BMJ Open Assessment of patient-reported outcomes after polytrauma – instruments and methods: a systematic review

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To cite: Ritschel M, Kuske S, Gnass I, *et al.* Assessment of patient-reported outcomes after polytrauma – instruments and methods: a systematic review. *BMJ Open* 2021;**11**:e050168. doi:10.1136/bmjopen-2021-050168

► Prepublication history and additional supplemental material for this paper are available online. To view these files, please visit the journal online (<http://dx.doi.org/10.1136/bmjopen-2021-050168>).

Received 11 February 2021
Accepted 14 September 2021

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ABSTRACT

Objectives We (1) collected instruments that assess health-related quality of life (HRQoL), activities of daily living (ADL) and social participation during follow-up after polytrauma, (2) described their use and (3) investigated other relevant patient-reported outcomes (PROs) assessed in the studies.

Design Systematic Review using the Preferred Reporting Items for Systematic Review and Meta-Analysis guideline.

Data sources MEDLINE, Embase, CINAHL, PsycINFO, CENTRAL, as well as the trials registers ClinicalTrials.gov and WHO ICTRP were searched from January 2005 to April 2018.

Eligibility criteria All original empirical research published in English or German including PROs of patients aged 18–75 years with an Injury Severity Score ≥ 16 and/or an Abbreviated Injury Scale ≥ 3 . Studies with defined injuries or diseases (e.g. low-energy injuries) and some text types (e.g. grey literature and books) were excluded. Systematic reviews and meta-analyses were excluded, but references screened for appropriate studies.

Data extraction and synthesis Data extraction, narrative content analysis and a critical appraisal (e.g. UK National Institute for Health and Care Excellence) were performed by two reviewers independently.

Results The search yielded 3496 hits; 54 publications were included. Predominantly, HRQoL was assessed, with Short Form-36 Health Survey applied most frequently. ADL and (social) participation were rarely assessed. The methods most used were postal surveys and single assessments of PROs, with a follow-up period of one to one and a half years. Other relevant PRO areas reported were function, mental disorders and pain.

Conclusions There is a large variation in the assessment of PROs after polytrauma, impairing comparability of outcomes. First efforts to standardise the collection of PROs have been initiated, but require further harmonisation between central players. Additional knowledge on rarely reported PRO areas (e.g. (social) participation, social networks) may lead to their consideration in health services provision.

PROSPERO registration number CRD42017060825.

Strengths and limitations of this study

- This systematic review was based on a comprehensive search strategy and conducted according to a registered and published protocol.
- First systematic review that provides an overview of patient-oriented instruments used in research after polytrauma.
- Throughout the review process, we followed the Preferred Reporting Items for Systematic Review and Meta-Analysis guideline.
- A limitation might be the restriction of the search period and the language.

INTRODUCTION

Severe injuries represent a leading cause of death and permanent disability.¹ In the central European region, severely injured people are referred to as having a ‘polytrauma’ or being ‘polytraumatised’.² A polytrauma is defined as at least two severe injuries in different body regions or organ systems, at least one of which is potentially life-threatening by itself or in combination with others, with an Injury Severity Score (ISS) ≥ 16 .^{1–4} According to the TraumaRegister DGU®, a German registry that covers patients with severe injuries, the number of patients with polytrauma (ISS ≥ 16) was 15 651 in 2019.⁵ Most affected were men (72%) with a mean age of 46.5 years.⁶

The survival rates after polytrauma have increased lately, bringing the quality of survival into the focus of research. One year after polytrauma, survivors often fail to reach pretraumatic status due to persisting medical problems.⁷ Disabilities such as respiratory problems, paraplegia or tetraplegia, prevent 40% from returning to their former workplace.^{8–9} They also have an impact on socioeconomic aspects and quality of life.^{9–11} Therefore, it is crucial to reduce the short-term and long-term burden after

polytrauma.^{9 11} In this context, the patients' perspective on polytrauma outcomes focussing on psychological, physical and social factors is getting more important for the patients themselves, their relatives and health-care professionals.^{11 12} Evaluating these patient-reported outcomes (PROs) is essential to complete the holistic assessment of relevant clinical outcomes after injury from a patient's perspective.

To assess the impact of polytrauma on health-related quality of life (HRQoL) and other important PROs, one must consult the person affected directly.^{12 13} HRQoL is already being recorded in registers like the Australian Victoria State Trauma Registry. The German TraumaRegister DGU® will also complement its assessment with HRQoL.¹⁴ Activities of daily living (ADL), defined as basic activities to fulfil independent living, along with physical and psychological needs, are meaningful outcome parameters in case of postpolytrauma impairment. In recent years, the concept of social participation has gained more attention in the political context¹⁵ and was therefore included in the review as an outcome of interest, along with HRQoL and ADL. Several working groups have controversially discussed which tools should be applied to assess PROs after polytrauma, at which time points, and in which way.^{13 16–24} However, guidelines with clear recommendations are lacking,¹³ and no systematic review could be identified.

Therefore, the aim of this systematic review was to:

1. collect instruments assessing HRQoL, ADL and social participation during follow-up after polytrauma.
2. describe their application in detail (e.g. duration of follow-up period, frequency of application and time point of measurements within the follow-up period).
3. investigate which other relevant PROs are additionally assessed in included studies (e.g. pain, depression, anxiety and cognitive function) without detailed analysis.

METHODS

This systematic review was conducted in line with the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) guideline (online supplemental file 1).²⁵

Data sources and search strategy

The search was conducted in MEDLINE, Embase, CINAHL (Cumulative Index to Nursing and Allied Health Literature), PsycINFO, CENTRAL (Cochrane Central Register of Controlled Trials), the trials registers ClinicalTrials.gov and WHO ICTRP (WHO International Clinical Trials Registry Platform), initially covering the period from 1 January 2005 until 3 August 2016, with a later update of the search until 5 April 2018. The search period was chosen because since 2005 interest in HRQoL in research and its implication in practice has been growing.²⁶ As one of our main aims was to collect instruments measuring HRQoL, we decided to include publications beginning with 2005. Our approach is supported by the emerging

importance of PROs in clinical research and their relevance to the future as a complement to clinical data.²⁷ Furthermore, the search period was selected to capture the most recent developments in research on PROs.

In addition, reference lists of eligible publications were examined. Textwords (tw) and MeSH-terms (mh) like 'polytrauma' (tw), 'multiple trauma' (mh), 'quality of life' (mh), 'activities of daily living' (tw), 'social participation' (mh) and 'pain' (mh) were used. The development of the search strategy was outlined in the study protocol²⁸ (online supplemental file 2) and is provided in more detail in online supplemental file 3.

Inclusion and exclusion criteria

The publications included primarily investigated PROs of patients aged 18–75 years with an ISS ≥ 16 and/or an Abbreviated Injury Scale (AIS) ≥ 3 during a clearly defined follow-up period. All original empirical research published in English or German was included. Publications examining special types of injury or illness—for example, low-energy injuries, single or mono injuries, burn injuries, war injuries or cancer—were excluded. We also excluded some publication types (grey literature, books, abstracts and editorials). Systematic reviews and meta-analyses were not included, too, but screened to identify further appropriate studies. More details about the inclusion and exclusion criteria were published in the study protocol.²⁸

Selection of publications and studies

Four teams with two reviewers each (MR–IG; KM–SK; MR–SOB and AI–AHF) screened the title and abstracts independently. To foster the process of eligibility decisions, the inclusion or exclusion of the first 50 publications was discussed by two reviewers (MR–IG). In a next step, four teams with two reviewers each (MR–IG; KM–SK; MR–SOB and KM–SOB) independently screened the full texts of the remaining publications for final inclusion. A third reviewer (MR, SK or IG) solved disagreements regarding the inclusion of publications for full-text screening and their final inclusion in this review. We identified publications relating to the same study and/or population. For this purpose, extensive research was conducted, and authors of the corresponding publications were contacted. The section 'Characteristics of included publications' outlines how we approached publications dealing with different research questions of the same study, comprising subpopulations drawn from a superior study population, reporting subprojects of a study project or presenting results of the same research question at different follow-up periods.

Data extraction and analysis

Data extraction was performed according to the requirements of Cochrane reviews.²⁹ For the first and second aim, two researchers (MR–IG) used a piloted data extraction sheet independently comprising the

following: first author, publication year and country, study design, aim of the study (objective), study population, treatment, applied instruments (incl. modifications), time of measurements, length of follow-up period, method of assessment (application), study results and results of the critical appraisal. Regarding the third aim, the other reported PROs were extracted and categorised in a separate extraction sheet. Narrative content analysis was performed regarding the assessment of HRQoL, ADL and social participation as well as further reported PROs.

Critical appraisal

Teams with two reviewers each (MR, IG, SK, KM and SOB) independently assessed the methodological quality and the risk of bias in each study type using standardised checklists of the UK National Institute for Health and Care Excellence (NICE),^{30 31} Scottish Intercollegiate Guidelines Network (SIGN)³² or the Mixed-Method Appraisal Tool.³³ Discrepancies were resolved by discussion between the reviewers or by a third reviewer.

Patient and public involvement statement

Patients were not involved in the design and implementation of this systematic review.

RESULTS

Search results

In total, 3485 references were retrieved. After a title and abstract screening as well as a full-text screening, further 11 records were identified by backward citation tracking. Finally, 54 eligible publications were included for data extraction (figure 1).

Characteristics of included publications

The publications (n=54) most often came from Germany (n=15, 28%) and the Netherlands (n=11, 20%); rarely from Austria, Denmark, France, Japan, Poland, Spain and Sweden (each n=1, 2%). One study has been carried out in Germany and Austria, another one in Europe, Asia, Australia, Africa, North-America and South-America. The publications primarily reported monocentric studies (n=44, 81%) and predominately comprised prospective cohort studies (n=26, 48%) (table 1).

The number of participants varied between 8³⁴ and 7612,³⁵ with an average age of 24.6±12.1³⁶ to 53.9±18.8³⁷ years and a proportion of men between 37.5%³⁴ and 84%.³⁸ The mean ISS ranged between 3.9±1.7³⁹ and 56.8 points^{40 41} and the AIS—reported in 18 publications—between zero and five points. Information regarding treatment of injuries was provided in n=31 publications (table 1).

Figure 1 Flow chart

Table 1 Overview of included publications

Author, year, country	Study design	Objective	Study population (number: N=(% male), age, ISS/AIS (range, mean±SD/median), kind of injury)	Treatment	Instrument(s) for assessment of			Time of measurement/length of follow-up period	Application/setting	Results
					QoL/HRQoL	(Social) Participation	ADL			
Abraham <i>et al</i> ¹⁰ 2014 USA	Prospective monocentric cohort study	Influence of inpatient delirium on HRQoL after polytrauma; association of depressive symptoms and symptoms of PTSD with domains of HRQoL	n=115 (55.7) Age: mean 42.4±16.7 ISS: 16→25, mean 30.4±9.2 AIS: NR Injury: extremity, head/neck (no brain injury), abdomen/pelvis, thorax	Days intensive care unit (ICU) stay (mean): 9.4±8.2 Ventilator days (mean): 3.4±6.4	SF-36	-	-	1 year after hospital release†	Personal, postal or telephone survey; NR	No association between delirium and HRQoL; higher levels of depressive symptoms and symptoms of PTSD associated with lower HRQoL; stronger association of depressive symptoms and HRQoL compared with symptoms of PTSD
Ahnberg <i>et al</i> ¹¹ 2014 Germany	Retrospective monocentric cohort study	Definition and influence of delayed foot fracture diagnosis on the overall outcome of polytraumatised patients	n=47 (68.1) Age: Md 39.0 ISS: Md 27.0 AIS: NR Early fracture diagnosis n=26 Age: Md 38 ISS: Md 29.0 AIS: NR Delayed fracture diagnosis n=21 Age: Md 44 ISS: Md 27.0 AIS: NR Injury: calcaneus, talus, metatarsalia, navicular, cuboid, cuneiformia, phalanges	Conservative and surgical Days ICU stay (Md): 6 Early fracture diagnosis Conservative and surgical Days ICU stay (Md): 8.0 Delayed fracture diagnosis Conservative and surgical Days ICU stay (Md): 4.0	SF-36	-	-	3.5–7.75 years, mean 5.67±1.58 years†	Self-administered questionnaire; NR	No significant differences between the two groups in clinical scores; no significant effects of delayed foot fracture diagnosis on the outcome of polytraumatised patients
Andruszkow <i>et al</i> ¹² 2013 Germany	Retrospective monocentric cohort study	Effects of additional upper extremity injuries or traumatic brain injuries (TBI) on functional, psychological and vocational outcome in polytraumatised patients	Study population of the Hannover rehab study Injury upper extremity n=229 (75) Age: mean 30.2±11.5 ISS: mean 20.2±8.6 AIS: NR Injury upper extremity and TBI n=32 (72) Age: mean 32.0±11.0 ISS: mean 32.1±6.4 AIS: NR Injury: upper extremity with and without TBI, chest, abdomen, spine, lower extremity	NR	HASPOC, SF-12	-	-	10–28 years, Md 17.5 years†	NR	Limitations of functional and vocational outcome due to additional upper extremity injuries in polytraumatised patients; no deterioration of long-term outcome in combined injury of the upper extremity with TBI compared with isolated TBI; no difference in the PCS and MCS of SF-12 in all three groups
Archer <i>et al</i> ¹³ 2012 USA	Prospective monocentric cohort study	Connection between fear of movement, catastrophising pain, pain and physical health	n=84 (58) Age: mean 43.1±17.13 ISS: mean 30.4±9.5 AIS: NR Injury: abdomen, chest, extremities, external, head/face, neck spine	Surgical Days ICU stay (mean): 9.3±7.7 Ventilator days (mean): 3.4±6.4	SF-12 (physical component scale)	-	-	2 years after trauma†	NR sent by post	Fear of movement and catastrophising pain contributes to poor long-term outcome of polytraumatised patients

Continued

Table 1 Continued

Author, year, country	Study design	Objective	Study population (number: N=(% male), age, ISS/AIS (range, mean±SD/median), kind of injury)	Treatment	Instrument(s) for assessment of			Time of measurement/length of follow-up period	Application/setting	Results
					QoL/HRQoL	(Social) Participation	ADL			
Attenberger <i>et al</i> ¹⁷ 2012 Switzerland	Prospective monocentric cohort study	Testing TOP module in the acquisition of long-term results of polytraumatised patients; validation by testing the association with selected variables and test results (criterion validity) and comparison of the results with internationally recognised QoL instruments (convergent validity); testing screening procedure of the TOP	n=117 (75.2) Age: 13–92, mean 39.6±20.5, Md 35.4 ISS: 17–45, 27.5±8.2, Md 27.0 AIS*: 0–5, mean 0.5±0.58–2.7 ±1.48, Md 0.0–3.0 Injury: inter alia brain injury	NR	EQ-5D, SF-36, ALOS, NHP TOP† (†dimensions 'pain' and 'function', also preinjury)	–	–	Mean 2.7±0.9 years post-traumat	Self-administered questionnaire sent by post	TOP indicated high rate of relevant problems of polytraumatised people; TOP is a reliable and well-discriminating instrument for recording relevant general HRQoL and trauma-specific aspects, which showed high correlation with other generic outcome measures
Baranyi <i>et al</i> ⁶² 2010 Austria	Retrospective monocentric cohort study	Occurrence of full or partial symptoms of PTSD including psychologically relevant dimensions and QoL in polytraumatised patients; relation of PTSD symptoms with QoL, social support, depressive mood and dissociative symptoms	n=52 (73.1) Age: mean 37.6±14.2 ISS: mean 33.1±12.61 AIS: NR Injury: inter alia head	NR	SF-36	–	–	1 year post-traumat	Self-administered questionnaire; outpatient clinic	High risk for PTSD and reduced HRQoL in people with polytrauma; lowest HRQoL in patients with full PTSD, followed by patients with partial symptoms and without PTSD; severe dissociative and depressive symptoms; greater limitations in some QoL dimensions
Bouman <i>et al</i> ⁶³ 2017 Netherlands	Prospective, multicentre, non-randomised controlled study	Effectiveness of the Fast Track (FT) rehabilitation programme on QoL and other health-related outcomes in comparison with conventional trauma rehabilitation service	FT group n=65 (75) Age: 18–75, mean 44.7±16.7 ISS: 4–66, mean 22.1±12.8, Md (IQR) 19.5 (±12–29) AIS: NR Non-FT group n=67 (84) Age: 18–73, mean 42.0±16.6 ISS: 4–50, mean 29.4±11.2, Md (IQR) 29 (±21–38) AIS: NR Injury: pelvic fracture, musculoskeletal injuries, neuro-trauma/head injuries	NR	SF-36† (†Baseline (preinjury status))	–	–	Baseline, 3, 6, 9, 12 months post-traumat††	Individual interviews, telephone interviews, postal survey; NR	Both groups improved their functional status and QoL; FT group showed faster functional recovery at 6 months compared with 9 months of Non-FT group; no different effects observable in both groups at 12 months

Continued

Table 1 Continued

Author, year, country	Study design	Objective	Study population (number: N=(% male), age, ISS/AIS (range, mean±SD/median), kind of injury)	Treatment	Instrument(s) for assessment of			Time of measurement/length of follow-up period	Application/setting	Results
					QoL/HRQoL	(Social) Participation	ADL			
Burghöfer <i>et al</i> ¹⁶ 2005 Germany	Prospective multicentric cohort study	Outcome 5 years after major blunt trauma	n=273 (70.3) Age: mean 37.5, Md: 34 ISS: 16–25: 29.3% 26–50: 63.0% 51–75: 7.7% AIS: NR Injury: severe blunt trauma	NR	SF-36	–	–	5 years after trauma†	Self-administered questionnaire or, in case of cognitive impairment, administered by relatives; NR	Significant differences in QoL between the trauma cohort and a reference population; relevant decrease of QoL in patients with initial unconsciousness and in severely injured patients; high proportion of patients with persisting pain (headache and lower limb pain); 61.7% were back in occupation, 43.5% of these in the former profession
Christensen <i>et al</i> ¹⁶ 2011 26 countries in Europe, Asia, Australia, Africa, North- and South-America	Prospective multicentric randomised placebo-controlled study	Identification of HRQoL dimensions most affected by polytrauma and predictors of poor HRQoL	n=347 (75) Age: mean 39±14 ISS: mean 31±11, Md 29 AIS*: 4+ Injury: abdomen, chest, external, extremity, face, head or neck	ICU stay (duration NR)	POLO chart	–	–	3 months post-trauma†	Self-administered questionnaire; NR	Notable reduced HRQoL in polytrauma survivors; physical well-being more affected than mental; greater mental impairment detectable by trauma-specific HRQoL instruments than by generic tools; demographic and socioeconomic characteristics as well as type of injury and treatment predict HRQoL
Dienstknecht <i>et al</i> ¹³ 2013 Germany	Retrospective monocentric cohort study	Functional and socioeconomic long-term results in patients with pelvic ring fractures	Study population of the Hannover Rehab study n=109 (72) Age: 5–55, mean 28.8 ISS: 16–44, mean 22.7 AIS: NR Injury: anterior, posterior and combined pelvic ring injuries, upper and lower limb fracture, thoracic injury, abdominal injury, spine fracture, neurological lesion of lower limb	Conservative und surgical	HASPOC, SF-12	–	–	10–27 years post-trauma, mean 16 years‡	Self-administered questionnaire as well as assessment via physician; examination in the trauma centre	Long-term functional limitations and socioeconomic effects of pelvic ring fractures; reduced QoL in patients with anterior and combined anterior and posterior pelvic ring injuries

Continued

Table 1 Continued

Author, year, country	Study design	Objective	Study population (number: N= (% male), age, ISS/AIS (range, mean±SD/median), kind of injury)	Treatment	Instrument(s) for assessment of			Time of measurement/length of follow-up period	Application/setting	Results
					QoL/HRQoL	(Social) Participation	ADL			
Frénisy <i>et al</i> ⁸¹ 2006 France	Prospective monocentric cohort study	Comparison of neurobehavioral and psychopathological disorders between patients with severe brain injuries (SBI) and patients after polytrauma (MULT)	SBI n=25 (80) Age: mean 26.97±9.58 ISS: mean 25.36±10.80 AIS: NR Injury: brain MULT n=25 (72) Age: mean 33.78±10.42 ISS: mean 22.04±10.06 AIS: NR Injury: bone fractures, thorax, abdomen	NR	-	-	-	6–24 months† SBI Mean 1.02±0.39† MULT Mean 0.93±0.41†	Face-to-face interview; NR	Similar psychopathological disorders in both groups; SBI-patients show significantly more neurobehavioral disorders and more obsessive symptoms; presence of cognitive disorders in MULT-patients
Gribnau <i>et al</i> ⁸² 2008 Netherlands	Retrospective monocentric cohort study	Injury characteristics, choice of treatment and QoL of people with U-shaped sacral fractures	n=8 (37.5) Age: 19–55, Md 29 ISS: 17–45, Md 23 AIS: NR Injury: skull fracture, subdural haematoma, facial fracture, thoracic injury (multiple rib fractures, pneumothorax, haemopneumothorax, sternal fracture, lung contusion), retroperitoneal haematoma, liver laceration	Surgical	EQ-6D	-	-	5–65 months post-trauma, Md 36 months†	Self-administered questionnaire sent by post	Pain, mood disorders and moderate mobility problems dominate QoL
Gross <i>et al</i> ⁴⁸ 2010 Switzerland	Prospective monocentric cohort study	Long-term work ability of patients after polytrauma; association of capacity to work with internationally accepted variables of functional outcomes or QoL	n=115 (76) Age: 14–92, mean 39.5±20.6 ISS: mean 27.5±8.2 AIS: mean 2.6±1.5 Reduced capacity to work n=61 (79) Age: mean 39.4±20.2 ISS: mean 30.2±7.7 AIS*: mean 0.5±0.6–3.1±1.5 Non-reduced capacity to work n=54 (72) Age: mean 39.6±21.2 ISS: mean 24.3±7.7 AIS*: mean 0.5±0.5–2.6±1.6 Injury: NR	Days ICU stay (mean): 8.4±12.5	EQ-5D†, SF-36†, NHP (†Baseline (preinjury status) assessed in hospital)	-	-	Inpatient stay, Md 2.5 (2.0; 3.3) years post-trauma§	Self-administered questionnaire sent by post	50% show reduced capacity to work; reduced QoL and persistent pain compared with the prepolytrauma condition; patient, injury, and treatment variables have impact on capacity to work; association of capacity to work with long-term results such as various functional outcomes, symptom status and QoL
Gross and Amsler ⁴⁹ 2011 Switzerland	Prospective monocentric cohort study	Prevalence and severity of pain after polytrauma compared with preinjury status using different pain measures; association of pain and HRQoL	n=102 (74) Age: mean 39.7±20.5 ISS: mean 27.1±8.0 AIS: NR Injury: NR	NR	EQ-5D†, SF-36†, NHP, TOP (separate questionnaire for retrospective assessment of preinjury status)	-	-	Mean 2.7±0.9 years post-trauma, Md 2.4 years†	Self-administered questionnaire sent by post	Pain in 85% of patients after polytrauma; higher prevalence and severity of pain compared with preinjury status; close correlation of posttraumatic pain with HRQoL and reduced capacity to work; differences in type and sensitivity of pain measures

Continued

Table 1 Continued

Author, year, country	Study design	Objective	Study population (number: N=(% male), age, ISS/AIS (range, mean±SD/median), kind of injury)	Treatment	Instrument(s) for assessment of			Time of measurement/length of follow-up period	Application/setting	Results
					QoL/HRQoL	(Social) Participation	ADL			
Gross <i>et al</i> ⁶⁰ 2012 Switzerland	Prospective monocentric cohort study	QoL and functional outcomes after polytrauma compared with preinjury status; discriminatory potential of different outcome scores between survivors with and without TBI	n=111 (75) Age: mean 39.5±20.9 ISS: mean 27.9±8.2 AIS*: mean 0.5±0.6–2.7±1.5 Patients with TBI n=45 Age: NR ISS: mean 31.1±7.3 AIS*: mean 0.7±0.6–3.9±0.7 Patients without TBI n=66 Age: NR ISS: mean 25.7±8.1 AIS*: mean 0.4±0.6–2.6±1.6 Injury: inter alia TBI	Days ICU stay (mean): 8.9±12.6	EQ-5D†, SF-36†, NHP, TOP (†separate questionnaire for retrospective assessment of preinjury status)	–	–	Mean 2.7±0.9 years post-trauma, Md 2.5 years†	Self-administered questionnaire sent by post	Notable reduced QoL and functional outcomes compared with preinjury status; worse outcomes in patients with TBI; SF-36 and NHP discriminate between patients with and without TBI
Hlidakis <i>et al</i> ⁷⁸ 2009 Poland	Prospective monocentric cohort study	Comparison of QoL after polytrauma in three consecutive 5-year periods using ICIDH	n=827 (71)† Age: mean 44.7 ISS: mean 27.6 AIS: NR Injury: head/neck, thorax, abdomen, pelvis and its organs, spinal column and spinal cord, upper and lower limbs	Surgical	ICIDH (only impairments)	–	–	3 years after completion of inpatient treatment†	NR; outpatient clinic	Reduced QoL in 50% of patients after polytrauma; improvement of QoL in one of four patients over 15 years
Holtslag <i>et al</i> ⁶² 2006 Netherlands	Prospective monocentric cohort study	Description of the characteristics of lower extremity injuries in patients after polytrauma and functional long-term outcomes using all domains of ICF and HRQoL and their association	n=186 (75) Age: 16–96, mean 37±17 ISS: mean 25±11 AIS: NR Injury: lower extremity injuries, pelvic injuries, TBI	Days ICU stay (mean): (range: 1–123)	SIP, SF-36	Assessment of criteria such as return to sports and work	GARS	10–18 months post-trauma, mean 14±1.6 months, Md 14 months‡	Self-administered questionnaire (if necessary, administered by relatives) sent by post	Serious long-term problems of mobility, activity and participation; mild to moderately limited HRQoL; low association of ICF domain functionality with HRQoL; limited concordance between instruments
Holtslag <i>et al</i> ⁶¹ 2007 Netherlands	Prospective monocentric cohort study	Long-term functional health status in patients after polytrauma; relationship between personal and injury-related characteristics vs long-term HRQoL	n=335 (74) Age: mean 37.7±17.1 ISS: mean 24.9±10.6 AIS: NR Injury: cranial, facial, upper extremity, chest, abdomen, pelvis, femur, lower leg, spine, spinal cord, peripheral nerve	Days ICU stay (mean): 12.9±18.7	SIP	–	–	12–18 months post-trauma, mean 45±47 days‡	Self-administered questionnaire sent by post	Long-term mild to moderately limited HRQoL; lower QoL in young male patients and patients with TBI, spinal cord and extremity injuries; greatest limitations in some SIP categories (work, ambulation, home management, recreation and pastimes, alertness and behaviour); comorbidity strong predictor of SIP scores

Continued

Table 1 Continued

Author, year, country	Study design	Objective	Study population (number: N=(% male), age, ISS/AIS (range, mean±SD/median), kind of injury)	Treatment	Instrument(s) for assessment of			Time of measurement/length of follow-up period	Application/setting	Results
					QoL/HRQoL	(Social) Participation	ADL			
Holtslag <i>et al.</i> ²⁴ 2007 Netherlands	Prospective monocentric cohort study	Long-term functional consequences from polytrauma, quantification of the influence of sociodemographic, injury-related and physical factors on outcomes	n=335 (74) Age: mean 37.7±17.1 ISS: mean 24.9±10.6 AIS: NR Injury: brain, chest, abdomen, spinal cord, lower extremity, upper extremity	Days ICU stay (mean): 12.9±18.7	EQ-5D	-	-	12–18 months post-trauma, mean 451±47 days†	Self-administered questionnaire (if necessary, administered by relatives) sent by post	Restriction of mobility, self-care and everyday activities, indication of pain and discomfort, anxiety and depression as well as cognitive complaints; localisation of injury, educational level and comorbidities are important independent predictors of long-term functional outcomes after polytrauma; better QoL via EQ-VAS than via utility score
Holtslag <i>et al.</i> ²⁴ 2008 Netherlands	Prospective monocentric cohort study	Impact of trauma on health in terms of burden of injury, years lived with disability in non-fatal diseases, years of life lost in fatal diseases and disability-adjusted life year (DALY)	Fatalities n=567 (62.6) Age: mean 48.4±23.3 ISS:>15 AIS: NR Injury: NR Severely injured n=335 (74.3) Age: mean 37.7±17.1 ISS:>15 AIS: NR Injury: NR	NR	EQ-5D	-	-	12–18 months after injury, mean 451±47 days†	NR	Substantial loss of healthy life years; at individual level, major trauma contributed an average of 25 DALYs to the burden of disease; at population level, major trauma caused 10 DALYs per 1000 inhabitants
Jackson <i>et al.</i> ²⁴ 2007 USA	Retrospective monocentric cohort study	Prevalence of and risk factors for persistent cognitive impairment as well as emotional and functional difficulties in people without intracranial haemorrhage	n=88 (67) Age: mean 45.0±14.3 ISS: 33.0±6.8 AIS: NR Injury: concussion, skull fracture	NR	SF-36	-	FAQ, KATZ ADL	12–24 months after hospital discharge†	Administered by a neuropsychologist or a psychometrist; evaluation at medical centre or place of residence	Substantial prevalence of persistent cognitive impairment, emotional dysfunction and functional decrements, most of all in people with concussion and skull fracture compared with those without these injuries; cognitive impairment was associated with functional deficits, poor QoL and an inability to return to work

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Table 1 Continued

Author, year, country	Study design	Objective	Study population (number: N=(% male), age, ISS/AIS (range, mean±SD/median), kind of injury)	Instrument(s) for assessment of			Time of measurement/length of follow-up period	Application/setting	Results
				Treatment	QoL/HRQoL	(Social) Participation	ADL		
Kaske <i>et al</i> ⁷⁷ 2014 Germany	Retrospective monocentric cohort study	Assessment of HRQoL using a trauma-specific instrument (POLO chart) in patients after polytrauma	n=129 (66.9) Age: mean 43.9±17.5 ISS: mean 21.5±13.3 AIS: ≥2 Injury: lower extremity, thorax, upper extremity, head, spine, pelvis, abdomen	Days ICU stay (mean): 9.2±9.6, Md (IQR ₂₅₋₇₅): 5 (2-14) Ventilator days (mean): 8.2±7.6, Md (IQR ₂₅₋₇₅): 5 (2-14)	POLO chart	-	-	Self-administered questionnaire sent by post	Physical impairments, mental and socioeconomic deficits in patients after polytrauma; reduced HRQoL in 64% of patients 2 years after polytrauma, in half of these patients severely impaired HRQoL; TOP is able to identify impairments and to guide rehabilitation resources
Lefering <i>et al</i> ⁷⁸ 2012 Germany and Austria	Diagnostic study	Phase IV validation of the trauma-specific TOP module as part of the POLO chart	Trauma group n=172 (73.8) Age: mean 38.8±14.4 ISS: 8-75, mean 26.7±11.2 AIS: NR Control group n=166 (65.1) Age: mean 42.9±15.0 ISS: 1-9, mean 3.9±1.7 AIS: NR Injury: NR	NR	POLO chart	-	Barthel Index	NR; visit to the hospital for a physical examination and to fill in the questionnaires	Significant differences in all QoL dimensions between trauma and control group; apart from physical domains, also impairment of other dimensions of QoL; results show good discriminatory abilities of the TOP and support its precision in collecting all relevant components of QoL in patients after polytrauma
Lippert-Grüner <i>et al</i> ⁶⁵ 2007 Germany	Prospective cohort study	HRQoL in patients with severe TBI, with and without concomitant polytrauma	n=49 (78) Age: 15-68, Md 32 ISS: NR AIS: NR Isolated TBI n=28 Age: mean 36 ISS: mean 27 AIS: NR TBI and polytrauma n=21 Age: mean 26 ISS: mean 40 AIS: >3 Injury: cranial injury	ICU (duration NR)	SF-36	-	-	Self-administered questionnaire during outpatient follow-up examinations	Comparable results for patients with severe TBI with and without concomitant polytrauma in SF-36 with the exception of physical function; indication of TBI as an important factor for HRQoL and outcomes after trauma; improvement of HRQoL over time
Livingston <i>et al</i> ⁸⁰ 2009 USA	Prospective monocentric cohort study	Long-term outcome of patients with prolonged (>10 days) ICU stay	n=100 (81) Age: 18-94, mean/Md 42 ISS: 26-30, mean/Md 28 AIS: 3-5 Injury: TBI, extremity fracture, pelvis fracture, lower extremity fracture	Surgical Days ICU stay: 19-24, mean 21, Md 19 Ventilator days: mean 16, Md 14	-	-	-	Telephone interview with patient	Overall self-reported QoL is generally good with significant impairments incl. inability to return to work (less than 50%) or regain preinjury level of activity and reintegration into society

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Table 1 Continued

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					QoL/HRQoL	(Social) Participation	ADL			
Marasco et al ³⁷ 2015 Australia	Retrospective monocentric cohort study	Long-term morbidity and QoL in patients with rib fractures	n=397 (75) Age: mean 53.9±18.8 ISS: mean 22.5±11.8 AIS: NR Thoracic group n=216 Age: NR ISS: mean 16.0±7.3 AIS: max. 3 Polytrauma group n=181 Age: NR ISS: mean 30.1±11.6 AIS: max. 4 Injury: head, neck, face, spine, thorax, abdomen, upper and lower extremity	NR	SF-12	-	-	6, 12, 24 months post-trauma [†]	Telephone interview with patient (if necessary, with proxy)	Significantly reduced QoL 24 months after multiple rib fractures; low return to work rate after 6 months; no differences between the groups in pain and QoL; limited function of the thorax group
McCarthy et al ⁶⁵ 2006 USA	Retrospective monocentric cohort study	Subjective psychosocial health of a population-based sample of adults with TBI	n=7612 (63.9) Age: 15–75+, mean 43.2±20.0 ISS: 4–18+, mean 13.7±7.6 AIS: 2–5 Injury: TBI	NR	SF-36 (psychosocial health scales MCS)	-	-	1 year after injury±3 month [†]	Telephone interview	29% reported poor psychosocial health 1 year after injury; less than 50% received mental health services; a high proportion reported unmet needs for mental health services
Ouellet et al ⁶⁵ 2009 Canada	Retrospective multicentric cohort study	Comparison of mental health in patients with polytrauma with and without TBI; factors associated with low mental health; perceived need for and access to mental health-related services	n=405 (64.6) Age: mean 41.1±15.1 ISS: mean 23.6±11.7 AIS: NR Patients with TBI n=239 (64.9) Age: mean 37.4±14.5 ISS: mean 27.9±9.1 AIS: NR Patients without TBI n=166 (61.0) Age: mean 46.4±14.5 ISS: mean 15.7±8.4 AIS: NR Injury: TBI, spine, upper limb, lower limb	Days ICU stay (mean): TBI: 10.3±14.3 Non-TBI: 4.2±8.2	SF-12, V.2 (MCS as well as all subscales which are related to mental health)	-	-	2–4 years post-trauma [†] Mean 3.3±0.7 years post-trauma [†] Mean 3.3±0.8 years post-trauma [†]	Telephone interview with patients; NR	Not significantly lower MCS-scores in polytrauma patients with TBI compared with patients without TBI; association of 6 factors with low mental health: age, sex, time since trauma, social support, pain and cognitive deficits; high need for mental health-related services but considerable difficulties in maintaining it
Overgaard et al ⁶⁶ 2011 Denmark	Prospective cross-sectional monocentric cohort study	Outcome 6–9 years after moderate to severe injury in terms of survival, HRQoL and employment status	n=322 (71) Age: 15–89, Md 34 ISS: 9–75, Md 17 AIS: NR Injury: blunt trauma	Surgical Days ICU stay: 1–62, Md 4	SF-36	-	-	6–9 years after admission, Md 7.4 years [†]	Self-administered questionnaire sent by post or telephone interview	78% of the patients survived the trauma; HRQoL was significantly lower for injured patients than a matched control group; 20% retired early

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Table 1 Continued

Author, year, country	Study design	Objective	Study population (number: N=(% male), age, ISS/AIS (range, mean±SD/median), kind of injury)	Treatment	Instrument(s) for assessment of			Time of measurement/length of follow-up period	Application/setting	Results
					QoL/HRQoL	(Social) Participation	ADL			
Post <i>et al</i> ¹¹ 2006 Netherlands	Retrospective monocentric cohort study	Return-to-work status and QoL in patients after polytrauma; analysis of injury-related parameters in relation to functional outcome	n=53 (81) Age: 19–64, mean 37.3±13.2, Md 34.0 ISS: 16–54, mean 23.5±8.2, Md 21.0 AIS: Md 0–5, 2.0–3.0 Injury: head, neck, face, thorax, abdomen, extremities, external	NR	SIP	–	–	1.3–2.2 years post-trauma, mean 1.8±0.3 years, Md 1.8 yearst	Self-administered questionnaire sent by post	Most patients after polytrauma return to their former work; compared with general population and less severely injured patients good QoL results; age, but not trauma severity or TBI is a predictor for long-term disability
Probst <i>et al</i> ⁴¹ 2010 Germany	Retrospective monocentric cohort study	Association of improved short-term outcomes after polytrauma with gender differences; long-term follow-up using QoL and rehabilitation status	Study population of the Hannover Rehab study n=637 (75.4) Age: M: mean 26.7±12.2 F: mean 25.9±13.0 ISS: M: mean 20.4±9.9 F: NR, 21.7±9.7 AIS*: M: Md 1–5 F: Md 1–6 Injury: head, face/neck, thorax, abdomen, skeletal system	Days ICU stay (mean): M: 15.4±25.0 F: 12.9±23.2 Ventilator days (mean): M: 11.2±13.3 F: 9.9±12.5	HASPOC, SF-12	–	–	M: 17.5±4.8 years post-trauma; F: 17.4±5.0 years after traumast	Interview with patients; assessment via physician and physical examination in the trauma centre	After polytrauma, more severe long-term limitations in women than men; no differences in rehabilitation status; longer sick leave times, significantly lower QoL and higher rates of PTSD and psychological support in women
Quale <i>et al</i> ⁴² 2009 Norway	Prospective monocentric cohort study	Incidence and risk factors of post-traumatic stress symptoms (PTSS)	n=79 (74.7) Age: mean 37±14.3 ISS: mean 25.6±12.3 AIS: NR Injury: spinal cord, head	Days ICU stay (mean): 62±61.4 Ventilator days (mean): 5.8±13.1	–	–	–	1–3 weeks after admittance to rehabilitation, median days since injury 39, quartiles 24–57±	Semistructured interviews, questionnaires; NR	Low incidence of PTSD, but higher incidence of PTSS; anxiety, female gender, negative attitudes towards emotional expression are risk factors for PTSS
Renovell-Ferrer <i>et al</i> ⁴³ 2017 Spain	Prospective monocentric cohort study	Comparison of aetiology, severity and functional outcome of people with operated displaced intra-articular calcaneal fractures between polytrauma patients and isolated cases	n=80 (71) Age: 16–74, mean 48.4, Md 47 ISS: >16 (14%) AIS: NR Injury: intra-articular calcaneal fractures, pelvic fracture, spine fracture	Surgical	SF-36	–	–	15–62 months after operation, mean 48 monthst	NR	No differences in outcome measures and second surgeries; increasing severity of trauma was associated with more second surgeries and worse outcomes; patients with psychiatric comorbidities reported worse HRQoL
Richter <i>et al</i> ⁴⁴ 2006 Germany	Prospective monocentric cohort study	Prevalence of PTSD; identification of risk factors for PTSD	n=37 (76) Age: mean 41.7±17.0 ISS: mean 30.4±10.7 AIS: NR Injury: NR	Days ICU stay: >30	–	–	–	7–58 months after discharge from ICU, mean 35±14 monthst	Self-administered questionnaire and interview; NR	Compared with non-trauma patients, higher risk for PTSD in trauma patients; ISS and ICU treatment not associated with PTSD

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Table 1 Continued

Author, year, country	Study design	Objective	Study population (number: N=(% male), age, ISS/AIS (range, mean±SD/median), kind of injury)	Treatment	Instrument(s) for assessment of			Time of measurement/length of follow-up period	Application/setting	Results
					QoL/HRQoL	(Social) Participation	ADL			
Ringburg <i>et al</i> ⁷ 2011 Netherlands	Prospective monocentric cohort study	HRQoL in patients after polytrauma; predictive factors for long-term poor functioning in the dimensions of HRQoL instruments	n=246 (66) Age: Md 40 ISS: Md 22 AIS: NR Injury: head, face, chest, abdomen, extremities	NR	EQ-5D, HUI 2, HUI 3	-	-	12 months post-trauma†	Self-administered questionnaire sent by post	HRQoL far below general population norms; high prevalence of specific limitations with female gender and comorbidity as predictors of long-term disability
Sampalis <i>et al</i> ²⁶ 2006 Canada	Retrospective multicentric cross-sectional cohort study	Functional status and QoL 12 months after injury	n=144 (61.8) Age: 18–85, mean 44.2±17.1 ISS: 1–49, mean 18.9±9.4 AIS: NR Injury: head/neck, extremity, face, thorax, abdominal, burns	Surgical and conservative Days ICU stay: 0.1–11.0, mean 3.44±0.9	SF-36, SIP	-	-	0.8–1.5 years, mean 1.3 years post-trauma†	Self-administered questionnaire sent by post	Residual impairments in functional capacity and QoL 1 year after injury; specific subgroups (injuries resulting from motor vehicle collisions, thoracic and head injuries) report diminished QoL; ICU treatment, prolonged length of hospital stay and surgical treatment are predictors for poor functional capacity and reduced QoL
Schmidt-Rohlfing <i>et al</i> ⁴² 2011 Germany	Retrospective monocentric cohort study	Correlation between scoring systems focusing on QoL and those focusing on functional status of knee joint	Study population of the Hannover Rehab study Patients with knee injury n=48 (73) Age: mean 29.7±11.8 ISS: mean 22±9.8 AIS: NR Patients with femur fracture n=107 (72) Age: mean 26.8±13.9 ISS: mean 23.3 AIS: NR Injury: knee, femoral fracture, head	Surgical	HASPOC, SF-12	-	-	Mean 16.9±4.9 years post-trauma†	Assessment via physician, NR	No correlation between scoring systems for functional knee condition and QoL; poorer outcome for patients with knee injuries compared with patients with femoral fractures
Simmel <i>et al</i> ⁴⁷ 2013 Germany	Retrospective monocentric cohort study	QoL and health status many years after polytrauma and influencing factors	n=127 (76) Age: mean 36 ISS: 26–75, mean 35.6 AIS: NR Injury: NR	Days ICU stay (mean): 21.1	POLO chart	-	-	38–108 months post-trauma, mean 70 months†	Self-administered questionnaire sent by post	Significantly reduced QoL and health status after polytrauma: higher age, female gender, low education and chronic previous illnesses have a negative impact on outcomes as well as difficulties with authorities/institutions, unemployment, long inpatient stays and subjectively inadequate inpatient treatment

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Table 1 Continued

Author, year, country	Study design	Objective	Study population (number: N=(% male), age, ISS/AIS (range, mean±SD/median), kind of injury)	Treatment	Instrument(s) for assessment of			Time of measurement/length of follow-up period	Application/setting	Results
					QoL/HRQoL	(Social) Participation	ADL			
Sirois <i>et al</i> ⁶⁶ 2009 Canada	Retrospective multicentric cohort study	Regional differences in perceived need for and barriers to post-acute rehabilitation services; long-term functional outcomes and physical health outcomes in patients after polytrauma	n=435 (64.5) Age: 18–65, mean 41.1±15.1 ISS: 1–75 AIS: NR Injury: spine, brain, extremity	NR	SF-12, V.2 (PCS and subscales physical function, role general health perception)	–	–	2–4 years, mean 3.3±0.7 years post-trauma†	Telephone interview with patient (if necessary, with proxy)	No regional differences in perceived need and barriers to post-acute rehabilitation services; no regional differences in long-term functional outcomes and physical health in patients after polytrauma, with the exception of a slightly lower score in SF-12 subscale physical functioning in regions with limited availability of rehabilitation services
Sluis <i>et al</i> ⁶⁹ 2005 Sweden	Retrospective monocentric cohort study	Outcome and QoL 5 years after injury and identification of factors potentially associated with outcome and QoL	n=205 (74) Age: 20–87, Md 39 ISS: 9–67, Md 14 AIS: 3–5 Injury: extremities, pelvic girdle, head and neck, chest, external/skin, abdominal or pelvic content, face	Surgical, conservative Days ICU stay: 1–86, mean 4	SF-36	–	–	5 years post-trauma†	Self-administered questionnaire sent by post, or telephone interview	Relevant decrease in HRQoL and permanent impairments as well as disabilities in most of the affected patients; length of hospital stay, days spent on ICU, surgical procedures, in-hospital major complications, age, recurrent injury and inadequate information are risk factors for poor HRQoL; injury severity did not predict poor HRQoL
Soberg <i>et al</i> ⁶⁸ 2007 Norway	Prospective monocentric cohort study	Complete and partial return to work rate; prognostic factors for complete return to work after polytrauma	n=100 (82) age: 18–67, 34.5±13.5 ISS: mean 28.1±11.3 AIS: NR Injury: head/neck, face, chest, abdomen/pelvic content, extremity, external, spinal cord	Ventilator days (median): 5 (IR 9)	SF-36	–	–	20.0±6.5 weeks, 1 year and 2 years post-trauma¶	Self-administered questionnaire sent by post, telephone interview of 2 patients	Complete return to work: four out of 10 patients 2 years after polytrauma, 2/3 actively attempting to return to work; lower education, low social functioning and >20 weeks in hospital or rehabilitation are risk factors for not returning to work; tendentially better mental health in returnees than in non-returnees to work, overall lower mental sum scores than for general population; physical health 1 year after trauma significantly lower than for general population

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Table 1 Continued

Author, year, country	Study design	Objective	Study population (number: N=(% male), age, ISS/AIS (range, mean±SD/median), kind of injury)	Treatment	Instrument(s) for assessment of			Time of measurement/length of follow-up period	Application/setting	Results
					QoL/HRQoL	(Social) Participation	ADL			
Soberg <i>et al</i> ⁶⁸ 2011 Norway	Prospective monocentric cohort study	Work status and trajectory of return to work after polytrauma; prognostic factors for the return to work of patients after polytrauma over 5 years	n=75 (83) Age: 18–67, 34.5±13.5 ISS: NRTW group: Mean 28.9±12.5 RTW group: Mean 25.8±10.8 AIS: NR Injury: head (TBI), face, chest, abdomen/pelvic content, spinal, upper extremity, lower extremity	NR	SF-36	–	–	20.0±9.5 weeks, 1 year, 2 years and 5 years post-trauma**	Self-administered questionnaire sent by post	Complete return to work of 50% of patients after polytrauma over 5 years, 23% receive disability benefits; higher education, better physical, social and cognitive functioning and use of coping strategies are prognostic factors for returning to work; generally better physical and mental functioning after trauma in returnees to work than in non-returnees
Stulemeijer <i>et al</i> ⁷⁰ 2006 Netherlands	Prospective monocentric cohort study	Impact of additional extracranial injuries on functional outcomes and on postconcussion symptoms in patients with mild TBI	Isolated TBI n=210 (63) Age: mean 35.2±12.3 ISS: 1–17, mean 4.7±3.4 AIS (head): 1–4, mean 1.9±0.7 TBI and extracranial injuries n=89 (74) Age: mean 37.9±12.0 ISS: 5–41, mean 14.5±7.4 AIS (head): 1–5, mean 2.3±0.8 Control group n=261 (45) Age, ISS, AIS: NR Injury: TBI, extremities, face, chest, abdomen, external	NR	–	–	SF-36 (subscales of physical and social functioning)	6 months post-trauma†	Self-administered questionnaire sent by post	Poorer functional outcomes (i.e. lower levels of physical function, lower rates of return to work and generally worse outcomes) of patients with additional extracranial injuries and mild TBI but equal level of postconcussion symptoms; greater impairment in patients after polytrauma compared with the control group with mild injuries
Suzuki <i>et al</i> ⁷⁰ 2007 Japan	Retrospective monocentric cohort study	Evaluation of long-term functional outcome of patients with unstable pelvic ring fractures and correlation with other factors	n=57 (49) Age: 16–72, mean 42 ISS: 9–50, mean 24.6 AIS: NR Injury: pelvic fracture	Surgical and conservative	SF-36	–	–	24.4–107.4 months, mean 47.2 months‡	Questionnaire during clinical reevaluation	Functional outcome was not associated with ISS, fracture location or type of fracture; neurologic injury correlated with poor functional outcome
Tee <i>et al</i> ⁷³ 2014 Australia	Prospective monocentric cohort study	Early predictors of suboptimal health status in patients after polytrauma with spine injuries	n=479 (71.8) Age: mean 47.5±19.1 ISS: Md 14 AIS: NR Injury: TBI, spine	NR	SF-12	–	–	1 year post-trauma†	NR	Early risk factors of suboptimal physical health or QoL are tachycardia, hyperglycaemia, multiple chronic pre-existing medical comorbidities and thoracic spine injuries

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Table 1 Continued

Author, year, country	Study design	Objective	Study population (number: N=(% male), age, ISS/AIS (range, mean±SD/median), kind of injury)	Treatment	Instrument(s) for assessment of			Time of measurement/length of follow-up period	Application/setting	Results
					QoL/HRQoL	(Social) Participation	ADL			
Van Delft-Schreurs <i>et al</i> ¹⁵ 2016 Netherlands	Retrospective monocentric cross-sectional cohort study	Structure and psychometric properties of the Dutch SMFA questionnaire in severely injured patients	n=173 (69) Age: mean 46±19 ISS: Md 21 AIS: ≥2 Injury: upper and lower extremity, TBI	NR	SMFA, WHOQOL-BREF	-	-	1.3–4.4 years post-trauma†	Self-administered questionnaire sent by post	Good psychometric properties of the Dutch SMFA in severely injured people and strong correlations between the SMFA and WHOQOL-BREF; Dutch SMFA seems to be valid and useful for generating an overview of physical limitations and emotional problems
Victorson <i>et al</i> ⁴⁴ 2008 USA	Mixed-method monocentric study	Development and validation of the injury distress index (IDI)	n=169 (66.1) Age: mean 34.5±11.1 ISS: NR AIS: 1–5 Injury: lower extremity, upper extremity, burn (21%)	Surgical, conservative	-	-	-	Mean 8 days after admission†	Self-administered questionnaire; trauma centre	IDI showed acceptable reliability and validity
Vles <i>et al</i> ⁷ 2005 Netherlands	Prospective monocentric cohort study	Prevalence and determinants of disabilities and return to work after severe injury	n=166 (81) Age: M: mean 33 F: mean 37 ISS: M: mean 23 F: mean 23 AIS: ≥2 Injury: cranium, brain, extremities, spine, pelvis, chest, thoracic contents, abdomen, pelvic contents	NR	EQ-5D	-	Change of daily activities and sports	12–69 months, mean/Md 41 months (3.4 years) after trauma†	Self-administered questionnaire sent by post, or telephone interview	Substantial impact of trauma on long-term functioning; follow-up between 12 and 24 months might be suitable for outcome assessment including quality of treatment
von Rüden <i>et al</i> ⁴⁰ 2013 Germany	Retrospective monocentric cohort study	Prognosis, incidence, trauma mechanism, mortality, invalidity, working ability/disability and QoL in patients after polytrauma with ISS ≥50	n=88 (77.3) Age: 18–63, mean 40.3±17.4 ISS: mean 56.8 AIS*: mean 1.7–4.4 Injury: head/brain, face, chest, abdomen, spinal cord, pelvis, upper limb, lower limb, soft tissues	Days ICU stay (mean): ISS <50: 14.4 ISS >50: 25.9 Ventilator days (mean): ISS <50: 13.4 ISS >50: 20.3	POLO chart	-	-	18–78 months post-trauma, mean 3.6 years†	Self-administered questionnaire sent by post; face-to-face interview with subgroup	Good prognosis for severely injured people, but QoL not satisfactory mainly due to psychological problems and chronic pain; 6.5% with ISS ≥50; main cause: motorbike accident; 36% mortality rate; 57% limited working ability
Williamson <i>et al</i> ⁷⁴ 2009 Australia	Prospective multicentric cohort study	Predictors of moderate or severe pain 6 months after injury	n=1290 (61) Age: 11–95 ISS: >15 AIS: NR Injury: extremities, spinal injuries	NR	SF-12 (only on discharge rating of status in the week before injury)	-	-	6.1–7.1 months after trauma (Md 6.5 months); before discharge, during follow-up by telephone at home (assessment of other PROs than HRQoL)§	Face-to-face interview in acute hospital before discharge and during follow-up by telephone at home	Prevalence of moderate or severe pain at follow-up was 30%; predictors of pain were educational status and compensation status; preinjury pain-related disability, pain intensity at discharge

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Table 1 Continued

Author, year, country	Study design	Objective	Study population (number: N=(% male), age, ISS/AIS (range, mean±SD/median), kind of injury)	Treatment	Instrument(s) for assessment of			Time of measurement/length of follow-up period	Application/setting	Results
					QoL/HRQoL	(Social) Participation	ADL			
Wurm <i>et al</i> ⁴¹ 2012 Germany	Retrospective monocentric cohort study	Posttraumatic QoL in patients after polytrauma with ISS ≥50	n=88 (77) Age: mean 40.3±17.4 ISS: mean 56.8 AIS*: mean 3.9–4.4 Injury: thorax, TBL, abdomen, spine, lower extremity	Days ICU stay (mean): 23 Ventilator days (mean): 20	POLO chart	–	–	18–78 months post-trauma, mean 3.6 years†	Self-administered questionnaire sent by post and personal interview with subgroup	Good survival rate but poor post-traumatic QoL mainly due to psychological problems and chronic pain
Zelle <i>et al</i> ⁴⁵ 2005 Germany	Retrospective monocentric cohort study	Comparison of objective and subjective outcome of patients after polytrauma with injuries below the knee joint and injuries of the lower extremity above the knee joint	Study population of the Hannover Rehab study n=389 (74) Age: mean 25.4±11.7 ISS: mean 20.2±9.3 AIS: NR Injury: lower extremity	NR	HASPOC, SF-12	–	–	Mean 17.3±4.8 years post-trauma‡	Self-administered questionnaire as well as assessment via physician; examination in the trauma centre	Significantly better objective and subjective outcomes of patients after polytrauma with injuries above the knee joint compared with injuries below the knee joint; no significant differences in the MCS of the SF-12
Zelle <i>et al</i> ⁴⁶ 2005 Germany	Retrospective monocentric cohort study	Comparison of long-term functional outcome after polytrauma between workers' compensation patients (WCP) and non-workers' compensation patients (N-WCP)	Study population of the Hannover Rehab study n=637 (75) Age: 3–60, mean 26.4 ISS: 4–54, mean 20.7±9.7 AIS: NR WCP n=233 (82.0) Age: mean 29.78±12.09 ISS: mean 20.60±10.00 AIS: NR N-WCP n=404 (71.5) Age: mean 24.56±12.12 ISS: mean 20.80±9.61 AIS: NR Injury: lower extremity, head, face, upper extremity, chest, abdomen, spine, neck, skin	NR	HASPOC, SF-12	–	–	10–28 years, mean 17.5 years‡ WCP Mean 17.36±4.77 years‡ N-WCP Mean 17.0±4.89 years‡	Self-administered questionnaire as well as assessment via physician; examination in the trauma centre	Worse subjective and objective outcomes in WCP; no significant differences in the MCS of the SF-12
Zwingmann <i>et al</i> ⁴⁷ 2016 Germany	Retrospective monocentric cohort study	Long-term HRQoL and changes in daily life of patients after polytrauma	n=147 (75.5) Age: 6.1–82.1, mean 40±19 ISS: 17–59, mean 28±10.6 AIS: NR Injury: NR	Days ICU stay (mean): 7.8±7.5	EQ-5D, SF-36, TOP	–	–	5.0–7.4 years post-trauma, mean 6±0.8 years‡	NR, verbal interview and/or written questionnaire sent by post	Impaired QoL due to pain and functional disability; association of negative socioeconomic effects and emotional repercussions

*AIS: AIS values shown for various body regions; IQR/IR: Interquartile Range; max.: highest value.

†Numbers displayed for Overall-Characteristic of study population.

‡One measurement.

§Two measurements.

¶Three measurements.

**Four measurements.

††Five measurements.

ADL: activities of daily living; AIS: Abbreviated Injury Scale; ALOS: Aachen Long-term Outcome Score; EQ-5D: European Quality of Life 5-Dimension; EQ-VAS: EQ-5D visual analogue scale; F: female; FAO: Functional Activities Questionnaire; FI: fast track; GAPS: Groningen Activity Restriction Scale; HASPOC: Hannover Score for Polytrauma Outcome; HRQoL: health-related quality of life; HU2, HU3, Health Utility index; ICF: International Classification of Functioning, Disability and Health; ICDH: International Classification of Impairments, Disabilities and Handicaps; ICU: Intensive Care Unit; IDI: Injury Severity Score; KATZ: Katz Index of Activities of Daily Living; M: male; MCS: Mental Component Summary score; Md, median; n: number; NHP: Nottingham Health Profile; NR, not reported; NRTW: non-return to work; PCS: Physical Component Summary score; POLO chart: Polytrauma Outcome Chart; PROs: patient-reported outcomes; PTSD: post-traumatic stress disorder; QoL: quality of life; RTW: return to work; SF-12, 12-item Short Form Health Survey; SF-36: Short Form-36 Health Survey; SIP: Sickness Impact Profile; SMFA: Short Musculoskeletal Function Assessment; TOP: Trauma Outcome Profile; WCP: workers' compensation patients; WHOQOL-BREF: WHO Quality of Life Instrument-Short Form.

Six publications were related to the Hannover Rehab study.^{36 42–46} Four reported the results of a polytrauma study project conducted at the University Hospital Basel, which included a subproject of a study project (EK 159/02) and a polytrauma cohort.^{47–50} Study projects at the University Medical Centre Utrecht displayed almost identical recruitment periods and locations (Holtslag *et al.*^{51 52} January 1999 to December 2000, Holtslag *et al.*^{53 54} January 1999 to January 2001,^{53 54} Holtslag *et al.*⁵³ analysed a subgroup out of n=335 participants;⁵³ Holtslag *et al.*⁵⁴ additionally included a group ‘Fatalities’.⁵⁴ Two publications^{55 56} used the same data collection but addressed different research questions (CIHR, grants no. MOP-62873, FRSQ, grant no. 3255). The publication by Sirois *et al.*⁵⁶ is the original study,⁵⁶ the publication by Ouellet *et al.*⁵⁵ is a secondary analysis.⁵⁵ Three publications comprised patients treated at the Murnau Trauma Centre from 2000 to 2005 and recorded in the TraumaRegister DGU®.^{40 41 57} The publication by von Rűden *et al.*⁴⁰ and Wurm *et al.*⁴¹ reported on the same investigation of a group of severely injured patients with an ISS >50; Simmel *et al.*⁵⁷ analysed those patients with an ISS >25.⁵⁷ Soberg *et al.*⁵⁸ investigated the same research question as Soberg *et al.*⁵⁹ with a follow-up of 5 years (table 1).

More than half of the publications appeared between 2005 and 2009; the number of annual publications seems to be decreasing since 2015. Table 1 provides an overview of the included publications.

Instruments used to assess HRQoL

In total, 15 different tools were used to assess HRQoL during follow-up after polytrauma. Of those, six were generic instruments: Short Form-36 Health Survey (SF-36, n=21, 39%),^{35 38 47–50 53 58–71} 12-Item Short Form Health Survey (SF-12, n=12, 22%),^{36 37 42–46 55 56 72–74} Nottingham Health Profile (n=4, 7%),^{47–50} Sickness Impact Profile (SIP, n=4, 7%),^{11 51 53 68} Short Musculoskeletal Function Assessment (SMFA, n=1, 2%)⁷⁵ and WHO Quality of Life Instrument-Short Form (WHOQOL-BREF, n=1, 2%).⁷⁵ In addition, four preference-based tools were applied: European Quality of Life 5-Dimension (EQ-5D, n=9, 17%),^{1 7 47–50 52 54 71} EQ-6D (n=1, 2%),³⁴ Health Utility Index Mark 2 (HUI 2, n=1, 2%)¹ and HUI 3 (n=1, 2%).¹ Three trauma-specific instruments were used: Hannover Score for Polytrauma Outcome (HASPOC, n=6, 11%),^{36 42–46} Trauma Outcome Profile (TOP, (n=4, 7%)^{47 49 50 71} and Aachen Long-term Outcome Score (ALOS, n=1, 2%).⁴⁷ The Polytrauma Outcome Chart (POLO Chart, n=6, 11%)^{39–41 57 76 77} was used as a modular instrument consisting of the Glasgow Outcome Profile, SF-36, EQ-5D and TOP. The International Classification of Impairments, Disabilities and Handicaps (ICIDH) was reported in one publication (n=1, 2%).⁷⁸ Fifteen publications combined two to five different instruments to assess HRQoL.^{1 36 42–50 53 68 71 75}

In some publications (n=5), instruments to assess HRQoL were only used partially (e.g. solely the mental or physical part, or selected subscales of the SF-36 or SF-12,

chapter ‘Disability’ of the ICIDH).^{35 55 56 72 78} Six publications conducted a retrospective collection of HRQoL via SF-36, SF-12, EQ-5D and TOP capturing the pretrauma status.^{38 47–50 74}

Instruments used to assess ADL

ADL was measured by different generic instruments: Groningen Activity Restriction Scale (GARS),⁵³ Functional Activities Questionnaire (FAQ),⁶⁴ Katz Index of Activities of Daily Living (KATZ ADL)⁶⁴ and Barthel Index (BI) (each n=1, 2%).³⁹ The SF-36 subscales of physical and social functioning (n=1, 2%)⁷⁹ were also used to record ADL. Two publications employed self-designed questions.^{7 35} Most frequently (n=5), a single instrument was applied to assess ADL.^{7 35 39 53 79}

Instruments used to assess (social) participation

One publication reported the assessment of participation by self-designed questions covering return to sports and work.⁵³

Table 2 displays the number of publications and the instruments used to assess HRQoL, ADL and (social) participation.

Application of instruments

A postal survey was most often used to assess HRQoL, ADL and (social) participation (n=17).^{1 11 34 47–53 57 58 68 72 75 77 79} Next in frequency were telephone interviews (n=5),^{35 37 55 56 80} expert assessments (n=2),^{45 64} face-to-face interview (n=1)⁸¹ and combinations of those (n=16).^{7 36 38 40 41 43 44 46 59 60 66 69 71 74 82 83} The research settings were: trauma centre,^{36 43 44 46 84} outpatient clinic,^{62 65 78} hospital,³⁹ medical centre or place of patient’s residence,⁶⁴ hospital and home.⁷⁴ In four publications, no information regarding the application of instruments was provided.^{42 54 67 73} Relatives or proxies were reported in five publications.^{37 52 53 56 63} While most instruments are used with several data collection methods and survey settings, the HASPOC, where reported, is only recorded in the trauma centre and is assessed by a physician in addition to the respondent.

Measurements during follow-up

PROs mentioned above were most frequently recorded at a single time point (n=47).^{1 7 11 34–36 39–47 49–57 60–64 66–73 75–84} Few publications reported two (n=3),^{48 65 74} three (n=2),^{37 59} four or five (each n=1)^{38 58} time points of assessment.

Duration of follow-up

Most often (n=13), a follow-up of one to one and a half year was reported.^{1 35 38 51–54 60 62 65 68 73 81} Six publications described a follow-up period of over 10 and up to 17.5 years.^{36 42–46} Rarely, shorter follow-up periods of 8 days⁸⁴ to 6 months^{74 79} were detected.

Further PROs assessed

Beyond HRQoL, ADL and (social) participation, assessments of further PROs were reported in the included publications. Most frequently, these comprised function,

Table 2 Quantitative overview of instruments assessing HRQoL, ADL and (social) participation in n=54 publications

PRO	Category	Instrument	N (%)
HRQoL	Generic instruments	Short Form-36 Health Survey (SF-36)	21 (39)
		12-Item Short Form Health Survey (SF-12)	12 (22)
		Nottingham Health Profile (NHP)	4 (7)
		Sickness Impact Profile (SIP)	4 (7)
		Short Musculoskeletal Function Assessment (SMFA)	1 (2)
		WHO Quality of Life Instrument-Short Form (WHOQOL-BREF)	1 (2)
	Preference-based instruments	European Quality of Life 5-Dimension (EQ-5D)	9 (17)
		EQ-6D*	1 (2)
		Health Utility Index Mark 2 (HUI 2)	1 (2)
	Trauma-specific instruments	Health Utility Index Mark 3 (HUI 3)	1 (2)
		Hannover Score for Polytrauma Outcome (HASPOC)	6 (11)
		Trauma Outcome Profile (TOP)	4 (7)
	Modular instruments	Aachen Long-term Outcome Score (ALOS)	1 (2)
		Polytrauma-Outcome-Chart (POLO Chart)	6 (11)
	Conceptual framework	The International Classification of Impairments, Disabilities and Handicaps (ICIDH)	1 (2)
ADL	Generic instruments	Self-designed questions	2 (4)
		Groningen Activity Restriction Scale (GARS)	each n=1 (2)
		Functional Activities Questionnaire (FAQ)	
		Katz Index of Activities of Daily Living (KATZ ADL)	
		Barthel Index (BI)	
(Social) Participation		SF-36 subscales physical and social functioning	1 (2)
		Self-designed questions	

*EQ-6D=EQ-5D comprising an additional question capturing a cognitive component (memory, concentration, coherence and IQ).
ADL, activities of daily living; HRQoL, health-related quality of life; PRO, patient-reported outcome.

pain and mental disorders (including depression and/or depressive symptoms, anxiety and post-traumatic stress disorder (PTSD)). Only few PROs focused on social support, cognition, subjective health status and social network.

Table 3 Quantitative overview of kind and number of further reported PROs in n=54 publications

PRO	N (%)
Function	19 (35)
Mental disorder	16 (30)
Pain	14 (26)
Social support	7 (13)
Cognition	6 (11)
Subjective health status	3 (5)
Social network	2 (4)
Neuropsychological disorder	1 (2)

PROs, patient-reported outcomes.

Table 3 provides an overview of the kind and number of further recorded PROs.

Critical appraisal results

The methodological quality and the risk of bias was appraised using the NICE-checklist for quantitative intervention studies,^{30 38 76} the NICE-checklist for quantitative studies reporting correlations and associations,^{1 7 11 31 34–37 40–74 77–83} the SIGN-checklist for diagnostic studies^{32 39 75} and the Mixed-Method Appraisal Tool.^{33 84}

Some methodological weaknesses were identified regarding the selection of the study population, consideration of confounders (e.g. age, sex), data analysis and presentation of results, internal validity and generalisability of study results.^{34 40–43 45 50 60 61 65 67 71 76–78 80 82 83} While most criteria of the critical appraisal were fulfilled, a moderate risk of bias was observed.^{7 11 36–39 44 46–53 56 57 59 60 62 63 66 69 72–75 79 81 84} A low risk of bias was observed in eight publications.^{1 35 54 55 58 64 68 70} The results of the critical appraisal are provided in online supplemental file 4.

DISCUSSION

Main findings

The present systematic review identified 54 publications contributing to the research questions. A great variety was observed among all investigated aspects. HRQoL was the most frequently recorded PRO, and SF-36, SF-12 and EQ-5D were the most frequently applied instruments to assess it. Data on ADL and (social) participation were rarely reported. Most questionnaires were sent out per mail. Measurements were predominantly performed at a single time point, and the follow-up period lasted mainly between one and one and a half year. Function, mental disorders and pain were the most frequently assessed categories of the other PROs.

Instruments for the assessment of HRQoL, ADL and (social) participation

In 48 of the included publications, HRQoL was assessed—predominantly with generic and preference-based HRQoL instruments such as SF-36, SF-12, EQ-5D and NHP. Thus, over a long period of time, results are available for the impact of polytrauma on HRQoL and its possible change over time.

Unsurprisingly, the SF-36, one of the oldest and most widely used instrument for assessing HRQoL,⁸⁵ is the most frequently reported instrument in publications included in this review. Along with the SF-12, SF tools accounted for 61% of all identified instruments. This result is supported by observations of other reviews conducted in the field of polytrauma.^{85–88}

Considering the use of the different instruments assessing HRQoL by the different trauma groups, it becomes apparent that instruments are used without a clearly recognisable pattern or reason. Similarly, no pattern can be identified to explain the use of the SF-12 instead of the SF-36. No information was provided in this regard in the publications. However, it can be assumed that the reason for using the SF-12 is that it takes less time to administer than the SF-36. In 1999, an international consensus conference on evidence-based guidelines for the systematic evaluation and assessment of HRQoL after polytrauma recommended the use of modular instruments comprising generic and trauma-specific aspects.⁸⁹ Generic instruments have been applied continuously over a long time period, have been translated into different languages and can be applied regardless of the underlying disease. They are suitable for assessing HRQoL after polytrauma since it can affect different body regions, show different injury patterns and lead to a variety of complications. In contrast, trauma-specific instruments capture targeted relevant problems and measure the longitudinal change of HRQoL.⁹⁰ Despite the recommendation, the POLO Chart is the only modular instrument comprising generic and trauma-specific aspects reported in the included publications.⁹⁰ HASPOC, TOP and ALOS were the trauma-specific tools used. HASPOC is an instrument designed to evaluate the quality of rehabilitation. Since it comprises instruments assessing inter alia HRQoL, ADL

and function,^{91 92} we decided to subsume it into the category 'HRQoL'.

Apart from assessing HRQoL, we were particularly interested in the measurement of ADL and social participation. Regarding the assessment of ADL, five different instruments and self-designed questions in six publications were observed in our review. (Social) participation was only reported once by Holtslag *et al*.⁵³ In summary, it was notable that ADL and (social) participation after polytrauma were seldom assessed. One reason might be that measures of HRQoL or function already include several questions related to ADL and (social) participation. Predominantly, (social) participation is researched in people with brain or spinal cord injuries. A general understanding and clear definition of the participatory construct is still missing, which might be another reason for the low reporting rates of (social) participation. It has been argued that (social) participation should be one of the main aspects in rehabilitation after polytrauma,⁹³ besides survival and function and there are a number of instruments available to assess this PRO.^{94–96} This could also be assumed for ADL.

Application of instruments

Most frequently, a postal questionnaire was used. Compared with personal interviews, questionnaires sent by mail are quicker and less expensive.⁹⁷ In addition, potential bias introduced by an interviewer is excluded. However, it is not possible to verify the person answering the questionnaire, comprehension questions cannot be clarified, the full completion of the questionnaire cannot be guaranteed and the proportion of non-responders is higher.⁹⁷ However, other methods of data collection like personal or telephone interviews also have limitations (e.g. influence of the interviewer on the person being interviewed),⁹⁷ thus all data collection methods may incorporate (different) biases. The consultation of a proxy answering the questions was rarely reported. Injuries, for example, traumatic brain injuries (TBI), may require the use of a proxy and could enable the collection of outcome data after polytrauma, despite a risk of bias.^{97 98} The present systematic review excluded publications reporting single or mono injuries like single TBIs, which might be the reason only few publications including proxies were detected.

The retrospective assessment of the pretrauma situation helps enable a comparison of results and obtain a holistic view of the outcome after an injury. Gross *et al*^{48 50} as well as Gross and Amsler⁴⁹ measured prefracture level of HRQoL over 2 years after trauma.^{48–50} However, there are limitations to this approach: memories of the pretraumatic situation can be distorted by various circumstances, which might increase the risk of recall bias.⁹⁹ Large population screenings or the use of population norms might help to evaluate the pretraumatic state of HRQoL.^{18 47} Baseline assessments should ideally be made in the first week after the event. However, this is not always possible due to the severity of the injury. Another

limitation might be that some instruments are not suitable for use in hospital. For example, changed behaviour patterns measured by the SIP can also result from the very fact of being an inpatient. Apart from HRQoL, functional recovery is also of great interest and an important factor for evaluating outcomes after a polytrauma. In comparison to HRQoL and due to better quantification, the retrospective evaluation of function is more feasible.¹⁸

Most of the included publications reported a single assessment of the PROs. However, the course of recovery cannot be derived from a single measurement. The aforementioned consensus conference recommended measurements at 3, 12 and 24 months after the event.¹⁷ Other groups suggested assessments of PROs after 1, 2, 4 and 12 months¹⁰⁰ or 6 and 12 months after the injury, and beyond 12 months in case of longer rehabilitation needs.¹³

The most frequently reported follow-up period were one to one and a half year. Six publications conducted follow-up periods of more than 10 years.

Further PROs assessed

Further reported PROs assessed mainly function, mental disorders and pain—outcomes that are highly affected by polytrauma. Social support, subjective health status, cognition or social network were rarely recorded. This might be explained as follows: instruments assessing HRQoL mainly capture subjective health status. While cognition is frequently affected by brain injuries, publications reporting study populations with single brain injuries were excluded from this review. Social network and social support seem to influence recovery and return to work after trauma^{101 102} and should therefore receive more attention in future research.

Recommendations for the assessment of PROs

The existing recommendations for the use and application of instruments—as well as time points of assessments and outcomes to be measured after polytrauma—differ substantially,^{13 17} but there are attempts to standardise outcome measurements.¹⁸ Classification systems might be helpful for a standardised assessment of PROs, facilitating the adequate selection of instruments for a specific research objective.²³ The internet platform PROMIS—Patient-Reported Outcomes Measurement Information System—provides research tools and is continuously updated with the latest developments and newly translated instruments.¹⁰³ An important step towards a standardised approach of collecting HRQoL was made in the TraumaRegister DGU® by the implementation of HRQoL assessment with the SF-12.¹⁴

Furthermore, several groups have focused on the definition of special outcome variables to be recorded as default parameters. Hoffman *et al.*²⁰ recommended the development of a ‘minimum data set’ based on the ICF.²⁰ A core outcome set relevant for the respective outcome could be defined. This procedure could guide decision-making for the collection and presentation of outcomes

in studies.²² In addition, ICF linking enabling a check of which ICF components are mapped by an instrument could support the tool selection for particular research questions.^{16 19} Other authors also support the idea of core outcome sets.^{21 24}

Strengths and limitations

This review was conducted thoroughly based on a registered protocol in line with the PRISMA-P quality and the PRISMA statement requirements. We provide a broad overview of instruments used for the collection of HRQoL, ADL and (social) participation, along with information on their application. In addition, this study offers an overview on further PROs reported in the context of polytrauma. First efforts to standardise the collection of PROs have been achieved to optimise comparability of outcomes, but further consistency between central players (e.g. trauma registers) is needed. Therefore, this review encourages further improvement in the assessment of PROs after polytrauma.

The present systematic review has some limitations. Selection bias can be assumed as the search was restricted by the search period and language. However, we performed backward citation tracking and saw that only a few additional articles could be included. Our study only included English and German language literature and thus does not provide an insight into published results in other languages. Therefore, it cannot be ruled out that relevant publications from low-income and middle-income countries containing local results in local languages were not included. However, we assume that scientific articles are predominantly published in English; thus, the results presented here should give a comprehensive impression related to the research questions of this systematic review.

We did not use the term ‘major trauma’. Therefore, we cannot rule out that relevant publications reporting major trauma were not included. However, major trauma seemed to be increasingly mentioned in connection with single and psychological trauma—neither of which met the inclusion criteria of our systematic review. We screened systematic reviews and meta-analyses to identify further appropriate studies and would have included publications reporting major trauma if they fulfilled the inclusion criteria of this systematic review. Still, we believe that the non-use of the term ‘major trauma’ has no impact on the results of this systematic review and the answers to the research questions.

CONCLUSION

The present review reveals variations across study findings, which impairs the comparability of outcomes after polytrauma. To improve this situation, a more standardised approach for recording PROs should be established. First efforts have been initiated, but further alignment between the central players, such as the trauma registers, is required. Continuous collection of core outcomes

during the regeneration of people with polytrauma could create the basis for a targeted use of treatments and their adaptation to the results of the outcome measurement. Moreover, there appears to be little research on (social) participation and on further PROs like social support and social network. PROs need more attention in polytrauma-related outcome research. After all, we need to know the patients' perspectives on relevant outcomes after polytrauma so as to consider their needs when providing health services.

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Funding This work was supported by the Academy for Trauma Surgery GmbH (AUC). The funding supported the conduct of this systematic review. There is no award or grant number for this funding.

Competing interests JS was executive secretary of the Academy for Trauma Surgery GmbH (AUC). The authors declare that they have no competing interests.

Patient consent for publication Not required.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement No data are available.

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