


# Functioning in victims of non-fatal traffic accident

*Funcionalidade em vítimas não fatais de acidente de trânsito*

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## 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.<sup>1,2</sup> 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.<sup>3</sup>

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.<sup>3,4</sup> 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.<sup>5</sup>

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.<sup>6</sup>

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.<sup>7</sup> 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.<sup>8</sup> 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.<sup>9-12</sup>

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.<sup>13</sup> 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.<sup>14</sup>

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.<sup>13,15-18</sup> 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.<sup>19</sup> and Bickenbach et al.,<sup>20</sup> 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.<sup>21</sup> A detailed protocol was registered on Prospero (CRD42023452808).

The 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, 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 accidente 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 ( $K \leq 0.4$  to  $< 0.8$ ), strong ( $K \leq 0.8$  to  $< 1.0$ ) and perfect ( $K = 1.0$ ).<sup>22</sup>

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.<sup>23,24</sup> 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.

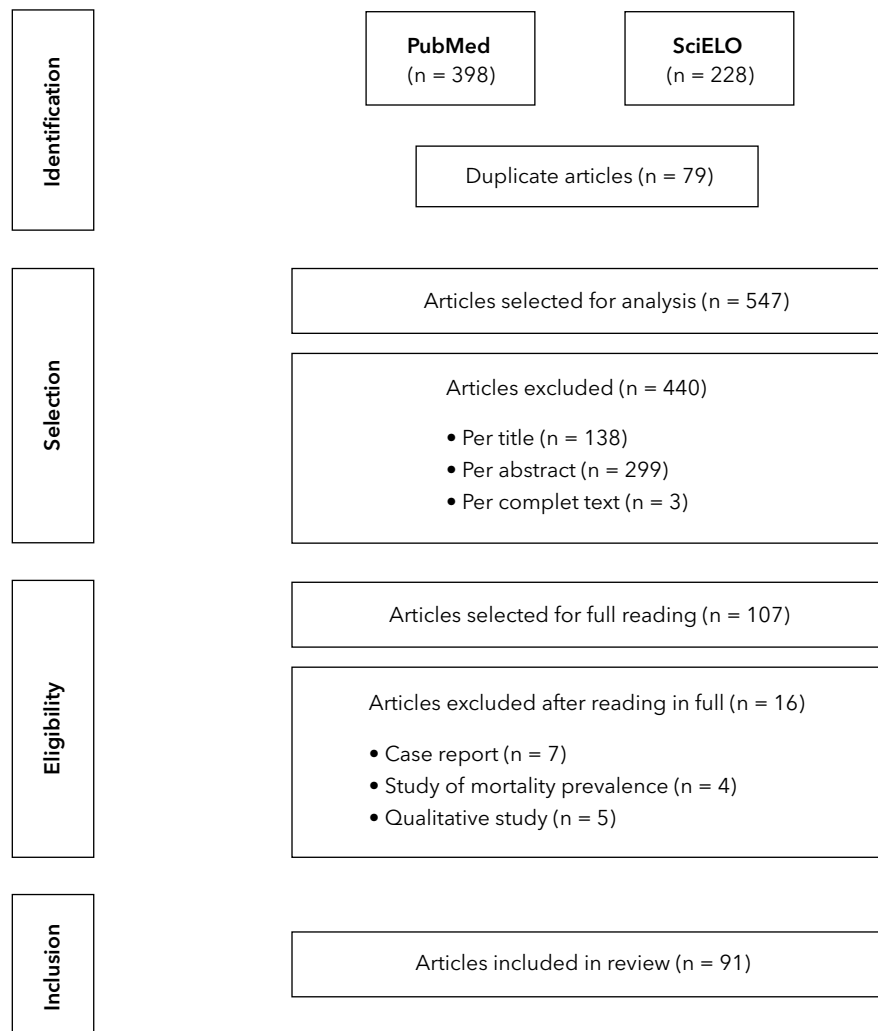
## Results

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%).<sup>22</sup> 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. <sup>39</sup> Nigeria, 2014	571	Injury, fracture of limbs, head, soft tissues, spine, burns	Cohort	Questionnaire	77.3
Agnihotri et al. <sup>40</sup> India, 2013	350	Fracture of the nasal, jaw, orbital, frontal bones	Cross sectional	Questionnaire	78.2
Airaksinen et al. <sup>41</sup> 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. <sup>43</sup> 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. <sup>44</sup> Saudi Arabia, 2018	237	Scalp laceration, fractures of craniofacial and facial bones, brain stem hemorrhage	Cohort study	Questionnaire	90.9
Ammori et al. <sup>45</sup> 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. <sup>46</sup> India, 2019	311	Lower face fractures, intracranial injury, abrasions, lacerations, contusions and extraoral communication	Cross-sectional	Questionnaire	81.8
Bambach et al. <sup>18</sup> Australia, 2014	49.082	Injuries to chest, lower limbs, head, lungs, rib fractures	Cross-sectional	Questionnaire	90.9
Barbosa et al. <sup>48</sup> Brazil, 2014	210	Injuries, fractures	Cross-sectional	Questionnaire	86.4
Brand et al. <sup>49</sup> 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. <sup>50</sup> India, 2013	212	Multiple injuries or multiple trauma to the lower limbs, fractures	Cross-sectional	Questionnaire	77.3
Behzadi et al. <sup>51</sup> Iran, 2020	3,277	Injuries to the lower limbs	Cross-sectional	Questionnaire	86.4
Bhoi et al. <sup>52</sup> India, 2018	359	Trauma to the head, skull, face	Cross-sectional	Questionnaire	95.5
Bener et al. <sup>53</sup> Qatar, 2012	1,762	Injuries to the head, face, neck and spine were most common	Cross-sectional	Questionnaire	95.5
Brito <sup>54</sup> Brazil, 2011	719	Spinal trauma	Cross-sectional	Standardized form and ICF	81.8
Candefjord et al. <sup>55</sup> Sweden, 2016	119,768	Chest and head trauma	Cross-sectional	ISS	95.5
Cardoso et al. <sup>56</sup> Brazil, 2020	203	Fracture-type injuries	Cohort	Questionnaire	86.4
Cardoso et al. <sup>57</sup> Brazil, 2020	203	Cuts, sprains, lacerations and multiple injuries	Cohort	Questionnaire	86.4
Chelly et al. <sup>58</sup> Tunisia, 2019	694	Traumatic brain injury	Retrospective cross-sectional	Questionnaire	86.4
Cheyne et al. <sup>59</sup> 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. <sup>60</sup> 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. <sup>61</sup> 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. <sup>62</sup> Israel, 2018	28,635	Traumatic brain injury; abdominal, chest, pelvis injuries	Cohort	AIS and ISS	90.9
Duan et al. <sup>63</sup> China, 2020	2,741	Traumatic injury to brain, chest, limbs	Cross-sectional	Questionnaire	95.5
El-Menyar et al. <sup>64</sup> Qatar, 2016	5,118	Lung contusions, rib fractures, pneumothorax and hemothorax, head injuries	Retrospective cross-sectional	Questionnaire	86.4
Etehad et al. <sup>65</sup> Iran, 2015	1,306	Polytrauma and trauma to multiple body regions, head and neck injuries	Cross-sectional	Questionnaire	86.4
Erem et al. <sup>66</sup> 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. <sup>67</sup> Germany, 2015	44,503	Leg, pelvic, upper extremity injuries, head trauma	Prospective cross-sectional	Questionnaire	100
Fekadu et al. <sup>68</sup> Ethiopia, 2019	299	Post-traumatic stress disorder, alcohol dependence, sleep disorders	Cohort study	PCL, PHQ-2 and AUDIT	90.9
Fernando et al. <sup>69</sup> Sri Lanka, 2017	579	Soft tissue injury, abrasions, contusions, lacerations and fractures	Retrospective cross-sectional	MLEF	81.8
Freitas et al. <sup>70</sup> 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. <sup>71</sup> Turkey, 2012	168	Injuries to extremities, multiple, head and neck, internal organs, arteries, nerves and fractures	Case-control	MLEF	81.8
Gomei et al. <sup>72</sup> Japan, 2013	115	Injuries and fractures of the head, chest, extremities, face, abdomen and spine	Retrospective cross-sectional	Questionnaire	86.4
Gorge et al. <sup>73</sup> 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. <sup>74</sup> 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. <sup>75</sup> 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. <sup>76</sup> 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. <sup>77</sup> China and Germany, 2018	43	Head trauma, brain injuries	Cohort	Questionnaire	90.9
Inamasu et al. <sup>78</sup> Japan, 2018	409	Traumatic brain injury	Retrospective cross-sectional	Questionnaire	95.5
Iteke et al. <sup>79</sup> Nigeria, 2011	150	Post-traumatic stress disorder	Case-control	Questionnaire	86.4
Ito et al. <sup>80</sup> 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. <sup>81</sup> 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. <sup>82</sup> Serbia, 2011	36	Concurrent eye injuries, eyeball ruptures, adnexal damage	Cross-sectional	Questionnaire	77.3
Kaiser et al. <sup>83</sup> Czech Republic, 2012	326	Brachial plexus injuries, root avulsion	Retrospective cross-sectional	Questionnaire	77.3
Karadana et al. <sup>42</sup> Turkey, 2013	2,003	Traumatic brain injury, extremities, chest and abdomen	Prospective cross-sectional	MFISS and ISS	81.8
Kovačević et al. <sup>84</sup> Croatia, 2020	155	Post-traumatic stress disorder, depression, anxiety	Cohort	Questionnaire	100
Kovačević et al. <sup>85</sup> 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. <sup>86</sup> 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. <sup>87</sup> Netherlands, 2014	1,250	Traumatic brain injury, contusion, skull fractures, hemorrhaging	Retrospective cross-sectional	Questionnaire	90.9
León et al. <sup>88</sup> 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. <sup>89</sup> Australia, 2011	95	Musculoskeletal injuries to neck, chest, upper/lower limbs, back, shoulder	Cohort	Questionnaire	100
Littleton et al. <sup>90</sup> Australia, 2012	193	Soft tissue injuries, fractures, abrasions and lacerations	Cohort	Questionnaire	100
Littleton et al. <sup>91</sup> Australia, 2014	95/98	Musculoskeletal injuries, being mild injuries	Case-control	Questionnaire	100
Littleton et al. <sup>92</sup> Australia, 2014	96/98	Musculoskeletal injuries to the neck, chest, back, lower/upper limbs, shoulder	Case-control	Questionnaire	100
Mahajan et al. <sup>93</sup> India, 2013	401	Fractures, abdominal injuries, abrasions and bruises, lacerations and open wounds	Cross-sectional	Questionnaire	77.3
Mahdian et al. <sup>94</sup> 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. <sup>95</sup> Iran, 2017	962	Polytrauma, fractures and dislocations of extremities	Retrospective cross-sectional	Questionnaire	95.5
Mai et al. <sup>96</sup> Vietnam, 2020	413	Problems with mobility, self-care, usual activities and pain/discomfort	Cross-sectional	Questionnaire	95.5
Majdan et al. <sup>97</sup> Austria, 2013	683	Traumatic brain injury, injuries to the abdomen, extremities, face, head and neck, chest	Cross-sectional	Questionnaire	100
Malta et al. <sup>98</sup> Brazil, 2016	60,202	Bodily injury, complications, disabilities	Cross-sectional	Questionnaire	86.4
Meredith et al. <sup>99</sup> Sweden, 2020	284	Fractures of the forearm, clavicle and tibia/fibula, hand, vertebrae and humerus	Case-control	STRADA and SFR	81.8
Mesquita Filho <sup>100</sup> Brazil, 2016	196	Low self-esteem and quality of life	Cross-sectional	WHOQOL-BREF	81.8
Meyyappan et al. <sup>101</sup> 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. <sup>102</sup> 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. <sup>103</sup> France, 2018	10,165	Injuries to the abdomen, pelvic, diaphragm	Cross-sectional	Questionnaire	81.8
Ngunde et al. <sup>104</sup> Cameroon, 2019	197	Lower limb injuries, fractures, lacerations and bruises/hematomas	Cross-sectional	Questionnaire	81.8
Nhac-Vu et al. <sup>105</sup> France, 2011	276	Serious injuries to the lower limbs and head	Cohort	Questionnaire	95.5
Nóbrega et al. <sup>106</sup> Brazil, 2014	2,570	Maxillofacial injuries, fractures of the mandible, maxilla, zygoma, dentoalveolar and dental injuries	Cross-sectional	Questionnaire	95.5
Nogami et al. <sup>107</sup> Japan, 2020	99	Maxillofacial injuries, fractures of the mandible, maxilla, zygoma, dentoalveolar and dental injuries	Retrospective cross-sectional	Questionnaire	86.4
Okamoto et al. <sup>108</sup> Japan, 2019	14	Open globe injuries, rupture and laceration	Retrospective cross-sectional	Questionnaire	86.4
Paiva et al. <sup>109</sup> Brazil, 2015	109	Polytrauma, injuries to limbs, skull, abdomen, chest, spine, face	Retrospective cross-sectional	Questionnaire	86.4
Pajediene et al. <sup>110</sup> Lithuania, 2015	71	Musculoskeletal injury to the neck and shoulder	Cohort	QTFQ, DRI, CFQ, HADS	90.9
Palmera-Suárez et al. <sup>111</sup> 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. <sup>112</sup> Spain, 2016	443	Communication problems, general tasks and demands, interactions and interpersonal relationships	Cross-sectional	Questionnaire	90.9
Pan et al. <sup>5</sup> 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. <sup>113</sup> Greece, 2017	93	Fractures to the head, face, chest, abdomen, spine, lower and upper extremities	Cohort	Questionnaire	100
Parreira et al. <sup>114</sup> 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. <sup>115</sup> India, 2014	182	Serious injuries, soft tissue injuries, lower limb fractures	Cross-sectional	Questionnaire	81.8
Pietzka et al. <sup>116</sup> Germany, 2020	12,613	Maxillofacial injuries, and to eyes, mouth and ear, neurocranium, cervical spine	Retrospective cross-sectional	Questionnaire	81.8
Rastović et al. <sup>117</sup> Bosnia and Herzegovina, 2018	75	Isolated neck injury, whiplash injury	Cross-sectional	Questionnaire	77.3
Reiniger et al. <sup>118</sup> Brazil, 2012	69	General, neurological, thoracic, orthopedic, vascular surgery	Cross-sectional	Questionnaire	81.8
Roccia et al. <sup>119</sup> Italy, 2019	605	Maxillofacial and face fractures	Retrospective cross-sectional	Questionnaire	81.8
Seid et al. <sup>120</sup> 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 <sup>121</sup> Pakistan, 2017	385	Abrasions, lacerations, fractures, contusions and bruises	Prospective cross-sectional	Questionnaire	81.8
Vahdati et al. <sup>122</sup> 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. <sup>123</sup> India, 2014	347	Injuries to extremities, maxillofacial, bruises, lacerations	Retrospective cross-sectional	Questionnaire	81.8
Tahir et al. <sup>124</sup> Pakistan, 2012	132,504	Abrasions	Retrospective cross-sectional	Questionnaire	81.8
Terrier et al. <sup>125</sup> France, 2017	963	Genitourinary, renal, testicular injuries	Retrospective cross-sectional	Questionnaire	95.5
Wangdi et al. <sup>126</sup> Bhutan, 2018	1,143	Human (careless driving, drunk), environmental (road conditions) and vehicle mechanical factors	Cross-sectional	Questionnaire	86.4
Woyessa et al. <sup>127</sup> Ethiopia, 2020	286	Multiple injuries, visceral; bone fractures, head and chest	Cross-sectional	Questionnaire	95.5
Yang et al. <sup>128</sup> 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 Questionnaire; 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.<sup>25,26</sup>

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.<sup>11,12,27</sup> 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 (%)
<b>Body functions</b>	-	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)
<b>Body structures</b>	-	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)
<b>Activities and participation</b>	-	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)
<b>Environmental factors</b>	-	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.<sup>3,28-30</sup> 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.,<sup>23,24</sup> 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.<sup>31</sup> 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.<sup>32</sup>

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.<sup>3,30,33-36</sup>

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.<sup>37</sup> 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.<sup>8,11,12,37,38</sup>

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.<sup>4,33,36</sup>

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

This 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.

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