire | 81.8 |

**Table 2** - Main characteristics of eligible studies on the consequences of traffic accidents and quality assessment for the systematic review (n = 91) (continued)

| Author, location, and year | N | Outcomes | Study type | Instruments | STROBE |
|---|---|---|---|---|---|
| Mohtasham-Amiri et al.[102] Iran, 2016 | 7,671 | Multiple injuries to upper and lower extremities, head and neck, abdomen and pelvis, spine, face | Cross-sectional | Questionnaire | 77.3 |
| Monchal et al.[103] France, 2018 | 10,165 | Injuries to the abdomen, pelvic, diaphragm | Cross-sectional | Questionnaire | 81.8 |
| Ngunde et al.[104] Camaroon, 2019 | 197 | Lower limb injuries, fractures, lacerations and bruises/hematomas | Cross-sectional | Questionnaire | 81.8 |
| Nhac-Vu et al.[105] France, 2011 | 276 | Serious injuries to the lower limbs and head | Cohort | Questionnaire | 95.5 |
| Nóbrega et al.[106] Brazil, 2014 | 2,570 | Maxillofacial injuries, fractures of the mandible, maxilla, zygoma, dentoalveolar and dental injuries | Cross-sectional | Questionnaire | 95.5 |
| Nogami et al.[107] Japan, 2020 | 99 | Maxillofacial injuries, fractures of the mandible, maxilla, zygoma, dentoalveolar and dental injuries | Retrospective cross-sectional | Questionnaire | 86.4 |
| Okamoto et al.[108] Japan, 2019 | 14 | Open globe injuries, rupture and laceration | Retrospective cross-sectional | Questionnaire | 86.4 |
| Paiva et al.[109] Brazil, 2015 | 109 | Polytrauma, injuries to limbs, skull, abdomen, chest, spine, face | Retrospective cross-sectional | Questionnaire | 86.4 |
| Pajediene et al.[110] Lithuania, 2015 | 71 | Musculoskeletal injury to the neck and shoulder | Cohort | QTFQ, DRI, CFQ, HADS | 90.9 |
| Palmera-Suárez et al.[111] Spain, 2015 | 443 | Changes in mobility, home life, self-care, vision, hearing, communication, interactions and interpersonal relationships, learning | Cross-sectional | Questionnaire | 90.9 |
| Palmera-Suárez et al.[112] Spain, 2016 | 443 | Communication problems, general tasks and demands, interactions and interpersonal relationships | Cross-sectional | Questionnaire | 90.9 |
| Pan et al.[5] Taiwan, 2014 | 653,386 | Skull, upper and lower limb, spine and trunk fractures, contusion, head, neck and trunk injury, lower limb | Cross-sectional | Questionnaire | 77.3 |
| Papadakaki et al.[113] Greece, 2017 | 93 | Fractures to the head, face, chest, abdomen, spine, lower and upper extremities | Cohort | Questionnaire | 100 |
| Parreira et al.[114] Brazil, 2012 | 924 | Extradural, acute subdural, subarachnoid hematomas, facial fractures, brain contusion, injuries to the extremities, fractures to the upper and lower limbs and severe injuries to the extremities, spinal cord trauma, rib fractures | Retrospective case-control | Questionnaire | 81.8 |
| Pathak et al.[115] India, 2014 | 182 | Serious injuries, soft tissue injuries, lower limb fractures | Cross-sectional | Questionnaire | 81.8 |
| Pietzka et al.[116] Germany, 2020 | 12,613 | Maxillofacial injuries, and to eyes, mouth and ear, neurocranium, cervical spine | Retrospective cross-sectional | Questionnaire | 81.8 |
| Rastović et al.[117] Bosnia and Herzegovina, 2018 | 75 | Isolated neck injury, whiplash injury | Cross-sectional | Questionnaire | 77.3 |
| Reiniger et al.[118] Brazil, 2012 | 69 | General, neurological, thoracic, orthopedic, vascular surgery | Cross-sectional | Questionnaire | 81.8 |
| Roccia et al.[119] Italy, 2019 | 605 | Maxillofacial and face fractures | Retrospective cross-sectional | Questionnaire | 81.8 |
| Seid et al.[120] Ethiopia, 2015 | 230 | Fractures and open wounds in lower and upper limbs and skull, and spine, rib, clavicle and pelvis fractures | Prospective cross-sectional | Questionnaire | 81.8 |

**Table 2** - Main characteristics of eligible studies on the consequences of traffic accidents and quality assessment for the systematic review (n = 91) (continued)

| Author, location, and year | N | Outcomes | Study type | Instruments | STROBE |
|---|---|---|---|---|---|
| Shamim[121] Pakistan, 2017 | 385 | Abrasions, lacerations, fractures, contusions and bruises | Prospective cross-sectional | Questionnaire | 81.8 |
| Vahdati et al.[122] Iran, 2014 | 181 | Polytrauma, fractures of limbs, skull, brain contusion, traumatic brain injury and rupture of the viscera | Cross-sectional | Questionnaire | 77.3 |
| Singh et al.[123] India, 2014 | 347 | Injuries to extremities, maxillofacial, bruises, lacerations | Retrospective cross-sectional | Questionnaire | 81.8 |
| Tahir et al.[124] Pakistan, 2012 | 132,504 | Abrasions | Retrospective cross-sectional | Questionnaire | 81.8 |
| Terrier et al.[125] France, 2017 | 963 | Genitourinary, renal, testicular injuries | Retrospective cross-sectional | Questionnaire | 95.5 |
| Wangdi et al.[126] Bhutan, 2018 | 1,143 | Human (careless driving, drunk), environmental (road conditions) and vehicle mechanical factors | Cross-sectional | Questionnaire | 86.4 |
| Woyessa et al.[127] Ethiopia, 2020 | 286 | Multiple injuries, visceral; bone fractures, head and chest | Cross-sectional | Questionnaire | 95.5 |
| Yang et al.[128] Taiwan, 2017 | 3.318 | Nasal, jaw, maxillary, orbital fractures | Retrospective cross-sectional | Questionnaire | 77.3 |

Note: N = sample size; AIS = Abbreviated Injury Scale; AUDIT = Alcohol Use Disorder Identification Test; CES-D = Center for Epidemiologic Studies-Depression Score; ICF = International Classification of Functioning, Disability and Health; CFQ = Cognitive Failures Questionnaire; DRI = Disability Rating Index; HADS = Hospital Anxiety and Depression Scale; IES-R = Impact of Events Scale - Revised; ISS = Injury Severity Score; MAIS = Maximum Abbreviated Injury Scale; MFISS = Maxillofacial Injury Severity Score ; MLEF = Medico-legal Examination Form; PCL = Post-Traumatic Stress Disorder (PTSD) Checklist; PHQ-2 = Patient Health Question; QTFQ = Quebec Task Force Questionnaire; SFR = Swedish Fracture Register; STRADA = Swedish Traffic Crash Data Acquisition; STROBE = Strengthening the Reporting of Observational Studies in Epidemiology; SWLS = Satisfaction with Life Scale; WHOQOL-BREF = World Health Organization Quality of Life - abbreviated version.

Regarding the frequency of the ICF categories most related in each component, body structure stood out (82.1%), as seen in Table 3. Of the 124 ICF categories classified in each domain, they were listed in the body function component six of eight chapters (30 categories); in the body structure component, all eight chapters were included (72 categories); in the activity and participation component, there were eight of nine chapters (20 categories); and two of the five chapters (two categories) in the environmental factors component (Table 3).

The most frequent second-level categories were: body function: emotional functions (b152), pain sensation (b280), functions related to joint mobility (b710), skin repair functions (b820); body structure: structure of the brain (s110), head and neck region (s710), upper extremity (s730), pelvic region (s740), lower extremity (s750), trunk (s760); activity and participation: dealing with stress and other psychological demands (d240). A total of 18 ICF second-level categories showed a prevalence greater than 5% in all eligible studies. Five categories were identified in the body function component, twelve categories in body structure, one category of activity and participation, and no category in environmental factors (Table 4).

## Discussion

This article explored globally available data and evidence to identify and categorize the consequences experienced by adult victims of non-fatal traffic accidents. By analyzing the studies included in the review, it was possible to identify the most relevant ICF categories in a variety of contexts.

These categories, together with their frequency of occurrence, can provide valuable guidance for developing ICF core sets that capture the most essential aspects of functioning and disability in specific populations. By filling this knowledge gap, we intend to contribute to an understanding of the implications of traffic accidents on the functioning and well-being of these individuals.

The articles eligible for this systematic review had observational methods as a study design that encompassed a variety of designs, such as cohort, case-control and cross-sectional studies. These studies allow direct observation of victims over time, capturing a wide range of information related to injuries, sequelae and functional disabilities, as well as psychosocial and quality of life aspects.[25,26]

Since its publication in 2001, the ICF has been recognized as a complete and comprehensive classification to describe health and health-related states, but its complete use is a challenge due to the extensive list of categories. Therefore, to make it more practical, the WHO proposed the development of core sets.[11,12,27] Using the ICF theoretical framework, it was possible to identify and quantify the consequences of traffic accidents in adults and extract the outcome measures cited in the 91 studies included in this systematic review.

**Table 3** - Frequency distribution of components and chapters of the International Classification of Functioning, Disability and Health (ICF) linked to the concepts contained in the selected studies

| Components/Chapters | ICF code | n (%) |
|---|---|---|
| **Body functions** | - | 85 (13.0) |
| Mental | b110-b199 | 15 (17.6) |
| Sensory functions and pain | b210-b299 | 16 (18.8) |
| Cardiovascular and respiratory systems | b410-b499 | 1 (1.2) |
| Genitourinary and reproductive | b610-b699 | 2 (2.4) |
| Neuromusculoskeletal | b710-b799 | 21 (24.7) |
| Skin and related structures | b810-b869 | 30 (35.3) |
| **Body structures** | - | 536 (82.1) |
| Structures of nervous system | s110-s199 | 20 (3.7) |
| Eye, ear and related structures | s210-s299 | 13 (2.4) |
| Nose | s310-s399 | 10 (1.9) |
| Structures of cardiovascular, immunologic and respiratory systems | s410-s499 | 10 (1.9) |
| Structures related to digestive, metabolic and endocrine systems | s510-s599 | 1 (0.2) |
| Structures related to genitourinary and reproductive system | s610-s699 | 6 (1.1) |
| Structures related to movement | s710-s799 | 467 (87.1) |
| Skin | s810-s899 | 9 (1.7) |
| **Activities and participation** | - | 29 (4.4) |
| Learning and applying knowledge | d110-d199 | 1 (3.4) |
| General tasks and demands | d210-d299 | 8 (27.6) |
| Communication | d310-d399 | 3 (10.3) |
| Mobility | d410-d499 | 8 (27.6) |
| Self-care | d510-d599 | 2 (6.9) |
| Domestic life | d610-d649 | 1 (3.4) |
| Interpersonal interactions and relationships | d710-d749 | 3 (10.3) |
| Major life areas | d810-d899 | 3 (10.3) |
| **Environmental factors** | - | 3 (0.5) |
| Natural environment and human-made changes to environment | e210-e299 | 1 (33.3) |
| Services, systems and policies | e510-e599 | 2 (66.7) |

**Table 4** - Second-level categories of the International Classification of Functioning, Disability and Health (ICF) with a prevalence greater than 5% in studies eligible (91) for the review

| ICF component | Category | Description of category |
|---|---|---|
| Body functions | b152 | Emotional functions |
| | b280 | Sensation of pain |
| | b710 | Functions related to joint mobility |
| | b715 | Functions related to joint stability |
| | b820 | Skin repair functions |
| Body structures | s110 | Structure of brain |
| | s220 | Structure of eyeball |
| | s310 | Structure of nose |
| | s320 | Structure of mouth |
| | s710 | Structure of head and neck region |
| | s720 | Structure of shoulder region |
| | s730 | Structure of upper extremity |
| | s740 | Structure of region |
| | s750 | Structure of lower extremity |
| | s760 | Structure of trunk |
| | s770 | Additional movement-related musculoskeletal structures |
| | s810 | Structures of skin areas |
| Activities and participation | d240 | Dealing with stress and other psychological demands |

A total of 769 concepts were extracted from the selected articles, 642 of which were linked to a total of 124 ICF categories. The number of concepts extracted from the results corroborates the complexity of the consequences of traffic accidents, thus establishing the categories most observed in research for inclusion in the ICF core set for non-fatal victims of traffic accidents. Although the clinical presentation of the studies may be diverse, the main consequences were injuries, fractures and trauma to various parts of the body.[3,28-30] Understanding the nature and extent of these consequences is crucial to establishing effective interventions, especially in the care and rehabilitation. of the victims.

According to the linking rules proposed by Cieza et al.,[23,24] most concepts (83.5%) contained in the outcome measures were linked to the ICF. The others were considered as not defined by the ICF, when its categories could not be chosen precisely, or as a health condition, when the significant concept was not contained in the ICF (mainly categories coded by ICD-10), and the combination of the two classifications was advised. In a systematic review to identify outcome measures from clinical trials on chronic ischemic heart disease, diabetes mellitus, obesity and obstructive pulmonary disease, Wolf et al.[31] reached the same result in linking the concepts.

Among the outcome measures extracted from the studies, the concepts were related to all components of the ICF: body functions; body structures; activities and participation; environmental factors). The majority, however, referred to the body structure component, considered in the ICF as a disability (when the individual presents a problem with the functions or structures of the body, such as a significant deviation or loss). Body functions are the physiological functions of body systems, including psychological functions, and body structures are anatomical parts such as organs, limbs and their components.[32]

Among body structure deficiencies, the most prevalent domain was structures related to movement, structure of the head and neck region, upper and lower

extremities, pelvic region and trunk, followed by the body functions component, in which the categories emotional functions, pain sensation, those related to joint mobility and stability and skin repair functions were the most linked, as in other studies.[3,30,33-36]

When using the ICF as a reference instrument, it appears that the classification establishes an integrated theoretical model of biomedical, social and personal aspects, the biopsychosocial model, ascending to the biomedical model based on the linearity of diseases and injuries.[37] At this juncture, it is observed It is clear that the second-level categories of the ICF established, as per the researchers' perspective, basically include aspects of the biomedical model, with a low frequency of the concepts of activity and participation and almost no category of environmental factors. Although environmental factors are essential to assess functioning as part of the context in which individuals live, the studies that made up this review did not highlight their relevance in interacting with the health conditions of the populations studied, as the approaches were heavily restricted to biological aspects.

Knowing that environmental factors influence the process of functioning and disability of individuals through interaction with the other components of the ICF (body functions and structures, activities and participation), even though this fact was not highlighted in this review, it is essential to consider them in the analysis of health impacts, given their link with human performance, social participation and the living and health conditions of the population.[8,11,12,37,38]

Although every year thousands of people suffer non-fatal injuries as a result of traffic accidents and become disabled, which interferes with the individual's ability to carry out activities expected in life in society, research describing the conditions of functioning and disability is still scarce, as well as environmental factors that interfere in the lives of victims of traffic accidents.[4,33,36]

Although every year thousands of people suffer non-fatal injuries as a result of traffic accidents and become disabled, which interferes with the individual's ability to carry out activities expected in life in society, research describing the conditions of functioning and disability is still scarce, as well as environmental factors that interfere in the lives of victims of traffic accidents.

The functioning and disability of traffic accident survivors are relevant topics because of the need to understand the victim's contextual universe, their performance and ability to carry out routine activities in society, including the contribution or interference of environmental factors in the state of health of these individuals.

## Conclusion

EThis systematic review identified and extracted an important number of primary concepts about the consequences of traffic accidents in the outcome measures of the selected studies. When linking them to the components of the ICF, a greater frequency of outcomes referring to structures related to movement, mobility and stability of joints and the sensation of pain was observed. It was evident that the studies included in this review focused on the characteristics of the biomedical model, with a look at the sick body, not looking at functioning or the environmental factors that contribute to the improvement or not of the individual's functioning.

These results will be combined with the results of three other preparatory studies. The four studies will capture the perspectives of researchers, traffic accident victims and experts, and will serve as the scientific basis for the development of an ICF core set for victims of non-fatal traffic accidents for use in research and clinical practice.

## Authors' contributions

FGDD and LRO were responsible for the conception and design of the study. FGDD and FSC collected the data and all authors contributed to the analysis and interpretation of the results and writing and reviewing the manuscript. All authors approved the final version of the manuscript and are responsible for all aspects of it, including ensuring its accuracy and integrity.

## References

1. Morais Neto OL, Montenegro MMS, Monteiro RA, Siqueira Jr JB, Silva MMA, Lima CM, et al. Mortalidade por acidentes de transporte terrestre no Brasil na última década: tendência e aglomerados de risco. Cienc Saude Colet. 2012;17(9):2223-36. DOI

2. Brasil. Ministério da Saúde. Secretaria de Vigilância em Saúde. Saúde Brasil 2014: uma análise da situação de saúde e das causas externas. Brasília: Ministério da Saúde; 2015. 462 p. Full text link

3. Organização Pan-Americana da Saúde. Relatório do Seminário no Brasil para fortalecer a implantação de medidas voltadas à mobilidade sustentável em cidades brasileiras. Brasília: OPAS; 2019. Full text link

4. World Health Organization. Global status report on road safety 2023. Genebra: WHO; 2023. Full text link

5. Pan RH, Chang NT, Chu D, Hsu KF, Hsu YN, Hsu JC, et al. Epidemiology of orthopedic fractures and other injuries among inpatients admitted due to traffic accidents: a 10-year nationwide survey in Taiwan. ScientificWorldJournal. 2014;2014:637872. DOI

6. Castaneda L, Castro SS. Publicações brasileiras referentes à Classificação Internacional de Funcionalidade. Acta Fisiatr. 2013;20(1):29-36. DOI

7. Buchalla CM. A Classificação Internacional de Funcionalidade, Incapacidade e Saúde. Acta Fisiatr. 2003;10(1):29-31. DOI

8. Ruaro JA, Ruaro MB, Souza DE, Fréz AR, Guerra RO. Panorama e perfil da utilização da CIF no Brasil – uma década de história. Rev Bras Fisioter. 2012;16(6):454-62. DOI

9. Ustün B, Chatterji S, Kostanjsek N. Comments from WHO for the Journal of Rehabilitation Medicine Special Supplement on ICF Core Sets. J Rehabil Med. 2004;(44 Suppl):7-8. DOI

10. Farias N, Buchalla CM. Classificação Internacional de Funcionalidade, Incapacidade e Saúde da Organização Mundial da Saúde: conceitos, usos e perspectivas. Rev Bras Epidemiol. 2005;8(2):187-93. DOI

11. Fontes AP, Fernandes AA, Botelho MA. Funcionalidade e incapacidade: aspectos conceptuais, estruturais e de aplicação da Classificação Internacional de Funcionalidade, Incapacidade e Saúde (CIF). Rev Port Saude Publica. 2010;28(2):171-8. Full text link

12. Riberto M. Core sets da Classificação Internacional de Funcionalidade, Incapacidade e Saúde. Rev Bras Enferm. 2011; 64(5):938-46. DOI

13. Ribeiro LC. Elaboração de conjunto principal da Classificação Internacional de Funcionalidade, Incapacidade e Saúde (CIF) para mulheres com câncer do colo do útero no Brasil [dissertation]. Rio de Janeiro: Escola Nacional de Saúde Pública Sérgio Arouca; 2015. 140 p. Full text link

14. Leonardi M, Lee H, Kostanjsek N, Fornari A, Raggi A, Martinuzzi A, et al. 20 Years of ICF-International Classification of Functioning, Disability and Health: uses and applications around the world. Int J Environ Res Public Health. 2022;19(18): 11321. DOI

15. Brach M, Cieza A, Stucki G, Füssl M, Cole A, Ellerin B, et al. ICF Core Sets for breast cancer. J Rehabil Med. 2004;(44 Suppl):121-7. DOI

16. Stucki A, Stoll T, Cieza A, Weigl M, Giardini A, Wever D, et al. ICF Core Sets for obstructive pulmonary disease. J Rehabil Med. 2004;(44 Suppl):114-20. DOI

17. Cieza A, Stucki A, Geyh S, Berteanu M, Quittan M, Simon A, et al. ICF Core Sets for chronic ischaemic heart disease. J Rehabil Med. 2004;(44 Suppl):94-9. DOI

18. Buchalla CM, Cavalheiro TR. Classificação Internacional de Funcionalidade, Incapacidade e Saúde e a Aids: uma proposta de core set. Acta Fisiatr. 2008;15(1):42-8. DOI

19. Selb M, Escorpizo R, Kostanjsek N, Stucki G, Üstün B, Cieza A. A guide on how to develop an International Classification of Functioning, Disability and Health Core Set. Eur J Phys Rehabil Med. 2015;51(1):105-17. Full text link

20. Bickenbach JE, Cieza A, Selb M, Stucki G. ICF Core Sets: Manual for Clinical Practice. Göttingen: Hogrefe & Huber Pub; 2020.

21. Galvão TF, Pereira MG. Revisões sistemáticas da literatura: passos para sua elaboração. Epidemiol Serv Saude. 2014;23(1): 183-4. Full text link

22. Arango HG. Bioestatística - Teórica e computacional. Rio de Janeiro: Guanabara Koogan; 2012.

23. Cieza A, Geyh S, Chatterji S, Kostanjsek N, Ustün B, Stucki G. ICF linking rules: an update based on lessons learned. J Rehabil Med. 2005;37(4):212-8. DOI

24. Cieza A, Fayed N, Bickenbach J, Prodinger B. Refinements of the ICF Linking Rules to strengthen their potential for establishing comparability of health information. Disabil Rehabil. 2019;41(5):574-83. DOI

25. Scheuringer M, Grill E, Boldt C, Mittrach R, Müllner P, Stucki G. Systematic review of measures and their concepts used in published studies focusing on rehabilitation in the acute hospital and in early post-acute rehabilitation facilities. Disabil Rehabil. 2005;27(7-8):419-29. DOI

26. Post MWM, Kirchberger I, Scheuringer M, Wollaars MM, Geyh S. Outcome parameters in spinal cord injury research: a systematic review using the International Classification of Functioning, Disability and Health (ICF) as a reference. Spinal Cord. 2010;48(7):522-8. DOI

27. Castro SS, Castaneda L, Araújo ES, Buchalla CM. Aferição de funcionalidade em inquéritos de saúde no Brasil: discussão sobre instrumentos baseados na Classificação Internacional de Funcionalidade, Incapacidade e Saúde (CIF). Rev Bras Epidemiol. 2016;19(3):679-87. DOI

28. Andrade SSCA, Jorge MHPM. Estimativas de sequelas físicas em vítimas de acidentes de transporte terrestre internadas em hospitais do Sistema Único de Saúde. Rev Bras Epidemiol. 2016;19(1):100-11. DOI

29. Andrade SSCA, Jorge MHPM. Internações hospitalares por lesões decorrentes de acidente de transporte terrestre no Brasil, 2013. Epidemiol Serv Saude. 2017;26(1):31-8. DOI

30. Ladeira RM, Malta DC, Morais Neto OL, Montenegro MMS, Soares Filho AM, Vasconcelos CH, et al. Acidentes de transporte terrestre: estudo Carga Global de Doenças, Brasil e unidades federadas, 1990 e 2015. Rev Bras Epidemiol. 2017;20(Suppl 1):157-70. DOI

31. Wolff B, Cieza A, Parentin A, Rauch A, Sigl T, Brockow T, et al. Identifying the concepts contained in outcome measures of clinical trials on four internal disorders using the International Classification of Functioning, Disability and Health as a reference. J Rehabil Med. 2004;(44 Suppl):37-42. DOI

32. Organização Mundial de Saúde. CIF: Classificação Internacional de Funcionalidade, Incapacidade e Saúde. São Paulo: Edusp; 2015. 334 p.

33. Macedo APFS, Oliveira LR, Buchalla CM, Scatena JHG. Características e deficiências físicas de vítimas de acidentes de trânsito atendidas no serviço de referência para reabilitação do estado de Mato Grosso, Brasil, 2010. Espac Saude. 2014; 15(4):22-33. Full text link

34. Paiva L, Pompeo DA, Ciol MA, Arduini GO, Dantas RAS, Senne ECV, et al. Estado de saúde e retorno ao trabalho após os acidentes de trânsito. Rev Bras Enferm. 2016;69(3):443-50. DOI

35. Benner JL, Noten S, Limsakul C, Van Der Slot WMA, Stam HJ, Selb M, et al. Outcomes in adults with cerebral palsy: systematic review using the International Classification of Functioning, Disability and Health. Dev Med Child Neurol. 2019;61(10):1153-61. DOI

36. Oliveira LR, Duarte FGD. Deficiências e incapacidades em vítimas de acidentes de trânsito em Mato Grosso, Brasil. Cad Saude Colet. 2021;29(1):12-24. DOI

37. Sampaio RF, Luz MT. Funcionalidade e incapacidade humana: explorando o escopo da classificação internacional da Organização Mundial de Saúde. Cad Saude Publica. 2009; 25(3):475-83. DOI

38. Morettin M, Bevilacqua MC, Cardoso MRA. A aplicação da Classificação internacional de Funcionalidade, Incapacidade e Saúde (CIF) na audiologia. Disturb Comun. 2008;20(3):395-402. Full text link

39. Adeoye PO, Kadri DM, Bello JO, Ofoegbu CK, Abdur-Rahman LO, Adekanye AO, et al. Host, vehicular and environmental factors responsible for road traffic crashes in a Nigerian city: identifiable issues for road traffic injury control. Pan Afr Med J. 2014;19:159. DOI

40. Agnihotri A, Galfat D, Agnihotri D. Incidence and pattern of maxillofacial trauma due to road traffic accidents: a prospective study. J Maxillofac Oral Surg. 2014;13(2):184-8. DOI

41. Airaksinen N, Nurmi-Lüthje I, Kröger H, Lüthje P. The ability of the ICD-AIS map to identify seriously injured patients in road traffic accidents - A study from Finland. Traffic Inj Prev. 2018;19 (8):819-24. DOI

42. Karadana GA, Aksu NM, Akkaş M, Akman C, Üzümcügil A, Özmen MM. The epidemiology and cost analysis of patients presented to Emergency Department following traffic accidents. Med Sci Monit. 2013;19:1125-30. DOI

43. Aladelusi T, Akinmoladun V, Olusanya A, Akadiri O, Fasola A. Analysis of road traffic crashes-related maxillofacial injuries severity and concomitant injuries in 201 patients seen at the UCH, Ibadan. Craniomaxillofac Trauma Reconstr. 2014;7(4):284-9. DOI

44. Aldwsari OM, Aldosari KH, Alzahrani MK, Alzahrani ZA, Alanazi AH, Alkhathlan KM, et al. Associated head injuries and survival rate of patients with maxillofacial fractures in road traffic accident: A prospective study in Saudi Arabia. J Family Med Prim Care. 2018;7(6):1548-54. DOI

45. Ammori MB, Eid HO, Abu-Zidan FM. Lower limb and associated injuries in frontal-impact road traffic collisions. Afr Health Sci. 2016;16(1):306-10. DOI

46. Arif MZ, Rajanikanth BR, Prasad K. The role of helmet fastening in motorcycle road traffic accidents. Craniomaxillofac Trauma Reconstr. 2019;12(4):284-90. DOI

47. Bambach MR, Mitchell RJ. The rising burden of serious thoracic trauma sustained by motorcyclists in road traffic crashes. Accid Anal Prev. 2014;62:248-58. DOI

48. Barbosa KGN, Lucas-Neto A, Gama BD, Lima-Neto JC, Lucas RSCC, d'Ávila S. Injuries and absenteeism among motorcycle taxi drivers who are victims of traffic accidents. J Forensic Leg Med. 2014;26:15-8. DOI

49. Brand S, Otte D, Mueller CW, Petri M, Haas P, Stuebig T, et al. Injury patterns of seniors in traffic accidents: A technical and medical analysis. World J Orthop. 2012;3(9):151-5. DOI

50. Bayan P, Bhawalkar JS, Jadhav SL, Banerjee A. Profile of non-fatal injuries due to road traffic accidents from a industrial town in India. Int J Crit Illn Inj Sci. 2013;3(1):8-11. DOI

51. Behzadi A, Shahba M, Etemadi S, Mohamadi B, Karvar M, Jafari Y, et al. Epidemiology and cost-analysis of emergency department patients treated following traffic accidents in Iran: A retrospective cross-sectional study. Int J Crit Illn Inj Sci. 2020;10(4):182-8. DOI

52. Bhoi S, Singh A, Sinha TP, Pal R, Galwankar S, Baluja A, et al. Magnitude and spectrum of injuries sustained in road traffic accidents among two wheeler riders and correlation with helmet use. J Emerg Trauma Shock. 2018;11(3):160-4. DOI

53. Bener A. A study on road traffic crashes and injuries in Qatar as reported by drivers. J Egypt Public Health Assoc. 2012;87(5-6):85-9. DOI

54. Brito JMPX. Incapacidade por traumatismo raquimedular secundário a acidentes de trânsito. Coluna/Columna. 2011;10 (3):175-8. DOI

55. Candefjord S, Buendia R, Caragounis EC, Sjöqvist BA, Fagerlind H. Prehospital transportation decisions for patients sustaining major trauma in road traffic crashes in Sweden. Traffic Inj Prev. 2016;17(Suppl 1):16-20. DOI

56. Cardoso JP, Mota ELA, Ferreira LN, Rios PAA. Productivity costs among people involved in traffic accidents. Cien Saude Coletiva. 2020;25(2):749-60. DOI

57. Cardoso JP, Mota ELA, Rios PAA, Ferreira LN. Associated factors from loss productivity among people involved in road traffic accident: a prospective study. Rev Bras Epidemiol. 2020; 23:e200015. DOI

58. Chelly H, Bahloul M, Ammar R, Dhouib A, Mahfoudh KB, Boudawara MZ, et al. Clinical characteristics and prognosis of traumatic head injury following road traffic accidents admitted in ICU "analysis of 694 cases". Eur J Trauma Emerg Surg. 2019; 45(2):245-53. DOI

59. Cheynel N, Gentil J, Freitz M, Rat P, Deballon PO, Kopp CB. Abdominal and pelvic injuries caused by road traffic accidents: characteristics and outcomes in a French cohort of 2,009 casualties. World J Surg. 2011;35(7):1621-5. DOI

60. Choi SH, Gu JH, Kang DH. Analysis of traffic accident-related facial trauma. J Craniofac Surg. 2016;27(7):1682-5. DOI

61. Copanitsanou P, Drakoutos E, Kechagias V. Posttraumatic stress, depressive emotions, and satisfaction with life after a road traffic accident. Orthop Nurs. 2018;37(1):43-53. DOI

62. Daskal Y, Alfici R, Givon A, Peleg K, Olsha O, Kessel B. Evaluation of differences in injury patterns according to seat position in trauma victims survived traffic accidents. Chin J Traumatol. 2018;21(5):273-6. DOI

63. Duan A, Zhou M, Qiu J, Feng C, Yin Z, Li K. A 6-year survey of road traffic accidents in Southwest China: Emphasis on traumatic brain injury. J Safety Res. 2020;73:161-9. DOI

64. El-Menyar A, Abdelrahman H, Al-Hassani A, Ellabib M, Asim M, Zarour A, et al. Clinical presentation and time-based mortality in patients with chest injuries associated with road traffic accidents. Arch Trauma Res. 2016;5(1):e31888. DOI

65. Etehad H, Yousefzadeh-Chabok Sh, Davoudi-Kiakalaye A, Dehnadi AM, Hemati H, Mohtasham-Amiri Z. Impact of road traffic accidents on the elderly. Arch Gerontol Geriatr. 2015;61(3):489-93. DOI

66. Erem G, Bugeza S, Malwadde EK. Clinical and cranial computed tomography scan findings in adults following road traffic accidents in Kampala, Uganda. Afr Health Sci. 2017;17(1):116-21. DOI

67. Ernstberger A, Joeris A, Daigl M, Kiss M, Angerpointner K, Nerlich M, et al. Decrease of morbidity in road traffic accidents in a high income country - an analysis of 24,405 accidents in a 21 year period. Injury. 2015;46(Suppl 4):S135-43. DOI

68. Fekadu W, Mekonen T, Belete H, Belete A, Yohannes K. Incidence of post-traumatic stress disorder after road traffic accident. Front Psychiatry. 2019;10:519. DOI

69. Fernando DM, Tennakoon SU, Samaranayake AN, Wickramasinghe M. Characteristics of road traffic accident casualties admitted to a tertiary care hospital in Sri Lanka. Forensic Sci Med Pathol. 2017;13(1):44-51. DOI

70. Freitas EBS, França ISX. Deficiências motoras e gravidade de traumas em motociclistas vítimas de acidentes de trânsito. Cogit Enferm. 2018;23(4):e57751. DOI

71. Bilgin NG, Mert E, Sezgin M. Evaluation of the effects of disabilities due to traffic accidents on the quality of life using SF-36 health survey. Acta Orthop Traumatol Turc. 2012;46(3):168-73. DOI

72. Gomei S, Hitosugi M, Ikegami K, Tokudome S. Assessing injury severity in bicyclists involved in traffic accidents to more effectively prevent fatal bicycle injuries in Japan. Med Sci Law. 2013;53(4):194-8. DOI

73. Gorge J, Alsufyani L, Almefreh G, Aljuhani S, Almutairi L, Al Babtain I, et al. The age and gender distribution of patients admitted following nonfatal road traffic accidents in Riyadh: A cross-sectional study. Int J Crit Illn Inj Sci. 2020;10(2):76-80. DOI

74. Gupta S, Klaric K, Sam N, Din V, Juschkewitz T, Iv V, et al. Impact of helmet use on traumatic brain injury from road traffic accidents in Cambodia. Traffic Inj Prev. 2018;19(1):66-70. DOI

75. Hadaye RS, Rathod S, Shastri S. A cross-sectional study of epidemiological factors related to road traffic accidents in a metropolitan city. J Family Med Prim Care. 2020;9(1):168-72. DOI

76. Helm M, Faul M, Unger T, Lampl L. Zuverlässigkeit notärztlicher Verdachtsdiagnosen [Reliability of emergency medical field triage: Exemplified by traffic accident victims]. Anaesthesist. 2013;62(12):973-80. DOI

77. Huang J, Peng Y, Yang J, Otte D, Wang B. A study on correlation of pedestrian head injuries with physical parameters using in-depth traffic accident data and mathematical models. Accid Anal Prev. 2018;119:91-103. DOI

78. Inamasu J, Nakaya M, Kujirai D, Mayanagi K, Nakatsukasa M. Frequency and characteristics of traumatic brain injury in restrained drivers involved in road traffic accidents. Acta Neurochir (Wien). 2018;160(10):1921-9. DOI

79. Iteke O, Bakare MO, Agomoh AO, Uwakwe R, Onwukwe JU. Road traffic accidents and posttraumatic stress disorder in an orthopedic setting in South-Eastern Nigeria: a controlled study. Scand J Trauma Resusc Emerg Med. 2011;19:39. DOI

80. Ito F, Tsutsumi Y, Shinohara K, Fukuhara S, Kurita N. Vehicle configurations associated with anatomical-specific severe injuries resulting from traffic collisions. PLoS One. 2019;14(10):e0223388. DOI

81. Johansson MS, Boyle E, Hartvigsen J, Stochkendahl MJ, Carroll L, Cassidy JD. A population-based, incidence cohort study of mid-back pain after traffic collisions: Factors associated with global recovery. Eur J Pain. 2015;19(10):1486-95. DOI

82. Jovanovic M, Hentova-Sencanic P, Vukovic D, Glisic S, Knezevic M. Simultaneous injuries to both eyes in traffic accidents. Graefes Arch Clin Exp Ophthalmol. 2011;249(12): 1761-4. DOI

83. Kaiser R, Waldauf P, Haninec P. Types and severity of operated supraclavicular brachial plexus injuries caused by traffic accidents. Acta Neurochir (Wien). 2012;154(7):1293-7. DOI

84. Kovačević J, Miskulin M, Degmecic D, Vcev A, Leovic D, Sisljagic V, et al. Predictors of mental health outcomes in road traffic accident survivors. J Clin Med. 2020;9(2):309. DOI

85. Kovačević J, Miškulin M, Ličanin MM, Barać J, Biuk D, Palenkić H, et al. Quality of life in road traffic accident survivors. Zdr Varst. 2020;59(4):202-10. DOI

86. Lee HY, Youk H, Lee J, Kang CY, Kong JS, Sung S, et al. Injury analysis of patients according to impact patterns involved in pedestrian traffic crashes. Traffic Inj Prev. 2018;19(sup1):S153-7. DOI

87. Leijdesdorff HA, van Dijck JTJM, Krijnen P, Vleggeert-Lankamp CLAM, Schipper IB. Injury pattern, hospital triage, and mortality of 1250 patients with severe traumatic brain injury caused by road traffic accidents. J Neurotrauma. 2014;31(5): 459-65. DOI

88. León AL, Ascuntar-Tello J, Valderrama-Molina CO, Giraldo ND, Constaín A, Puerta A, et al. Grouping of body areas affected in traffic accidents. A cohort study. J Clin Orthop Trauma. 2018;9(Suppl 1):S49-55. DOI

89. Littleton SM, Cameron ID, Poustie SJ, Hughes DC, Robinson BJ, Neeman T, et al. The association of compensation on longer term health status for people with musculoskeletal injuries following road traffic crashes: emergency department inception cohort study. Injury. 2011;42(9):927-33. DOI

90. Littleton SM, Hughes DC, Poustie SJ, Robinson BJ, Neeman T, Smith PN, et al. The influence of fault on health in the immediate post-crash period following road traffic crashes. Injury. 2012;43(9):1586-92. DOI

91. Littleton SM, Hughes DC, Poustie SJ, Robinson BJ, Neeman T, Smith PN, et al. An early intervention programme had no detectable influence on the health status of people with musculoskeletal injuries following road traffic crashes: comparative study. Injury. 2014;45(1):304-11. DOI

92. Littleton SM, Hughes DC, Gopinath B, Robinson BJ, Poustie SJ, Smith PN, et al. The health status of people claiming compensation for musculoskeletal injuries following road traffic crashes is not altered by an early intervention programme: a comparative study. Injury. 2014;45(9):1493-9. DOI

93. Mahajan N, Aggarwal M, Raina S, Verma LR, Mazta SR, Gupta BP. Pattern of non-fatal injuries in road traffic crashes in a hilly area: A study from Shimla, North India. Int J Crit Illn Inj Sci. 2013;3(3):190-4. DOI

94. Mahdian M, Sehat M, Fazel MR, Moraveji A, Mohammadzadeh M. Epidemiology of urban traffic accident victims hospitalized more than 24 hours in a level III trauma center, Kashan County, Iran, during 2012-2013. Arch Trauma Res. 2015;4(2):e28465. DOI

95. Mahdian M, Fazel MR, Sehat M, Khosravi G, Mohammadzadeh M. Epidemiological profile of extremity fractures and dislocations in road traffic accidents in Kashan, Iran: a glance at the related disabilities. Arch Bone Jt Surg. 2017;5(3):186-92. Full text link

96. Mai HT, Vu HM, Ngo TT, Vu GT, Nguyen HLT, Hoang MT, et al. The status of first aid and its associations with health outcomes among patients with traffic accidents in urban areas of Vietnam. Int J Environ Res Public Health. 2020;17(12):4600. DOI

97. Majdan M, Mauritz W, Wilbacher I, Janciak I, Brazinova A, Rusnak M, et al. Traumatic brain injuries caused by traffic accidents in five European countries: outcome and public health consequences. Eur J Public Health. 2013;23(4):682-7. DOI

98. Malta DC, Andrade SSCA, Gomes N, Silva MMA, Morais Neto OL, Reis AAC, et al. Injuries from traffic accidents and use of protection equipment in the Brazilian population, according to a population-based study. Cien Saude Colet. 2016;21(2):399-409. DOI

99. Meredith L, Kovaceva J, Bálint A. Mapping fractures from traffic accidents in Sweden: How do cyclists compare to other road users? Traffic Inj Prev. 2020;21(3):209-14. DOI

100. Mesquita Filho M. Quality of life and self-esteem in traffic victims in physical therapy. Fisioter Mov. 2016;29(4):703-11. DOI

101. Meyyappan A, Subramani P, Kaliamoorthy S. A comparative data analysis of 1835 road traffic accident victims. Ann Maxillofac Surg. 2018;8(2):214-7. DOI

102. Mohtasham-Amiri Z, Dastgiri S, Davoudi-Kiakalyeh A, Imani A, Mollarahimi K. An epidemiological study of road traffic accidents in Guilan Province, Northern Iran in 2012. Bull Emerg Trauma. 2016;4(4):230-5. Full text link

103. Monchal T, Ndiaye A, Gadegbeku B, Javouhey E, Monneuse O. Abdominopelvic injuries due to road traffic accidents: Characteristics in a registry of 162,695 victims. Traffic Inj Prev. 2018;19(5):529-34. DOI

104. Ngunde PJ, Akongnwi ACN, Mefire CA, Puis F, Gounou E, Nkfusai NC, et al. Prevalence and pattern of lower extremity injuries due to road traffic crashes in Fako Division, Cameroon. Pan Afr Med J. 2019;32:53. DOI

105. Nhac-Vu HT, Hours M, Charnay P, Chossegros L, Boisson D, Luauté J, et al. Predicting self-reported recovery one year after major road traffic accident trauma. J Rehabil Med. 2011; 43(9):776-82. DOI

106. Nóbrega LM, Cavalcante GMS, Lima MMSM, Madruga RCR, Ramos-Jorge ML, d'Avila S. Prevalence of facial trauma and associated factors in victims of road traffic accidents. Am J Emerg Med. 2014;32(11):1382-6. DOI

107. Nogami S, Yamauchi K, Morishima H, Otake Y, Kouketsu A, Higuchi K, et al. Mandible fractures and dental injuries related to road traffic accidents over a 12-year period-retrospective multicentre study. Dent Traumatol. 2021;37(2):223-8. DOI

108. Okamoto Y, Morikawa S, Okamoto F, Mitamura Y, Ishikawa H, Ueda T, et al. Traffic accident-related open globe injuries. Retina. 2019;39(4):779-85. DOI

109. Paiva L, Monteiro DAT, Pompeo DA, Ciol MA, Dantas RAS, Rossi LA. Readmissions due to traffic accidents at a general hospital. Rev Lat Am Enfermagem. 2015;23(4):693-9. DOI

110. Pajediene E, Janusauskaite J, Samusyte G, Stasaitis K, Petrikonis K, Bileviciute-Ljungar I. Patterns of acute whiplash-associated disorder in the Lithuanian population after road traffic accidents. J Rehabil Med. 2015;47(1):52-7. DOI

111. Palmera-Suárez R, López-Cuadrado T, Almazán-Isla J, Fernández-Cuenca R, Alcalde-Cabero E, Galán I. Disability related to road traffic crashes among adults in Spain. Gac Sanit. 2015;29(Suppl 1):43-8. DOI

112. Palmera-Suárez R, López-Cuadrado T, Brockhaus S, Fernández-Cuenca R, Alcalde-Cabero E, Galán I. Severity of disability related to road traffic crashes in the Spanish adult population. Accid Anal Prev. 2016;91:36-42. DOI

113. Papadakaki M, Ferraro OE, Orsi C, Otte D, Tzamalouka G, von-der-Geest M, et al. Psychological distress and physical disability in patients sustaining severe injuries in road traffic crashes: Results from a one-year cohort study from three European countries. Injury. 2017;48(2):297-306. DOI

114. Parreira JG, Gregorut F, Perlingeiro JAG, Solda SC, Assef JC. Análise comparativa entre as lesões encontradas em motociclistas envolvidos em acidentes de trânsito e vítimas de outros mecanismos de trauma fechado. Rev Assoc Med Bras (1992). 2012;58(1):76-81. DOI

115. Pathak SM, Jindal AK, Verma AK, Mahen A. An epidemiological study of road traffic accident cases admitted in a tertiary care hospital. Med J Armed Forces India. 2014;70(1):32-5. DOI

116. Pietzka S, Kämmerer PW, Pietzka S, Schramm A, Lampl L, Lefering R, et al. Maxillofacial injuries in severely injured patients after road traffic accidents-a retrospective evaluation of the TraumaRegister DGU® 1993-2014. Clin Oral Investig. 2020;24(1):503-13. DOI

117. Rastović P, Gojanović MD, Perić I, Pavlović M, Lesko J, Galić G, et al. Anthropometric characteristics and traffic accident circumstances of patients with isolated whiplash injury in University Clinical Hospital Mostar. Med Glas (Zenica). 2018;15(1):59-65. DOI

118. Reiniger LO, Sousa RMC, Nogueira LS, Costa ALS. Vítimas de ocorrência de trânsito submetidas a procedimentos cirúrgicos: características e intercorrências transoperatórias. Rev Esc Enferm USP. 2012;46(Esp):58-64. DOI

119. Roccia F, Sotong J, Savoini M, Ramieri G, Zavattero E. Maxillofacial injuries due to traffic accidents. J Craniofac Surg. 2019;30(4):e288-93. DOI

120. Seid M, Azazh A, Enquselassie F, Yisma E. Injury characteristics and outcome of road traffic accident among victims at adult emergency department of Tikur Anbessa specialized hospital, Addis Ababa, Ethiopia: a prospective hospital based study. BMC Emerg Med. 2015;15:10. DOI

121. Shamim M. Pattern of Injuries from road traffic accidents presented at a rural teaching institution of Karachi. Indian J Surg. 2017;79(4):332-7. DOI

122. Vahdati SS, GhafarZad A, Rahmani F, Panahi F, Rad AO. Patterns of road traffic accidents in north west of Iran during 2013 New Year holidays: complications and casualties. Bull Emerg Trauma. 2014;2(2):82-5. Full text link

123. Singh R, Singh HK, Gupta SC, Kumar Y. Pattern, severity and circumtances of injuries sustained in road traffic accidents: a tertiary care hospital-based study. Indian J Community Med. 2014;39(1):30-4. DOI

124. Tahir N, Naseer R, Khan SM, Macassa G, Hashmi W, Durrani M. Road traffic crashes managed by Rescue 1122 in Lahore, Pakistan. Int J Inj Contr Saf Promot. 2012;19(4):347-50. DOI

125. Terrier JE, Paparel P, Gadegbeku B, Ruffion A, Jenkins LC, N'Diaye A. Genitourinary injuries after traffic accidents: Analysis of a registry of 162,690 victims. J Trauma Acute Care Surg. 2017;82(6):1087-93. DOI

126. Wangdi C, Gurung MS, Duba T, Wilkinson E, Tun ZM, Tripathy JP. Burden, pattern and causes of road traffic accidents in Bhutan, 2013-2014: a police record review. Int J Inj Contr Saf Promot. 2018;25(1):65-9. DOI

127. Woyessa AH, Heyi WD, Ture NH, Moti BK. Patterns of road traffic accident, nature of related injuries, and post-crash outcome determinants in western Ethiopia - A hospital based study. Afr J Emerg Med. 2021;11(1):123-31. DOI

128. Yang CS, Chen SCC, Yang YC, Huang LC, Guo HR, Yang HY. Epidemiology and patterns of facial fractures due to road traffic accidents in Taiwan: A 15-year retrospective study. Traffic Inj Prev. 2017;18(7):724-9. DOI