


REVIEW

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# Measuring post-discharge socioeconomic and quality of life outcomes in trauma patients: a scoping review

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## Abstract

**Purpose:** Trauma is a global public health challenge. Measuring post-discharge socioeconomic and quality-of-life outcomes can help better understand and reduce the consequences of trauma.

**Methods:** We performed a scoping review to map the existing research on post-discharge outcomes for trauma patients, irrespective of the country or setting in which the study was performed. The scoping review was conducted by searching six databases – MEDLINE, EMBASE, the Cochrane Library, Global Index Medicus, BASE, and Web of Science – to identify all articles that report post-discharge socioeconomic or quality of life outcomes in trauma patients from 2009 to 2018.

**Results:** Seven hundred fifty-eight articles were included in this study, extracting 958 outcomes. Most studies (82%) were from high-income countries (HICs). More studies from low- and middle-income countries (LMICs) were cross-sectional (71%) compared with HIC settings (46%). There was a wide variety of different definitions, interpretations, and measurements used by various articles for similar outcomes. Quality of life, return to work, social support, cost, and participation were the main outcomes studied in post-discharge trauma patients.

**Conclusions:** The wide range of outcomes and outcome measures reported across different types of injuries and settings. This variability can be a barrier when comparing across different types of injuries and settings. Post-discharge trauma studies should move towards building evidence based on standardized measurement of outcomes.

**Keywords:** Post-discharge, Socioeconomic outcomes, Trauma, Injury, Scoping review

## Key findings

- The findings indicate that a wide variety of different social, economic, and quality of life outcomes have been studied across the peer-reviewed and gray articles.
- Different articles have different definitions, different interpretations, and different measurement tools for

the same outcomes. Therefore, is a need to standardize these outcomes and the way they are measured.

- Most of the research came from high-income countries hence the need to push for more research on the outcomes due to injuries in low- and middle-income countries

## Introduction

Every year around 4.5 million people die from trauma—the clinical entity composed of physical injury and the body's associated response [1]—which is more than the fatalities recorded from HIV/AIDS, tuberculosis, malaria,

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and maternal mortality combined [2, 3]. Globally, trauma accounts for one-tenth of disability-adjusted life-years (DALYs), a burden largely in low and middle-income countries (LMICs) [4, 5]. Improved trauma management has reduced the number of deaths and attention has shifted to non-fatal traumas [6]. Consequently, post-discharge outcomes among survivors is an emerging field in public health research [7–9].

Trauma can have social consequences, and can affect relationships, participation in the community, independent living, and social functioning [10, 11]. It could result in direct financial costs including out-of-pocket expenses for treatment as well as indirect financial costs due to disability or loss of livelihoods, pushing families into poverty [12, 13]. Some studies show that up to 40% of trauma survivors are unable to work even 1 year after discharge [14–16]. These socioeconomic outcomes together can have a substantial effect on the health-related quality of life (QoL) [17–20]. However, there is limited research on these long-term outcomes experienced by trauma survivors [21].

### Rationale and objectives

Existing research on post-discharge socioeconomic and QOL outcomes among trauma patients, tends to focus on specific mechanism of trauma such as road traffic crashes, specific sociodemographic groups, specific injury types, such as traumatic brain injury, or specific factors such as socio-economic status [22–26]. Given the dispersed nature of the existing research on these outcomes among trauma patients across different populations and settings, collating the existing evidence base can highlight key findings and identify gaps [27, 28]. The aim of this paper is to provide an overview of the existing knowledge on post-discharge socio-economic and QoL outcomes in trauma patients. It will explore the different outcome measures and the tools used to assess these outcomes in post-discharge trauma patients.

## Methods

### Protocol and registration

The protocol for this paper was developed using Arksey and O'Malley's methodology for scoping reviews [29, 30]. It maps the extent and range of the field of study using five steps: (1) identifying the research question, (2) identifying relevant studies, (3) study selection, (4) charting the data, and (5) collating, summarizing, and reporting the results. The protocol was registered at Prospero before the review was undertaken (CRD42018103940) [31]. The Preferred Reporting Items for Systemic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) Checklist was followed for reporting the results of the study (Supplementary File Table S1) [32].

### Eligibility criteria

In this study we defined trauma as having any of the codes in chapter XX, block V01-Y36, in the International Classification of Disease 10th-revision (ICD 10) [33]. Studies on post-discharge trauma patients reporting measures of socio-economic and QOL outcomes were included in this review. The outcomes were based on the International Classification of Functioning, Disability and Health (ICF) checklist [34] and the WHO Manual for estimating the economic costs of injuries due to interpersonal and self-directed violence (WHO Manual) [12]. They included: social functioning, social adjustment, community participation, social relationships, social behavior, independent living, loss of livelihood, return to work, out-of-pocket expenses, indirect financial costs, health expenditures, cost analysis, and socio-economic factors. Publications in English using any design for measuring or reporting on these outcomes were included. We chose literature from September 2009 to August 2018 as this covered research that was relatively recent.

### Information sources and search strategy

To be comprehensive we used both published and grey literature sources. The published studies were searched using the electronic databases MEDLINE, EMBASE, and the Cochrane Library. For the grey literature, Global Index Medicus, BASE, and Web of Science were searched to identify reports and other articles. The search terms were developed based on ICF and the WHO Manual, and on inputs from the authors. The final terms were searched as keywords in the titles, abstracts and subject headings (like MeSH) as appropriate. The search strategy is available in Supplementary Material (Supplementary File Table S0).

### Selection of sources of evidence

While the criteria for selection were determined at the outset, certain criteria were defined post hoc as we became familiar with the literature. These were applied to all the articles. We excluded citations that involved injuries such as whiplash, needle-prick, aneurysms, neuropathies as they did not fit in with our definition of trauma. We also excluded articles specifically only focusing on sexual assault or self-harm, as they would involve emotional and psychological aspects affecting post-discharge outcomes, different from other mechanism of trauma. We excluded physiological, functional, and psychological outcomes. The selected studies were imported into the online systematic review software Rayyan [35].

The study selection process involved two stages of screening: first, a review of the title and abstract; and second, a full-text review. In the first stage of screening, SDD and MGW independently screened the title and

abstract of all retrieved results for inclusion. Any articles that were deemed relevant by at least one reviewer were included in the full-text review. SDD and MGW independently screened full-text articles, and any discordance was reviewed once again by each reviewer until consensus was reached. SDD has worked in public health research is part of trauma studies in public hospitals in LMICs. MGW is a clinician and has been the principal investigator of trauma research projects in LMICs. Both have worked for nearly a decade and have a reasonably good knowledge of trauma. However, they have not worked extensively on long-term post-discharge outcomes and this may have shaped the search strategy and data synthesis.

#### Data charting process, data items and synthesis of results

For the included articles, a data collection instrument was developed to capture the article's relevance and to extract the outcomes studied. It included: publication year, study design, country, income setting (high, middle, low income country based on the World Bank classification [36]), type of trauma such as mechanism of injury (fall, assault, road traffic crash, etc.), the socio-economic and QoL outcomes, unit of measurement, and the follow-up period. The WHO Disability Assessment Schedule (WHODAS 2.0), which is based on the ICF

framework, was used to classify the outcomes [37]. Of its six domains, mobility, self-care, getting along, life activities, and participation were used for classifying the outcomes extracted. In addition, two more domains were used: costs and quality of life.

#### Critical appraisal of quality of results

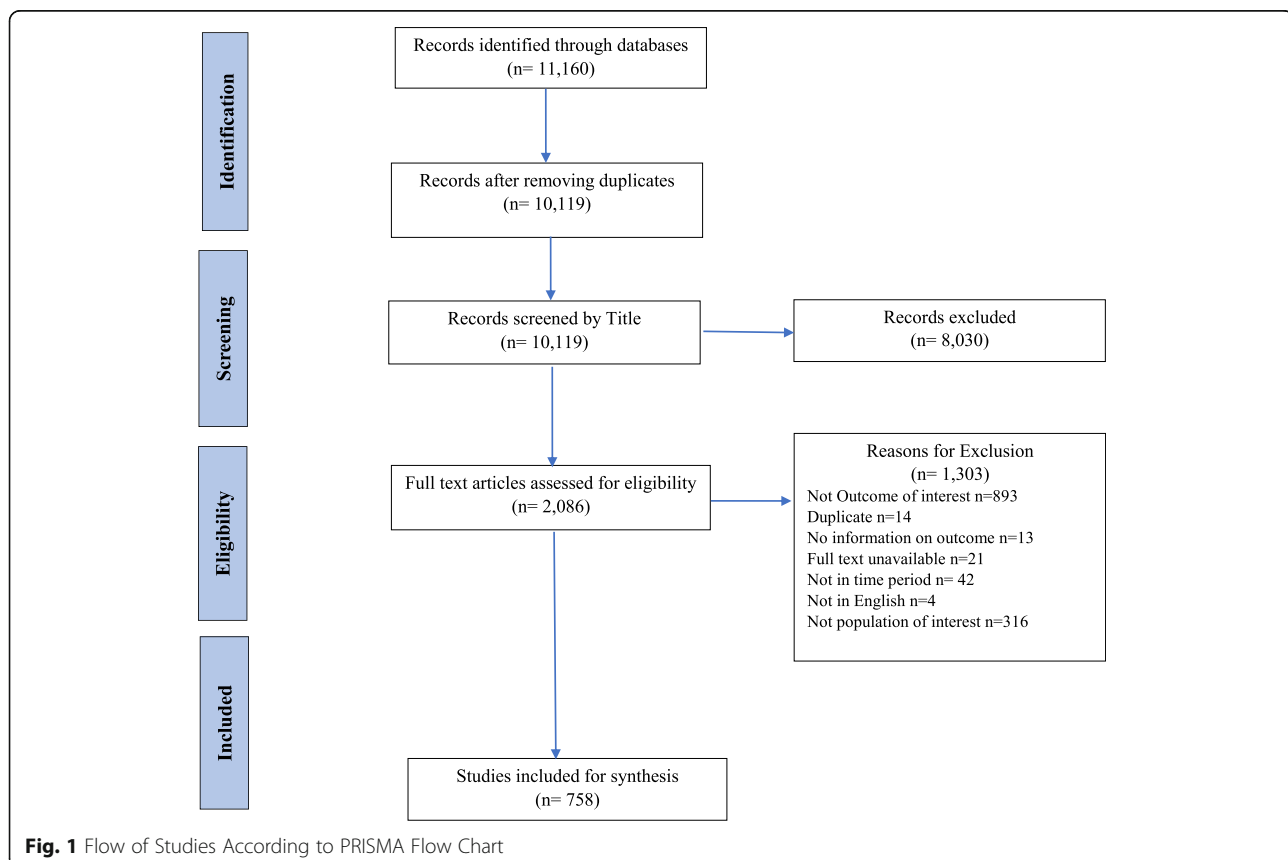
No appraisal of methodological quality or risk of bias of the included articles was done. This is consistent with guidance on conducting scoping reviews [29, 32].

## Results

#### Selection and characteristics of sources of evidence

The initial search from all the sources generated 11,160 references, out of which 2086 were selected based on their titles and abstract. After having read the articles in full, 758 articles were selected for inclusion in the review. The main reasons for excluding full-text articles were wrong outcome of interest ( $n = 893$ ) or wrong population of interest ( $n = 316$ ). The process flowchart is given in Fig. 1.

Around one-tenth of the articles were unpublished reports (grey literature) such as conference abstracts, policy briefs, doctoral thesis, poster presentations, and consensus meetings ( $n = 68$ ). Of the remaining articles ( $n = 690$ ), 57 were reviews, including systematic reviews



( $n = 37$ ), 40 were qualitative, 18 were study protocols and tool validation studies, and nine were case series, editorials, or letters to editors. There were four articles that were analyses of secondary data or databases, and there was one modelling paper (Table 1).

Out of the quantitative studies ( $n = 561$ ), a majority were cross-sectional or observational studies ( $n = 302$ ) followed by cohort-based studies ( $n = 244$ ). A majority of the cohort studies were prospective ( $n = 207$ ); the rest included longitudinal ( $n = 15$ ), retrospective ( $n = 15$ ), randomized control trials ( $n = 5$ ), and quasi-experimental studies ( $n = 2$ ). There were three articles that were retrospective analyses of prospectively collected data. Seven articles were mixed-method studies. Five of the articles were abstracts for which the full-text could not be found.

A majority ( $n = 625$ , 82.5%) of the articles were from high-income countries, with the US ( $n = 162$ ), Australia ( $n = 97$ ), and the Netherlands ( $n = 52$ ) the top contributors. Of the 105 articles from middle-income countries (both upper and lower), China ( $n = 14$ ), India ( $n = 14$ ), and Iran ( $n = 14$ ) were the top contributors. Among the six articles from low-income countries, there were two from Nepal and one each from Benin, Haiti, Malawi, and Uganda. Of the articles, 22 were studies involving

countries of different income levels. More details about the included studies are available in the Supplementary Materials (Supplementary File Tables: S2—Distribution of studies by year of publication, S3—Distribution by studies follow-up period, S4—Distribution of studies by country).

There was a difference seen when comparing the study designs of articles by the income level of countries. Out of the 111 studies from LMICs, more than two-thirds (70.2%) had a cross-sectional design ( $n = 78$ ). The rest were cohort-based studies. On the other hand, of the 625 articles from HICs, only one-third (34.4%) were cross-sectional studies ( $n = 215$ ).

Of the articles that reported a follow-up period ( $n = 574$ ), the average follow-up was 56 months (around 4.5 years; the range was 0.25 months to 720 months). However, the follow-up period for most studies was up to 1 year (48.7%,  $n = 280$ ). Just over 12% of the studies had a follow-up period of more than 5 years ( $n = 133$ ).

In this review we divided the studies into two broad groups: studies on patients with a specific type of body injury (isolated injuries or with associated injuries) and studies on patients with a specific mechanism of injury. Most of the studies were based on patients with a specific type of body injury ( $n = 604$ ). A majority of the studies focusing on a specific body part were on traumatic brain injury (TBI) ( $n = 262$ ), followed by spinal-cord injury ( $n = 171$ ), limb injury ( $n = 33$ ), hip injury ( $n = 18$ ), and others ( $n = 14$ ). There were also 106 articles focusing on multiple body regions injured or polytrauma.

The remaining 154 articles were focused on patients with specific mechanisms of injury. The most common were burns ( $n = 43$ ) and road traffic injuries ( $n = 43$ ), followed by occupational injuries ( $n = 31$ ), sports injuries ( $n = 14$ ), and assaults ( $n = 14$ ). The rest included self-harm, falls, and terrorism ( $n = 9$ ) (Table 2).

### Synthesis of results

A total of 78 different outcomes were reported 982 times in the 758 studies included in the review. This is because many studies focused on more than one outcome. Classification of the extracted outcomes into domains is shown in Table 3.

By far the most commonly reported outcome among the included articles was quality of life ( $n = 424$ ), followed by return to work ( $n = 179$ ), social support ( $n = 63$ ), cost ( $n = 50$ ), and participation ( $n = 41$ ). Table 4 provides the five most common tools used to measure the 10 outcomes that are reported most. A table with the all the outcomes is provided in the Supplementary Materials (Supplementary File Table S5—List of Reported Outcomes and Outcome Measures).

**Table 1** Characteristics of the Included Articles

Study Characteristics	Count (%)
Year of Publication ( $n = 758$ )	
2009–2010	108 (14)
2011–2012	141 (19)
2013–2014	148 (20)
2015–2016	208 (27)
2017–2018	153 (20)
Study Setting ( $n = 758$ )	
High-Income Countries	625 (82)
Middle-Income Countries	105 (14)
Low-Income Countries	6 (0.8)
Mixed	22 (3)
Study Design ( $n = 758$ )	
Cross-sectional Studies	302 (40)
Cohort-based Studies	244 (32)
Grey Literature	68 (9)
Qualitative Studies	40 (5)
Systematic Reviews	37 (5)
Others	67 (9)
Follow-up period ( $n = 574$ )	
Up to 1 year	280 (49)
2–5 years	161 (28)
More than 5 years	133 (23)

Range: 0.25 months–720 months, Average 4.5 years

**Table 2** Types and Mechanisms of Injury in the Included Articles

Type of Injury	Count (%)
Body part injured (n = 604)	
Traumatic Brain Injury	262 (43)
Spinal Cord Injury	171 (28)
Polytrauma	106 (18)
Limb Injury	33 (6)
Hip injury	18 (3)
Others	14 (2)
Mechanism of Injury (n = 154)	
Road Traffic Injury	43 (28)
Burns	43 (28)
Occupational Injuries	31 (20)
Sports injuries	14 (9)
Assaults	14 (9)
Others	9 (6)

On analyzing the five most reported outcomes among the three most common types of injury in both of the injury categories, it was seen that quality of life and return-to-work are the most commonly studied outcomes across all types of injuries (Table 5).

## Discussion

### Summary of evidence

This scoping review was conducted to map the current knowledge on post-discharge socioeconomic and QoL outcomes in trauma patients by reviewing 78 outcomes extracted from 758 articles included in the study. The most commonly studied outcomes across the studies were quality of life, return-to-work (RTW), social support, cost, and participation. Short Form Survey (SF-36/12/8) and Craig Hospital Assessment and Reporting Technique (CHART) were the most commonly used tools to measure quality of life and participation, respectively. Simple yes or no answers were generally used to measure RTW and social support, while detailed questions on direct costs were used for estimating costs.

Our results show great variability in terms of the different socio-economic and QoL outcomes studied and measures or tools used. This highlights the high heterogeneity in the study of these outcomes across different types of trauma, patients, and settings. In the reviewed articles, a wide variety of different definitions and interpretations are used for the same outcomes. These inconsistencies may be due to the lack of standardization of definitions of the outcomes. For example, many articles used the terms “health status” and “health outcomes” to study and measure quality-of-life. On the other hand, articles used the term “daily activity” to describe self-care

tasks like grooming or cleaning while others used it to describe shopping or volunteering and even quality-of-life. Despite the global guidelines such as ICF and WHODAS [37, 38] created to unify and standardize post-discharge outcomes, only a few studies have used them in defining or measuring outcomes after trauma.

This lacunae has also been pointed out in other reviews of post-discharge outcomes among trauma patients [25, 39, 40]. The variability makes comparisons across different types of injuries and settings challenging. There is increasing recognition of the need to standardize outcomes and outcome measures to improve estimation of risk, comparisons between settings, and delivery of care [41, 42]. Moving towards a global use of standardized outcome measures can build a body of homogeneous and uniform evidence on different outcomes. This may help future researchers and policy-makers to better understand the burden of post-discharge trauma.

Our results show that a substantial proportion (more than 80%) of the existing research on post-discharge patients comes from high-income settings. This is in line with research on orthopedic trauma [43], fractures [44], and TBI [45] that similarly show low trauma research outputs from LMIC settings. This means that the current knowledge on post-discharge outcomes in trauma patients is largely based on evidence from high-income settings [46–48].

In our analysis, in comparison to HICs, studies from LMICs were predominately cross-sectional in design without any cohort-based follow-ups (46% vs 71%). Such designs largely form the lower levels of evidence in health research hierarchy [49]. This indicates the need for more cohort-based research to study the trends and long-term effects of trauma morbidity, especially for LMIC settings. The reasons for this limited research from LMICs are attributed to the paucity of resources in these settings to conduct cohort follow-ups as well as the financial barriers in publishing them in peer-reviewed journals, which are often behind paywalls [47, 50].

On further analysis, our results show that more than half of the higher levels of evidence studies (prospective cohorts and RCTs) from LMICs were the product of collaborations with HIC institutions (9 out of 17). Therefore, future research projects could aim to foster such joint research to build local capacity, provide more resources, and increase the output of evidence from LMICs. Academic collaborations between HICs and LMICs has been suggested as the way forward to address this disparity in good quality research from LMICs which have disproportionate burden of trauma [51, 52].

Building on our findings, future research could narrowly focus of specific socioeconomic and QoL outcomes, and provide more detailed evidence on their



**Table 3** Classification of Reported Outcomes into Domains based on WHODAS 2.0

Domain	Outcomes
Mobility (Moving and getting around)	Mobility Physical Activity
Self-care (Attending to one's hygiene, dressing, eating and staying alone)	Restricted Mobility Everyday Activity Daily Activity
Getting Along (Interacting with other people)	Caregiver Family Life Family Support Impact on Family Life Interpersonal Relationships Perceived Social Support Role of Caregiver Support Workplace support
Life Activities (Domestic responsibilities, leisure, work and school)	Activities Daily Activity Employment Outcome Employment Status Environmental Assistance Impact on Employment or Studies Impact on Leisure/Sports Job Stability Labour Market Participation Reintegration Retention of Work Return to Work Social Leisure Activities Social Roles Social Role participation Social Role Change Sustained Return to Work Time off Work Unpaid Work Work Work Satisfaction
Participation (Involvement in a life situation)	Community and Social Life Community Integration Community Participation Environmental Barriers Independence Integration Life Participation Life Satisfaction

**Table 3** Classification of Reported Outcomes into Domains based on WHODAS 2.0 (Continued)

Domain	Outcomes
	Limited Social Interaction Participate in Social Life Participation Satisfaction/Satisfaction with life Sentinel Events Social Activities Social Adaptation Social Adjustment Social Behavior Social Consequences Social Functioning Social Inclusion Social Integration Social Interaction Social Isolation Social Life Social Networks Social Participation Social Support Societal Participation
Costs (Out-of-pocket expenditures and financial losses)	Cost Economic Impact Financial Coping/Source Financial Difficulty/Load Financial Security Financial Status Financial Strain Medical Costs Productivity Costs Social Costs Socioeconomic Deprivation Socioeconomic Status
Quality of Life (individual's perception of their position in life)	Health Outcome Health Status Quality of Life

definitions, measurements, and quality of evidence across different injuries and settings. Systematic reviews and meta-analyses of the outcomes based on this scoping review will enable in-depth study and comparisons of the outcomes across different studies. Additionally, other unexplored outcomes such as physiological functioning, psychological outcomes, and impact on caregivers can become the focus of future studies.

**Table 4** Most Reported Outcomes and the most used Outcome Tools for the outcomes

Outcome	Tools
Quality of Life ( <i>n</i> = 425)	Short-Form 36/12/6 (SF-36/12/6) ( <i>n</i> = 197); Euro Quality of Life (EuroQoL: EQ-6D/5D/3D) ( <i>n</i> = 66); World Health Organization Quality of Life Assessment (WHOQOL-BREF) ( <i>n</i> = 54); Quality of Life after Brain Injury (QOLIBRI) ( <i>n</i> = 43); Burn Specific Health Scale-Brief (BSHS-B) ( <i>n</i> = 18)
Return to Work ( <i>n</i> = 180)	Back to any work (Yes/No) ( <i>n</i> = 145); Sickness leave/Time off ( <i>n</i> = 16); Unemployment benefits ( <i>n</i> = 6); Staying at work for at least a month ( <i>n</i> = 2); Activities Component of EQ-5D ( <i>n</i> = 2)
Social Support ( <i>n</i> = 63)	Support from family, friends, and neighbors (Yes/No) ( <i>n</i> = 13); Multidimensional Scale of Perceived Social Support (MSPSS) ( <i>n</i> = 12); Social Support Questionnaire (SSQ) ( <i>n</i> = 7); Social Provision Scale (SPS-12) ( <i>n</i> = 5); Interpersonal Support Evaluation List (ISEL) ( <i>n</i> = 5)
Cost ( <i>n</i> = 52)	Direct costs: cost of treatment, medical costs, out-of-pocket expenditure, non-medical expenses such as transport, etc. ( <i>n</i> = 20); Medical costs: hospitalizations, drugs, treatment costs, consultations, etc. ( <i>n</i> = 14); Indirect: Loss of employment-number of days missed and average monthly income, etc. ( <i>n</i> = 12); Any out-of-pocket expenditures ( <i>n</i> = 4)
Participation ( <i>n</i> = 41)	Craig Hospital Assessment and Reporting Technique (CHART) ( <i>n</i> = 11); Utrecht Scale for Evaluation of Rehabilitation-Participation (USER-Participation) ( <i>n</i> = 5); International Classification of Functioning, Disability and Health Checklist (ICF) ( <i>n</i> = 5); Community Integration Questionnaire (CIQ) ( <i>n</i> = 4); WHO Disability Assessment Schedule (WHODAS II) ( <i>n</i> = 2); Community Integration Measure (CIM) ( <i>n</i> = 2)
Community Integration <sup>a</sup> ( <i>n</i> = 35)	Community Integration Questionnaire (CIQ) ( <i>n</i> = 21); Community Integration Measure (CIM) ( <i>n</i> = 5); Craig Handicap Assessment and Reporting Technique (CHART) ( <i>n</i> = 4); The Sydney Psychosocial Reintegration Scale (SPRS) ( <i>n</i> = 2)
Life Satisfaction <sup>a</sup> ( <i>n</i> = 22)	Satisfaction with Life Scale (SWLS) ( <i>n</i> = 9); Life Satisfaction Questionnaire (LiSat) ( <i>n</i> = 8); Life Satisfaction Index (LSI) ( <i>n</i> = 3)
Social Participation <sup>a</sup> ( <i>n</i> = 22)	Participation Assessment of Recombined Tools ( <i>n</i> = 3); Craig Handicap Assessment and Reporting Technique (CHART) ( <i>n</i> = 2)
Health Status <sup>a</sup> ( <i>n</i> = 12)	Short-Form 36 (SF-36) ( <i>n</i> = 6); Euro Quality of Life (EQ-5D) ( <i>n</i> = 5)
Social Integration <sup>a</sup> ( <i>n</i> = 7)	Craig Handicap Assessment and Reporting Technique (CHART) ( <i>n</i> = 3)

<sup>a</sup>Remaining tools only used once

Future research on post-discharge socioeconomic outcomes in trauma patients should refer to international frameworks such as ICF and WHODAS to use the appropriate terminology and clearly define the outcome of

interest. Using validated tools, which have been applied in different settings, to measure outcomes can build a standardized system of evidence to better understand the long-term outcomes of trauma. Additionally, future research can

**Table 5** Most Reported Outcomes by Type of Injury

Injury Type	Outcome	Count (%)
<b>Body Part Injured</b>		
TBI ( <i>n</i> = 262)	Quality of Life	142 (54)
	Return to work	48 (18)
	Community Integration	11 (4)
	Life Satisfaction	9 (3)
	Costs	5(2)
SCI ( <i>n</i> = 171)	Quality of Life	91 (53)
	Participation	17 (8)
	Social Support	16 (8)
	Return to work	13 (7)
	Social Participation	7(4)
Polytrauma ( <i>n</i> = 106)	Quality of Life	46 (43)
	Return to work	26 (25)
	Costs	19 (18)
	Social Support	4 (4)
	Health Status	4(4)
<b>Mechanism of Injury</b>		
Burns <sup>a</sup> ( <i>n</i> = 43)	Quality of Life	28 (65)
	Social Support	4 (9)
	Return to work	3 (7)
Road Traffic Injuries <sup>a</sup> ( <i>n</i> = 43)	Quality of Life	20 (46)
	Costs	9 (20)
	Return to work	7 (16)
	Health Status	2(4)
Occupational Injuries <sup>a</sup> ( <i>n</i> = 31)	Return to work	24
	Quality of Life	4
	Costs	2

<sup>a</sup>Remaining outcomes only used once

focus on outcomes such as social functioning, social roles, productivity costs, and catastrophic expenditure, which remain less studied in trauma patients.

### Limitations

Our scoping review has several limitations. Firstly, the nature of scoping reviews is to focus on providing breadth rather than depth of information. But this was apt for the objective of this study to map the current knowledge on post-discharge outcomes in trauma patients. Secondly, our search was limited to studies in English, potentially leading to exclusion of relevant articles in other languages. Thirdly, the searches for the outcomes were based on terms from the ICF, the WHO Manual, and other articles accessed by the authors.

Given the vast variability in the outcomes reported, this could have excluded certain other socioeconomic and QoL outcomes. While the World Bank's categorization of

countries was from one point in time (i.e., 2018), the studies were from a 10-year period, during which time a country's income categorization could have fluctuated. The articles mainly focused on patients with specific body type of injuries such as TBI or spinal cord injury. Therefore, it is difficult to comment on whether specific mechanisms of injury such as self-harm or falls, the second and third leading causes of injuries respectively, were adequately covered [5].

### Conclusions

There is great variability in the outcomes and outcome measures reported across different types of injuries and settings. This would make comparative research and meta-analysis of the outcomes challenging. Quality of life, return-to-work, social support, cost, and participation were the main outcomes studied in post-discharge trauma patients. Post-discharge trauma studies should move towards building evidence based on standardized measurement of outcomes.

### Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s41687-021-00346-6>.

**Additional file 1.** Search Strategy.

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### Authors' contributions

SDD, NR, HR, CSL, and MGW contributed to the study conception and design of the study. Data search, screening, extraction, and analysis were performed by SDD and MGW. The first draft of the manuscript was written by SDD. NR, HR, CSL, and MGW commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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### Availability of data and materials

Information on the search strategy has been given in the [Supplementary Materials](#).

### Declarations

#### Ethics approval and consent to participate

This study was scoping review and did not involve participants directly, therefore did not require in ethics approval and consent.

#### Consent for publication

Not applicable.

#### Competing interests

The authors declare that they have no competing interests.



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**References**

- Gerdin, M. (2015). *The risk of dying*.
- Toroyan, T., Peden, M. M., & Iach, K. (2013). WHO launches second global status report on road safety. *Inj Prev*, 19(2), 150. <https://doi.org/10.1136/injuryprev-2013-040775>.
- Roth, G. A., Abate, D., Abate, K. H., Abay, S. M., Abbafati, C., Abbasi, N., ... Murray, C. J. L. (2018). Global, regional, and national age-sex-specific mortality for 282 causes of death in 195 countries and territories, 1980–2017: A systematic analysis for the global burden of disease study 2017. *Lancet*, 392(10159), 1736–1788. [https://doi.org/10.1016/S0140-6736\(18\)32203-7](https://doi.org/10.1016/S0140-6736(18)32203-7).
- Alonge, O., Agrawal, P., Talab, A., Rahman, Q. S., Rahman, A. F., El Arifeen, S., & Hyder, A. A. (2017). Fatal and non-fatal injury outcomes: Results from a purposively sampled census of seven rural subdistricts in Bangladesh. *Lancet Glob Health*, 5(8), e818–e827. [https://doi.org/10.1016/S2214-109X\(17\)30244-9](https://doi.org/10.1016/S2214-109X(17)30244-9).
- Haagsma, J. A., James, S. L., Castle, C. D., Dingels, Z. V., Fox, J. T., Hamilton, E. B., ... Vos, T. (2019). Burden of injury along the development spectrum: Associations between the socio-demographic index and disability-adjusted life year estimates from the global burden of disease study 2017. *Inj Prev*, 26(Suppl 1), 1–15. <https://doi.org/10.1136/injuryprev-2019-043296>.
- de Jongh, M. A., Kruitthof, N., Gosens, T., van de Ree, C. L., de Munter, L., Brouwers, L., ... group, B. (2017). Prevalence, recovery patterns and predictors of quality of life and costs after non-fatal injury: The Brabant injury outcome surveillance (BIOS) study. *Inj Prev*, 23(1), 59. <https://doi.org/10.1136/injuryprev-2016-042032>.
- Mistiaen, P., & Poot, E. (2006). Telephone follow-up, initiated by a hospital-based health professional, for postdischarge problems in patients discharged from hospital to home (Review). *Cochrane Database Syst Rev*, 4. <https://doi.org/10.1002/14651858.CD004510.pub3.www.cochranelibrary.com>.
- Studerus-Germann, A. M., Engel, D. C., Stienen, M. N., von Ow, D., Hildebrandt, G., & Gautschi, O. P. (2017). Three versus seven days to return-to-work after mild traumatic brain injury: A randomized parallel-group trial with neuropsychological assessment. *Int J Neurosci*, 127(10), 900–908. <https://doi.org/10.1080/00207454.2017.1278589>.
- Nhac-Vu, H. T., Hours, M., Charney, P., Chossegros, L., Boisson, D., Luaute, J., ... Laumon, B. (2011). Predicting self-reported recovery one year after major road traffic accident trauma. *J Rehabil Med*, 43(9), 776–782. <https://doi.org/10.2340/16501977-0854>.
- Temkin, N. R., Corrigan, J. D., Dikmen, S. S., & Machamer, J. (2009). Social functioning after traumatic brain injury. *J Head Trauma Rehabil*, 24(6), 460–467. <https://doi.org/10.1097/HTR.0b013e3181c13413>.
- Rainer, T. H., Yeung, J. H. H., Cheung, S. K. C., Yuen, Y. K. Y., Poon, W. S., Ho, H. F., ... Graham, C. A. (2014). Assessment of quality of life and functional outcome in patients sustaining moderate and major trauma: A multicentre, prospective cohort study. *Injury*, 45(5), 902–909. Retrieved from. <https://doi.org/10.1016/j.injury.2013.11.006>.
- World Health Organization (2008). Manual for estimating the economic costs of injuries due to interpersonal and self-directed violence. Geneva: Switzerland Retrieved from [http://apps.who.int/iris/bitstream/10665/43837/1/9789241596367\\_eng.pdf](http://apps.who.int/iris/bitstream/10665/43837/1/9789241596367_eng.pdf).
- Nguyen, H., Ivers, R., Jan, S., Martiniuk, A., & Pham, C. (2013). Catastrophic household costs due to injury in Vietnam. *Injury*, 44(5), 684–690. <https://doi.org/10.1016/j.injury.2012.05.006>.
- Ahmed, W., Alwe, R., & Wade, D. (2017). One-year functional outcomes following major trauma: Experience of a UK level 1 major trauma Centre. *Clin Rehabil*, 31(12), 1646–1652. <https://doi.org/10.1177/0269215517712044>.
- Holtslag, H. R., Post, M. W., van der Werken, C., & Lindeman, E. (2007). Return to work after major trauma. *Clin Rehabil*, 21(4), 373–383. <https://doi.org/10.1177/0269215507072084>.
- Gabbe, B. J., Simpson, P. M., Harrison, J. E., Lyons, R. A., Ameratunga, S., Ponsford, J., ... Cameron, P. A. (2016). Return to work and functional outcomes after major trauma. *Ann Surg*, 263(4), 623–632. <https://doi.org/10.1097/SLA.0000000000001564>.
- Ivers, R., Bhandari, M., & Norton, R. (2014). A call to research: Documenting the non-fatal outcomes of injury. *Injury*, 45(6), 921–922. <https://doi.org/10.1016/j.injury.2014.02.020>.
- Müller, R., Landmann, G., Béchir, M., Hinrichs, T., Arnet, U., Jordan, X., & Brinkhof, M. W. G. (2017). Chronic pain, depression and quality of life in individuals with spinal cord injury: Mediating role of participation. *J Rehabil Med*, 49(6), 489–496. <https://doi.org/10.2340/16501977-2241>.
- Ferdiana, A., Post, M. W. M., King, N., Bültmann, U., & van der Klink, J. J. L. (2018). Meaning and components of quality of life among individuals with spinal cord injury in Yogyakarta Province, Indonesia. *Disabil Rehabil*, 40(10), 1183–1191. <https://doi.org/10.1080/09638288.2017.1294204>.
- Chu, S., Tsai, Y., Xiao, S., & Huang, S. (2017). Quality of return to work in patients with mild traumatic brain injury: a prospective investigation of associations among post-concussion symptoms, neuropsychological functions, working status and stability. *Brain Inj*, 31(12), 1674–1682. <https://doi.org/10.1080/02699052.2017.1332783>.
- Rios-Diaz, A. J., Lam, J., & Zogg, C. K. (2016). The need for Postdischarge, patient-centered data in trauma. *JAMA Surg*, 151(12), 1101–1102. <https://doi.org/10.1001/jamasurg.2016.2343>.
- Rissanen, R., Berg, H. Y., & Hasselberg, M. (2017). Quality of life following road traffic injury: A systematic literature review. *Accid Anal Prev*, 108(March), 308–320. <https://doi.org/10.1016/j.aap.2017.09.013>.
- Wantonoro, W., Kuo, W. Y., & Shyu, Y. L. (2020). Changes in health-related quality of life for older persons with cognitive impairment after hip fracture surgery: A systematic review. *J Nurs Res*, 23(3), 23. <https://doi.org/10.1097/jnr.0000000000000371>.
- Cancelliere, C., Donovan, J., Stockendahl, M. J., Biscardi, M., Ammendolia, C., Myburgh, C., & Cassidy, J. D. (2016). Factors affecting return to work after injury or illness: Best evidence synthesis of systematic reviews. *Chiropractic Manual Ther*, 24(1), 32. <https://doi.org/10.1186/s12998-016-0113-z>.
- Bloom, B., Thomas, S., Ahrensberg, J. M., Weaver, R., Fowler, A., Bestwick, J., ... Pearce, R. (2018). A systematic review and meta-analysis of return to work after mild traumatic brain injury. *Brain Inj*, 32(13–14), 1623–1636. <https://doi.org/10.1080/02699052.2018.1532111>.
- Polinder, S., Haagsma, J. A., Belt, E., Lyons, R. A., Erasmus, V., Lund, J., & Van Beeck, E. F. (2010). A systematic review of studies measuring health-related quality of life of general injury populations. *BMC Public Health*, 10(1), 1–13. <https://doi.org/10.1186/1471-2458-10-783>.
- Clinical, N. H. S., & Groups, A. (2010). Regional networks for major trauma, (September).
- Gururaj, G. (2013). Injury prevention and care: An important public health agenda for health, survival and safety of children. *Ind J Pediatr*, 80(S1), 100–108. <https://doi.org/10.1007/s12098-012-0783-z>.
- Arksey, H., & O'Malley, L. (2005). Scoping studies: Towards a methodological framework. *Int J Soc Res Methodol*, 8(1), 19–32. <https://doi.org/10.1080/1364557032000119616>.
- Colquhoun, H. L., Levac, D., O'Brien, K. K., Straus, S., Tricco, A. C., Perrier, L., ... Moher, D. (2014). Scoping reviews: Time for clarity in definition, methods, and reporting. *J Clin Epidemiol*, 67(12), 1291–1294. <https://doi.org/10.1016/j.jclinepi.2014.03.013>.
- David, S., Wärmberg Gerdin, M., Roy, N., Solomon, H., & Stålsby Lundborg, C. (n.d.). Measuring post-discharge socioeconomic and quality of life (QOL) in trauma patients: a scoping review and systematic review. PROSPERO. Retrieved 7 June 2019, from [https://www.crd.york.ac.uk/prospero/display\\_record.php?RecordID=103940](https://www.crd.york.ac.uk/prospero/display_record.php?RecordID=103940).
- Tricco, A. C., Lillie, E., Zarin, W., Brien, K. K. O., Colquhoun, H., Levac, D., ... Garrity, C. (2016). RESEARCH AND REPORTING METHODS PRISMA extension for scoping reviews (PRISMA-ScR): Checklist and explanation. *Ann Intern Med*, 169(7), 467–473. <https://doi.org/10.7326/M18-0850>.
- World Health Organization. (2016). International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10)-WHO Version for 2016. Retrieved from <http://apps.who.int/classifications/icd10/browse/2016/en#XX>.

34. World Health Organization (WHO). (2003). International Classification of Functioning, Disability and Health. World Health Organization, (Version 2.1a, Clinician Form), 1–15. Retrieved from <http://www.who.int/classifications/icf/icfchecklist.pdf?ua=1>.
35. Ouzzani, M. (2017). Rayyan — A web and mobile app for systematic reviews. *Syst Rev*, 2016(1), 1–10. <https://doi.org/10.1186/s13643-016-0384-4>.
36. World Bank. (2019). World Bank Country and Lending Groups. Retrieved 5 April 2019, from <https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups>.
37. Üstün, T., Kostanjsek, N., Chatterji, S., & Rehm, J. (Eds.) (2010). Measuring health and disability: Manual for WHO disability assessment schedule (WHODAS 2.0). World Health Organization. Geneva: World Health Organization Press Retrieved from [https://apps.who.int/iris/bitstream/handle/10665/43974/9789241547598\\_eng.pdf?sequence=1](https://apps.who.int/iris/bitstream/handle/10665/43974/9789241547598_eng.pdf?sequence=1).
38. World Health Organization (WHO) (2013). How to use the ICF a practical manual for using the international classification of functioning, disability and health (ICF) ICF a practical manual for using the international classification of functioning, disability and health (ICF) exposure draft for c. Geneva: Retrieved from <http://www.who.int/classifications/drafticfpracticalmanual2.pdf?ua=1>.
39. Saltychev, M., Eskola, M., Tenovu, O., & Laimi, K. (2013). Return to work after traumatic brain injury: Systematic review. *Brain Inj*, 27(13–14), 1516–1527. <https://doi.org/10.3109/02699052.2013.831131>.
40. Rosenberg, G. M., Stave, C., Spain, D. A., & Weiser, T. G. (2018). Patient-reported outcomes in trauma: A scoping study of published research. *Trauma Surg Acute Care Open*, 3(1), e000202. <https://doi.org/10.1136/tsaco-2018-000202>.
41. Kelley, T. A. (2015). International consortium for health outcomes measurement ( ICHOM ). *Trials*, 16(Suppl 3), O4. <https://doi.org/10.1186/1745-6215-16-S3-O4>.
42. Porter, M. E., Ph, D., Larsson, S., Ph, D., & Lee, T. H. (2019). Standardizing patient outcomes measurement. *N Engl J Med*, 374(6), 504–506.
43. Graham, S. M., Brennan, C., Laubscher, M., Maqungo, S., Lalloo, D. G., Perry, D. C., ... Harrison, W. J. (2019). Orthopaedic research in low-income countries: A bibliometric analysis of the current literature. *Sicot-J*, 5, 41. <https://doi.org/10.1051/sicotj/2019038>.
44. Sun, J., Ding, R., Ma, T., Shi, X., Bao, C., & Guan, H. (2017). Worldwide research productivity in fracture surgery: A 10-year survey of publication activity. *Exp Ther Med*, 14(2), 1260–1264. <https://doi.org/10.3892/etm.2017.4585>.
45. Tropeano, M. P., Spaggiari, R., Ileyassoff, H., Park, K. B., Koliass, A. G., Hutchinson, P. J., & Servadei, F. (2019). A comparison of publication to TBI burden ratio of low- and middle-income countries versus high-income countries: How can we improve worldwide care of TBI? *Neurosurg Focus*, 47(5), 8–13. <https://doi.org/10.3171/2019.8.FOCUS19507>.
46. Baker, T. (2015). *Critical Care in low Resource Settings*.
47. Wisborg, T., Montshiwa, T. R., & Mock, C. (2011). Trauma research in low- and middle-income countries is urgently needed to strengthen the chain of survival. *Scand J Trauma Resuscitation Emerg Med*, 19(October), 62. <https://doi.org/10.1186/1757-7241-19-62>.
48. Wisborg, T., Manskow, U. S., & Jeppesen, E. (2017). Trauma outcome research – More is needed. *Acta Anaesthesiol Scand*, 61(4), 362–364. <https://doi.org/10.1111/aas.12875>.
49. Howick, J., Chalmers, I., Glasziou, P., Greenhalgh, T., Heneghan, C., Liberati, A., ... Thornto, H. (2011). Explanation of the 2011 Oxford Centre for Evidence-Based Medicine (OCEBM) levels of evidence (background document). In Oxford Centre for Evidence-Based Medicine Retrieved from <https://www.cebm.net/index.aspx?o=5653%0A%0A>.
50. Kelaher, M., Ng, L., Knight, K., & Rahadi, A. (2016). Equity in global health research in the new millennium: Trends in first-authorship for randomized controlled trials among low and middle-income country researchers 1990–2013. *Int J Epidemiol*, 45(6), 2174–2183. <https://doi.org/10.1093/ije/dyw313>.
51. Wu, H.-H., Liu, M., Patel, K. R., Turner, W., Baltus, L., Caldwell, A. M., ... Shearer, D. W. (2017). Impact of academic collaboration and quality of clinical orthopaedic research conducted in low- and middle-income countries. *Sicot-J*, 3, 6. <https://doi.org/10.1051/sicotj/2016042>.
52. Meara, J. G., Leather, A. J. M., Hagander, L., Alkire, B. C., Alonso, N., Ameh, E. A., ... Yip, W. (2015). Global surgery 2030: Evidence and solutions for achieving health, welfare, and economic development. *Lancet*, 386(9993), 569–624. [https://doi.org/10.1016/S0140-6736\(15\)60160-X](https://doi.org/10.1016/S0140-6736(15)60160-X).

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