Change of Functioning in Persons With Severe Musculoskeletal Injuries Over Time: A Multilevel Analysis

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Research

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Abstract

Background: The World Health Organization (WHO) recommends the WHO Disability Assessment Schedule (WHODAS) 2.0 as a generic assessment instrument to collect data on functioning and disability. The questionnaire was developed specifically to capture the activities and participation domain as defined by the International Classification of Functioning, Disability and Health (ICF). Evidence on the most relevant factors predicting WHODAS 2.0 outcome in the context of musculoskeletal injuries are controversial. This study aims to assess change in functioning of patients with severe musculoskeletal injuries undergoing inpatient rehabilitation over time.

Methods: A longitudinal multicentre study was conducted, following up 571 participants with severe musculoskeletal injuries over the course of a first inpatient rehabilitation stay until 3 months after discharge. At admission, data on sociodemographic, health-related aspects, functioning and contextual factors were collected. WHODAS 2.0 assessed functioning. Data were analysed using a multilevel model approach.

Results: The mean WHODAS 2.0 declined from admission to discharge and 3-month follow-up, indicating an improvement in functioning. Multilevel analyses revealed age, duration of inpatient rehabilitation, severity of the injury, injury localizations, number of comorbidities, emotional functioning, pain, being informed about the injury, subjective prognosis on return to work and agreement on treatment targets as factors influencing change in functioning over time.

Conclusions: In a rehabilitation setting, a healthcare professional can promote an increase in functioning, for example, by ensuring that there are treatment targets defined and agreed on with the patient and that the patient feels sufficiently informed about the injury. The identified factors could potentially be used for a short screening at admission to rehabilitation to estimate the patient's change of functioning over time.

Trial registration number and date of registration: DRKS00014857; July 04, 2018.

Background

More than one billion people worldwide, corresponding to about 15% of the world's population, live with some degree of disability. Of these, 110 to 190 million experience considerable impairments in functioning (1). It is estimated that injuries constitute about 10% of the global burden of disease (2), and the importance of injuries regarding substantial impairment of health is confirmed by latest analyses from the Global Burden of Disease Study 2017 (3). Nevertheless, there has been a decrease in global mortality due to injuries over the last decades (3). Research and especially rehabilitation outcome research is now focusing on functioning, quality of life and return to work (RTW) due to the decline of mortality rate and the increase of survival rate (4–7).

As injuries are not only associated with physical functioning but also mental and social aspects, a biopsychosocial perspective is recommended to be addressed in trauma rehabilitation research (8–12). Improving activities and participation of patients in addition to restoring and improving their body structures and functions is becoming increasingly important in rehabilitation as well (13).

The biopsychosocial perspective has been adopted by the World Health Organization`s (WHO) International Classification of Functioning, Disability and Health (ICF) (14). According to the conceptualization of the ICF, functioning is an umbrella term for body structures (anatomical aspects), body functions (physiological and mental functions), as well as activities and participation. Contextual factors are defined as environmental factors (physical, social and attitudinal environment in which people live) and personal factors (14). The ICF can be used to map

problems in functioning and contextual factors of persons with musculoskeletal injuries to the components of the classification mentioned beforehand.

To know about (long-term) consequences of musculoskeletal injuries and associations with functioning and disability is essential for an optimal rehabilitation treatment and management (6, 13). Particularly patient-reported outcomes play an important role in assessing functioning and health (15–17), as well as in evaluating the outcome quality of rehabilitative treatment (17, 18). WHO's recommended generic assessment instrument to collect data on functioning and disability is the WHO Disability Assessment Schedule (WHODAS) 2.0 (19). The questionnaire has been developed specifically to capture the activities and participation domain as defined by the ICF and covers six domains of life (cognition, mobility, self-care, getting along, life activities, participation).

Evidence on the most relevant factors predicting WHODAS 2.0 outcome in the context of musculoskeletal injuries are controversial, although various studies have shown that for instance the severity of the injury (20–23), comorbidities (21–24), premorbid disability (21–23, 25) or the symptom severity (26–29) have an influence on the WHODAS score. Thus, it remains unclear in which activities and participation domains patients are limited and restricted and whether or how these limitations and restrictions change over time.

The objective of the study is therefore to assess the change in functioning of patients with severe musculoskeletal injuries undergoing inpatient rehabilitation over time using the WHODAS 2.0 and by applying multilevel analyses. The specific aims are:

1. to analyse how functioning of patients with severe musculoskeletal injuries changes over the course of a first inpatient rehabilitation stay until three months after discharge; and
2. to identify the factors influencing these changes over time.

Materials And Methods

Design

We performed a longitudinal multicentre study within the project "Predicting the Rehabilitation Outcome after trauma based on the ICF" (icfPROreha), which was carried out in ten rehabilitation centres throughout Germany. The project aims to identify factors influencing RTW and quality of life in patients with severe musculoskeletal injuries at the time of admission to inpatient rehabilitation by collecting data on sociodemographic, health-related aspects, functioning, quality of life and contextual factors. In this study, the WHODAS 2.0 was applied to a large population with severe musculoskeletal injuries in inpatient rehabilitation for the first time.

Within the project an expert panel was implemented including 24 experts with different backgrounds related to clinical and rehabilitative practice, administration and research (physicians, therapists, rehabilitation managers, representatives of accident insurances) which guided the conceptualization of the project and methodolgy.

The project is a cooperation effort of the Department for Workman's Compensation Rehabilitation at the BG Hospital Murnau and the Chair of Public Health and Health Services Research at LMU Munich.

LMU Munich and the respective ethic committees of the involved rehabilitation centres gave ethical approvals for the study. Registration to the German Registry for Clinical Studies proceeded on July 04, 2018 (Registration number: DRKS00014857).

Participants

Our study sample consists of patients being admitted to rehabilitation at one of the ten participating rehabilitation centres between August 2018 and December 2019. We included patients who fulfilled the following inclusion criteria: (a) aged 18–65 years (working age), (b) diagnosis of severe musculoskeletal injury, (c) first inpatient rehabilitation treatment after injury, (d) trauma or accident occurred a maximum of 16 weeks ago, (e) aim of the study was understood and (f) participants provided informed consent.

We excluded patients with (a) lesions of the major nerves including spine injuries, (b) neurological symptoms, (c) traumatic brain injuries and (d) insufficient knowledge of the German language to fill in patient-reported outcome measures.

Measures

Within the project icfPROreha a comprehensive set of variables was used. This variable set was decided on and operationalized during a two-day structured and consensus-building process by the expert panel. The panel decided on the variables based on the results of scoping reviews and expert surveys performed by researchers of LMU Munich prior to the workshop. Standardized instruments, and more specifically patient-reported outcomes, were used wherever possible. For the present study, we selected a reduced set of variables which was chosen based on published literature and discussions within the research team (see Table 1).

In this analysis, we used the following standardized patient-reported outcome measures:

Functioning was assessed with the German version of the *WHODAS 2.0* 12-item self-administered or interviewer-administered version. The response options of the 12 items range from 0 = no difficulties to 4 = extreme difficulties/cannot do which sum up to a total score of 0 to 48, with zero indicating maximum functioning (19).

Emotional functioning was assessed with the *Patient-Health-Questionnaire 4* (PHQ-4), an ultra-brief self-report measure which combines a 2-item depression scale (PHQ-2) and a 2-item anxiety scale (GAD-2) to a summed score between 0 and 12 (30, 31).

Self-efficacy was assessed with the *General Self-Efficacy Short Scale* (Allgemeine Selbstwirksamkeit Kurzskala, ASKU). It was constructed for the general German-speaking population. The mean value of the three individual items makes up the total score (32).

Resilience was measured with the *Resilience Scale RS-11* which is a shortened version of the original scale by Wagnild and Young (1993) (33). The 11 items on a 7-point likert scale are added up to a total score (34).

Heavy drinking and/or active alcohol abuse or dependence were identified using the *Alcohol Use Disorder Identification Test Consumption Questions* (AUDIT-C). The values of the three questions are summed up resulting in a possible score of 0–12 (35).

Data Collection

Patients fulfilling the above-mentioned inclusion criteria were informed about the aim and procedure of the study and were invited to participate when admitted to one of the ten inpatient rehabilitation centres. Patients who were willing to participate signed informed consent. Gender, age and funding agency of rehabilitation were collected for the patients which did not agree to participate. Patients were recruited between August 2018 and December 2019. The study coordinators and physicians involved in the study underwent a training in recruitment strategy and data collection.

Patients filled in an electronic survey using a mobile device during the first three days after admission (T1) and one to three days before discharge (T2). There was also the possibility to complete the survey using a paper-based form if there was a problem with the electronic device or a patient wished to do so. Three-month follow-ups (T3) were conducted by telephone interviews performed by trained interviewers. If the patients were contacted at least five times by telephone and were not reached or if they specifically requested it, a questionnaire was sent to them by postal mail.

Data was collected and anonymously stored on a protected server at LMU Munich using the web-based application Research Electronic Data Capture (REDCap) (36).

Data Analysis

Descriptive Analysis

We examined the distributions of the variables (mean, standard deviations, absolute and relative frequencies) to ensure that the data met the assumptions for statistical tests. Some variables needed to be recoded due to low frequencies of response options. Table 1 shows the recoding of these variables.

Table 1

Set of variables, labels, response options and recoding of variables.

Variable	Label	Response Options	Recoding of variables
Demographics			
Age[#] [†]		[in years]	
Gender[#] [†]		1 = female 2 = male	0 = female 1 = male
Personal Factors			
Living situation	Do you live…	1 = alone 2 = with others	
Social burden	How many financially dependent children do you have?	[number]	0 = no socially stressful circumstances 1 = any socially stressful circumstances
	Are there any special circumstances in your family that burden you?	0 = no 1 = yes, care for a relative 2 = yes, single parent 3 = yes, other	
Education[#]	What is your highest general school leaving certificate? [a]	1 = pupil 2 = no graduation 3 = 8th or 9th grade 4 = 10th grade 5 = entrance qualification for a university of applied sciences 6 = higher education entrance qualification 7 = other graduation / free text	Free text (7) was allocated to other categories
Vocational training	Do you have a completed vocational training?	0 = no 1 = yes	
Cultural background	What is/are your native language(s)?	1 = German 2 = Turkish 3 = Polish	0 = German 1 = Other

		4 = Russian 5 = Italian 6 = Other	
Subjective prognosis on return to work (RTW)[# †]	Do you think that, based on your current state of health, you will still be able to do your current job in a year's time?	1 = unlikely 2 = not sure 3 = very likely	
Self-efficacy	3 items (e.g. I can rely on my abilities in difficult situations)[2]	1 = strongly disagree to 5 = strongly agree	
Satisfaction with life	Before the accident, how satisfied were you - all in all - with your life?	Visual Analogue Scale [0 = completely not satisfied to 100 = completely satisfied]	
Resilience[# †]	11 items (e.g. I like myself.)[3]	1 = disagree to 7 = agree	
Health-related aspects			
Overall health[#]	How would you describe your overall health right now?[4]	1 = excellent 2 = very good 3 = good 4 = not that good 5 = bad	1 = very good (1, 2) 2 = good (3) 3 = not good (4, 5)
Body mass index	Body weight [kg] / height [m]^2		
Severity of injury[# †]	Physician's assessment	Up to five diagnoses marked as (V) = non-severe injury (S) = severe injury	0 = no injury was marked as severe 1 = at least one injury was marked as severe
Injury localizations[# †]	Physician's assessment	1 = head (without facial skull) 2 = facial skull, face 3 = cervical spine 4 = chest 5 = abdomen 6 = back (thoracic or	1 = one injury localization 2 = two injury localizations 3 = three or more injury localizations

		lumbar spine) 7 = arms (including shoulder) 8 = legs (including hip and pelvic bones) 9 = external and other injury (Multiple answers possible)	
Comorbidities[#] [†]	In the following list, please mark your current diseases. (e.g. cardiovascular diseases, cancer, etc.)[5]	0 = not present 1 = medical diagnose 2 = own diagnose	0 = no (further) comorbidities 1 = one (further) comorbidity 2 = two (further) comorbidities 3 = three or more (further) comorbidities
Smoking status[#]	Do you smoke?[6]	1 = yes, daily 2 = yes, occasionally 3 = no, not any more 4 = never smoked	
Heavy drinking	3 items (e.g. How often do you drink alcoholic beverages?)[7]	0 = never 1 = less than once a month 2 = 1 time per month 3 = 1 time per week 4 = daily or almost daily 5 = no information*	
Game addiction[#]	On average, how much time do you spend playing games on your computer, game console, smartphone/tablet or surfing the Internet for private purposes ("indeterminate surfing") on a normal working day?	0 = < 60 min. 1 = 1 to < 2 hours 2 = 2 to < 3 hours	0 = less than 60 min (0) 1 = more or equal 60 min

		3 = 3 to < 4 hours 4 = 4 to < 5 hours 5 = ≥ 5 hours 6 = no information	(1-5) 2 = no information (6)
Duration of rehabilitation[#] [†]	Duration of inpatient rehabilitation; dates assessed by clinic	[Dates]	[Weeks]
Functioning			
Job situation before the accident[#]	How was your job situation before the accident?	1 = fully employed 2 = partially employed (half-day, hourly) 3 = unfit for work 4 = registered jobseeker 5 = other	Free text (5) was assigned to categories
Inability to work before the accident[#]	How many weeks in the last 12 months before the accident were you unable to work in total?	[weeks]	
Pain [#] [†]			
at rest	How severe is your pain at rest?	Visual Analogue Scale [0 = no to 100 = excruciating pain]	Higher value was used for pain
under stress	How severe is your pain under stress?	Visual Analogue Scale [0 = no to 100 = excruciating pain]	
Sleep functions[#] [†]	How do you sleep?	Visual Analogue Scale [0 = very well to 100 = very badly]	
Emotional functioning[#] [†]	4 items (Over the last two weeks, how often have you been bothered by the following problems? E.g. feeling nervous, anxious or on edge)[8]	0 = not at all 1 = several days 2 = more than half the days 3 = nearly every day	
Taking care of health	How much do you care about your health in general?[6]	1 = very much 2 = much	1 = less (4, 5)

		3 = moderate 4 = less 5 = not at all	2 = moderate (3) 3 = much (1, 2)
Environmental Factors			
Residential situation#	What is your residential situation?	1 = ground level 2 = at a floor 3 = accessible via elevator 4 = accessible without elevator	0 = not barrier-free 1 = barrier-free
Income#	What is the monthly net income of your household? [€]	1 = < 900 2 = 900 to < 1300 3 = 1300 to < 1700 4 = 1700 to < 2300 5 = 2300 to <3200 6 = 3200 to < 4000 7 = 4000 to < 5000 8 = ≥ 5000 9 = no information	1 = below 1700 (1-3) 2 = 1700 to < 2300 (4) 3 = 2300 to <3200 (5) 4 = 3200 or more (6-8) 5 = no information (9)
Financial assets# †	Do you currently have financial difficulties?	0 = no 1 = yes 2 = no information	
Main earner	The household income corresponds to my personal income	0 = no 1 = yes 2 = no information	
Job profile	In your current job, you are …	1 = self-employed 2 = dependent	

Work-related injury#	I had the accident …	1 = at work 2 = on my way to/from work 3 = at my free time/doing sports 4 = in traffic 5 = at home / in the garden	0 = no work-related injury (3-5) 1 = work-related injury (1,2)
Support at work#	How much do you feel supported by your employer and colleagues?	1 = not supported at all 2 = something supported 3 = moderately supported 4 = quite supported 5 = very supported	1 = not supported (1) 2 = moderately supported (2,3) 3 = supported (4,5)
Ongoing legal dispute#	Are there currently still legal disputes in connection with the accident?	0 = no 1 = yes	
Previous rehabilitative treatment	In connection with the current injury I have already received rehabilitative treatment	0 = no 1 = yes	
Information about injury# †	Do you feel sufficiently informed about your injury and the consequences of your injury?	0 = no 1 = yes	
Case management	Do you already have personal contact with a professional helper, rehabilitation manager or an insurance clerk?	0 = no 1 = yes	
Treatment targets# †	Are there treatment targets which were defined and agreed on?	0 = no 1 = yes	
Satisfaction with assistive devices and therapy#	How satisfied are you with the current supply of assistive devices and therapy?	1 = completely satisfied 2 = satisfied 3 = moderately satisfied 4 = rather not satisfied 5 = completely not satisfied	1 = less satisfied (3-5) 2 = moderately satisfied (2) 3 = satisfied (1,2)
Social insurance benefits	Do you expect additional benefits from a private insurance?	0 = no 1 = yes	

		2 = no information	
Support by family and friends	How much do you feel supported by your family and friends?	1 = not supported at all 2 = something supported 3 = moderately supported 4 = quite supported 5 = very supported	1 = not supported (1) 2 = moderately supported (2,3) 3 = supported (4,5)
Acceptance by family/partner	How much does your family/partner accept the new situation after the injury?	0 = no family / partner 1 = not at all 2 = something 3 = moderate 4 = pretty much 5 = very 6 = no information	0 = no family / information (0, 6) 1 = not at all (1) 2 = moderate (2,3) 3 = much (4,5)
Stressful life events[#]	Has there been at least one stressful life event (e.g. death of spouse/partner/family member, divorce or separation from spouse/partner, illness of a family member, dismissal without notice, unemployment, change in financial situation) in the last 12 months?	0 = no 1 = yes	

[#] p-value < 0.05 in exploratory analysis; [†] included in multilevel models; * coded as missing; [a] ALLBUS: German General Social Survey (51); [b] ASKU: General Self-Efficacy Short Scale (32); [c] RS-13: Resilience Scale (34); [d] POLO: Polytrauma-Outcome-Chart (52); [e] WAI: Work Ability Index (53); [f] GEDA: Current Health in Germany (54);

[g] AUDIT-C: Alcohol Use Disorder Identification Test Consumption Questions (35); [h] PHQ-4: Patient-Health-Questionnaire 4 (30)

Modelling Change of Functioning over Time

We analysed the outcome (WHODAS 2.0 score) based on a multilevel model with time treated as categorical variable with the levels admission (T1), discharge (T2) and 3-month follow-up (T3). Model specifications were made according to the recommendations of Singer (37).

Exploratory Analysis

We added each potential predictor without and with time interaction separately to the basic time model, and the model fit was compared using the Akaike Information Criterion (AIC). The research team then decided on the variables to be included in a model consisting of so-called basic factors (such as age) and injury-related factors, as well as additional factors (personal factors, environmental factors).

We added the selected variables concerning basic factors and injury-related factors step by step to the model, beginning with the variables which showed the most improvement in AIC. To assess the effect of additional factors, we included them separately in the model, again using the AIC to compare the goodness of fit of the models. To come up with a final model, we included all selected basic, injury-related and additional factors in a full model and removed non-significant effects ($p \geq 0.05$).

We imputed missing values in the standardized patient-reported outcome measures according to the respective instructions for analysis. Otherwise, we did not undertake missing data imputation. SAS software (version 9.4) (38) was used for all statistical analyses.

Results

Descriptive Analyses

In total, 797 of 1060 eligible patients agreed to participate in the study by the end of the recruitment period. Those who refused to participate (n = 263, 24.8 %) did not differ in age and gender from those who decided to do so. In our analysis we included 571 participants (72.7 % male (n = 415), mean age 47.4 years (SD = 12.2)) from whom complete WHODAS 2.0 data over the three time points admission (T1), discharge (T2) and 3-month follow-up (T3) was available.

The mean duration of the inpatient rehabilitation was 5.4 weeks (SD = 3.4); 28.2 % (n = 160) of the patients suffered a polytrauma and 43.5 % (n = 247) were diagnosed with a severe injury. The characteristics of the study population is shown in Table 2. The most frequent diagnoses were fractures and dislocation of the foot (anklebone/heel bone/tarsals) and vertebra fractures, deformities and instabilities (9.2 % each) followed by fractures of the pelvic ring, deformity or instability (6.3 %). Table 3 displays the six most frequent diagnoses according to the Index of Injuries for Inpatient Treatment of the German Social Accident Insurance (DGUV) (39), as well as the corresponding ICD-10 codes (40).

Table 2
Characteristics of participants (n = 571).

Characteristics	Mean	SD[a]
Age	47.4	12.2
Duration of rehabilitation [weeks] (n = 568)	5.4	3.4
	n	**%**
Gender		
Male	415	72.7
Female	156	27.3
Cultural background		
German	532	93.2
Non-German	39	6.8
Living situation		
Alone	145	25.4
With others	426	74.6
Injury localizations (n = 568)		
One injury localization	408	71.8
Two injury localizations	102	18
Three or more injury localizations	58	10.2
Severity of injury (n = 568)		
Non-severe injury[b]	321	56.5
Severe injury[c]	247	43.5
Comorbidities		
No comorbidity	38	6.7
One comorbidity	157	27.5
Two comorbidities	156	27.3
Three or more comorbidities	220	38.5

[a] SD: Standard deviation; [b] Diagnosis according to the Index of Injuries for Inpatient Treatment of the German Social Accident Insurance DGUV (39)

Table 3
The six most frequent diagnoses (n = 571; multiple answers possible).

Diagnosis[a]	ICD-10 code	n	%
Fractures and dislocation of foot (anklebone/heel bone/tarsals)	S92.0–92.2, S93.0, S93.31	85	9.2
Vertebra fractures, deformities and instabilities	S12.0–12.7, S22.0–22.1, S32.0	85	9.2
Fractures of the pelvic ring, deformity or instability	S32.1–32.7	58	6.3
Fractures of the lower leg in case of multiple fractures, fractures of levels or joint involvement	S82.5–82.7, S82.11, S82.21, S82.31	52	5.6
Fractures of the thigh near the hip joint	S72.0–S72.2,	47	5.1
Fractures of proximal lower leg with joint involvement	S82.1, S82.41	47	5.1

[a] Diagnosis according to the Index of Injuries for Inpatient Treatment of the German Social Accident Insurance DGUV (39); [b] ICD-10: International Classification of Diseases (40)

The mean WHODAS 2.0 total score was 21.0 (SD = 9.9) at admission, 14.9 (SD = 8.3) at discharge and 12.5 (SD = 7.6) at 3-month follow-up. Figure 1 shows details on the distribution of the WHODAS 2.0 mean score of the whole population for the different domains.

Modelling Change of Functioning over Time

The development of the WHODAS 2.0 score from admission over discharge to 3-month follow-up can be described with the following model: WHODAS score = 21.042–6.165*T2–8.524*T3

Exploratory Analyses

Out of our dataset which included 43 variables in total, 27 variables showed effects ($p < 0.05$) either alone or in interaction with time when they were added one by one to the model just including time (see Table 1 variables marked with #). Table 4 provides details on the improvement of model fit for these variables, as well as the chosen variables to be included in further analyses based on consultations in the research team and their assignment to the blocks. Although gender did not show significance ($p \leq 0.101$) when being added to the model of time, it was decided to be entered as forced-in variable into further exploratory models.

Table 4

AIC[a] values for effects of single predictors with p-value < 0.05, without and with time interaction, sorted from lowest AIC[a] (i.e. best model fit) to highest AIC[a] (i.e. worst model fit).

Basic Time Model plus	**AIC[a] Variable**	**AIC[a] Variable * Time**
Emotional functioning*§	11551.8	**11545.8**
Duration of rehabilitation*#	11605.6	**11588.4**
Job situation before the accident	**11616.7**	11621.6
Injury localizations*†	**11626.2**	11627.1
Pain*§	**11633.4**	11636.7
Severity of injury*†	**11638.0**	1164.5
Overall health	**11642.3**	11647.8
Subjective prognosis on RTW*§	**11647.3**	11653.7
Satisfaction with assistive devices and therapy	**11650.7**	11656.6
Information about injury*§	11657.2	**11652.4**
Comorbidities*†	**11655.8**	11665.5
Ongoing legal dispute	11667.0	**11660.0**
Sleep functions*§	**11661.5**	11665.2
Education	11683.0	**11680.7**
Support at work	**11685.0**	11690.3
Stressful life events	11688.9	**11687.4**
Treatment targets defined and agreed on*§	**11688.6**	11690.1
Financial assets*§	**11689.5**	
Smoking		**11689.7**
Residential situation	**11696.7**	11699.9
Inability to work before the accident	**11697.0**	11697.3
Work-related injury		**11697.4**
Age*#		**11698.3**

[a] Akaike Information Criterion; bold: lower AIC;

* Included in further analyses; # basic factor; † injury-related factor; § additional factor

Basic Time Model plus	AIC[a] Variable	AIC[a] Variable * Time
Resilience*[§]	**11698.8**	
Basic Time Model	*11701.1*	
Case management	11703.1	**11703.0**
Game addiction		**11703.4**
Income		**11706.6**
[a] Akaike Information Criterion; bold: lower AIC;		
* Included in further analyses; [#] basic factor; [†] injury-related factor; [§] additional factor		

The results obtained from the multilevel analysis of the basic and injury-related factors are presented in Table 5. Each stepwise inclusion of both factors improved the AIC of the model. Except for the variables *gender* and *severity of injury*, all factors consistently showed significant effects in the models. Including the additional factors *emotional functioning*, *pain*, *subjective prognosis on RTW*, *information about injury*, *sleep functions*, *rehabilitative goal*, *financial assets* and *resilience* separately in the multilevel model also resulted in an improvement of the AIC for each variable (see Table 6).

Table 5
Results of multilevel models, stepwise addition of basic factors (age, gender, duration of inpatient rehabilitation) and injury-related factors (severity of injury, injury localizations, number of comorbidities).

Model	**Time**	**Age**	**Gender**	**Duration of inpatient rehabilitation**	**Severity of injury**	**Injury localizations**	**Number of comorbidities**
Variables	**Estimate** (p-value)						
Intercept (T1)	**21.042** (< 0.001)	**19.719** (< 0.001)	**23.739** (< 0.001)	**19.850** (< 0.001)	**19.372** (< 0.001)	**19.187** (< 0.001)	**18.080** (< 0.001)
T2	**-6.165** (< 0.001)	**-6.165** (< 0.001)	**-9.302** (< 0.001)	**-7.196** (< 0.001)	**-7.196** (< 0.001)	**-7.196** (< 0.001)	**-7.196** (< 0.001)
T3	**-8.524** (< 0.001)	**-8.524** (< 0.001)	**-11.523** (< 0.001)	**-9.281** (< 0.001)	**-9.281** (< 0.001)	**-9.281** (< 0.001)	**-9.281** (< 0.001)
Age (T1)		-0.015 (0.607)	-0.017 (0.565)	-0.017 (0.566)	-0.013 (0.6487)	-0.010 (0.723)	-0.048 (0.089)
Age*T2		**0.066** (0.015)	**0.066** (0.015)	**0.065** (0.016)	**0.065** (0.016)	**0.065** (0.016)	**0.065** (0.016)
Age*T3		**0.063** (0.019)	**0.063** (0.019)	**0.061** (0.022)	**0.061** (0.022)	**0.061** (0.022)	**0.061** (0.022)
Gender			-1.095 (0.111)	**-1.458** (0.030)	**-1.55** (0.021)	**-1.638** (0.0135)	-0.842 (0.1952)
Duration of rehabilitation				**0.829** (< 0.001)	**0.816** (< 0.001)	**0.764** (< 0.001)	**0.687**(< 0.001)
Duration of rehabilitation*T2				**-0.380** (< 0.001)	**-0.380** (< 0.001)	**-0.380** (< 0.001)	**-0.380** (< 0.001)
Duration of rehabilitation*T3				**-0.398** (< 0.001)	**-0.398** (< 0.001)	**-0.398** (< 0.001)	**-0.398** (< 0.001)
Severity of injury					**1.256** (0.037)	**1.000** (0.095)	**1.442** (0.013)
Two injury localizations						**1.591** (0.042)	1.411 (0.062)
Three or more injury localizations						**2.972** (0.003)	**2.850** (0.003)
One comorbidity							-0.737 (0.544)
Two comorbidities							1.667 (0.173)

[a]Akaike Information Criterion; bold: p-value < 0.05

Model	Time	Age	Gender	Duration of inpatient rehabilitation	Severity of injury	Injury localizations	Number of comorbidities
Three or more comorbidities							**4.077** (0.008)
AIC	11701.1	11698.3	11697.7	11583.0	11580.6	11573.5	11536.5
[a]Akaike Information Criterion; bold: p-value < 0.05							

Table 6

AIC[a] for models including basic factors, injury-related factors and additional factors, sorted from lowest (i.e. best model fit) to highest (i.e. worst model fit).

Variable	AIC[a]
Emotional functioning*Time	**11413.6**
Pain	**11485.2**
Information*time	**11491.6**
Subjective prognosis on RTW	**11498.9**
Sleep functions	**11517.5**
Treatment targets defined and agreed on	**11526.0**
Financial assets	**11528.4**
Resilience	**11531.3**
[a]Akaike Information Criterion; bold: p-value of effect estimate < 0.05	

Final Model

A complete model including all predictors mentioned in Table 6 resulted in an AIC of 11356.6. The removal of the non-significant effects ($p \geq 0.05$) gender, sleep functions, financial assets and resilience resulted in a drop of the AIC to 11352.1, which marked the best model. The final model describing functioning over time therefore included *time*, *age*, *duration of inpatient rehabilitation*, *severity of injury*, *injury localizations*, *number of comorbidities*, *emotional functioning*, *pain*, *information about injury*, *subjective prognosis on RTW* and *treatment targets defined and agreed on* (see Table 7).

Table 7
Results of the final multilevel model describing functioning measured by the WHODAS 2.0 total score.

Variable	Details	Model	Estimate*	p-value
Time	Categorical [Reference: T1]	Intercept	**18.266**	< 0.001
		T2	**-6.701**	< 0.001
		T3	**-9.572**	< 0.001
Age	Continuous [Years]	Age (T1)	-0.033	0.196
		Age*T2	**0.064**	0.016
		Age*T3	**0.058**	0.030
Duration of rehabilitation	Continuous [Weeks]	Duration of rehabilitation (T1)	**0.569**	< 0.001
		Duration of rehabilitation*T2	**-0.364**	< 0.001
		Duration of rehabilitation*T3	**-0.377**	< 0.001
Severity of injury	Dichotomous	Severity of injury	**1.069**	0.034
Injury localizations	Categorical [Reference: One injury localization]	Two injury localizations	1.096	0.096
		Three or more injury localizations	**2.174**	0.001
Comorbidities	Categorical [Reference: No comorbidities]	One comorbidity	-0.430	0.682
		Two comorbidities	1.054	0.319
		Three or more comorbidities	**2.315**	0.028
Emotional functioning	Continuous [Range: 0–12]	Emotional functioning (T1)	**0.906**	< 0.001
		Emotional functioning *T2	-0.197	0.111
		Emotional functioning *T3	**-0.325**	0.009
Pain	Continuous [Range: 0–100]	Pain	**0.048**	< 0.001
Information about injury	Dichotomous	Information (T1)	**-3.357**	< 0.001
		Information*T2	0.011	0.989
		Information*T3	**1.607**	0.047

* bold: p-value < 0.05

Variable	Details	Model	Estimate*	p-value
Subjective Prognosis on RTW	Categorical [Reference: Unlikely]	Not sure	-1.254	0.208
		Very likely	**-2.925**	0.003
Treatment targets defined and agreed on	Dichotomous	Treatment targets defined and agreed on	**-1.200**	0.019
* bold: p-value < 0.05				

Discussion

The present study shows that the mean total WHODAS 2.0 score measuring functioning in persons with severe musculoskeletal injuries declines over the course of a first inpatient rehabilitation stay until 3 months after discharge, with a larger difference between admission to and discharge from the hospital than between discharge and 3-month follow-up. Of initially 43 possible factors influencing the development of functioning, the following ten variables were included in the final model to predict change in functioning additionally to time: age, duration of inpatient rehabilitation, severity of injury, injury localizations, number of comorbidities, emotional functioning, pain, information about injury, subjective prognosis on RTW and treatment targets defined and agreed on.

The improvement in functioning over time - as measured with the WHODAS - seems plausible, since rehabilitation does not only aim to restore body functions, but also to improve patient's activities and participation (13). The general tendency of the WHODAS 2.0 to decline after an injury is also supported by other studies (8, 20, 29, 41), however, these studies most often refer to a longer period of time.

Prior studies are controversial about the influence of gender on the WHODAS 2.0 score in trauma patients (20, 21, 29). In our analysis, gender did not show significant effects when it was added to the basic time model. Despite this, we decided to treat it as forced-in variable in the exploratory models based on expert consultation. Removing gender resulted in an improved model fit. In line with this the final model did not contain the variable. This could be due to the fact that in our cohort, comorbidity seems to be a stronger predictor for the development of functioning over time than gender. Increasing age was associated with worsened functioning at discharge and 3-month follow-up in our final model, even though it had no statistically significant influence on the baseline WHODAS 2.0 score. This finding is in line with previous research (20, 21). A longer period of inpatient rehabilitation was associated with poorer functioning at baseline, which might be explained by the nature of the injuries: Injuries resulting in worse functioning probably also require a longer inpatient rehabilitation. In contrast, at discharge and 3-month follow-up every additional week of inpatient rehabilitation positively influenced functioning which is also confirmed by Soberg and colleagues (29).

In our study, injury severity was measured according to the Index of Injuries for Inpatient Treatment of the German Social Accident Insurance (DGUV) (39). Nevertheless, having a severe injury was found to be associated with functioning. This is also confirmed in other studies measuring severity using the Injury Severity Score (ISS) (42) or New Injury Severity Score (NISS) (43) (20, 21, 29, 44). Having three or more injury localizations as well as having three or more comorbidities both resulted in an increase of the WHODAS 2.0 total score. This fits well with the results of Davie et al. (41) who found multimorbidity to be associated with poorer functioning.

We found that decreased emotional functioning was associated with worse functioning at baseline in our final model. This is in good agreement with studies which reported depression (25, 27, 45), stress (25, 46, 47) or post-traumatic

stress disorder (28, 45) to be related to a higher WHODAS 2.0 score. Pain showed an association with functioning. With each additional point in pain on a visual analogue scale (ranging from 0 – no pain to 100 worst pain) the WHODAS 2.0 total score increased by 4.8 points. This finding is consistent with previous research by Saltychev et al. (26) who found correlations of musculoskeletal pain with WHODAS 2.0 score, as well as Silva et al. (27) who identified global pain to be the most important predictor for the total score.

The aspect of being confident to go back to the pre-injury job and to be able to do the previous job in one year's time significantly improved functioning. To our knowledge, there is no other study specifically asking for subjective prognosis on RTW in a setting comparable to ours. However, evidence exists for the perception of the injury to be a threat to life or long-term disability negatively influences the development of the WHODAS 2.0 (21–23). These findings indicate that having a positive perspective or attitude concerning the future might positively effect functioning. Also, defining and agreeing on treatment targets are considered to be a fundamental part of the rehabilitation process in clinical practice. Yet, a systematic review by Levack et al. could not clearly conclude that "goal setting" influences the patient's engagement for their rehabilitation process or their functional outcome (48). For the process of goal setting itself, Rose et al. identified in their systematic review a clear value in the cooperation between healthcare professionals and patients to decide on the best procedure for rehabilitation (49). In our study, an existing agreement on a treatment targets as well as feeling informed about the injury and its consequences were associated with improved functioning. These results support the importance of goal setting and the involvement of patients in the patient-centred decision process. However, feeling informed did not show consistent effects at discharge and 3-month follow-up. In fact, the model even showed an increase in WHODAS 2.0 at 3-month follow-up. This suggests feeling sufficiently informed might change during the course of the inpatient rehabilitation. Further research is needed to fully explain the reasons for this discrepancy.

We would like to stress that only data collected by the end of March 2020 was used for the analyses in this paper. By the end of March 2020, restraining orders and curfews had been imposed by the federal and state governments in Germany because of the COVID-19 pandemic. In telephone interviews, many participants reported that the restrictions due to the COVID-19 pandemic negatively affected their mood and their answers to the WHODAS 2.0 questionnaire. Therefore, we decided to exclude all data collected after this time point.

One major strength of our study was that the study population was comparable in terms of age and gender to the German trauma population according to the German TraumaRegister DGU® (mean age 50.5; 70.2 % male) (50). Furthermore, the study had a large sample size and different study sites across Germany. We used the WHODAS 2.0, a short, valid and reliable instrument recommended by WHO, to measure functioning, as well as other standardized instruments wherever possible. Since the second part of our study was of exploratory nature, the entire project team was involved to ensure that the preselection of variables was done in a meaningful way by taking into account a clinical and content-related perspective and was not based on statistical analyses only.

Several limitations might have influenced the reported results. First, one must be aware that the results only cover patients with musculoskeletal injuries and are probably not transferable to other patient populations, especially to patients with severe neurological injuries. Second, the order in which the variables were added to the model was arbitrary, and a different order could have led to different results. Besides, it is unclear whether participants who could not be contacted for their 3-month follow-up are missing at random. This could be a potential source for bias.

The self-administered and the interviewer-administered version of the WHODAS 2.0 were applied, therefore there might be an effect on the participants' answers. Finally, the findings from this study may not be transferable to a long-term

change over time in functioning assessed with the WHODAS 2.0. The results can however be updated once the entire project is completed and will include further time points up to 78 weeks after discharge from inpatient rehabilitation.

In conclusion, our study identified several factors which can be collected at admission to inpatient rehabilitation to predict functioning of patients with musculoskeletal injuries. The results highlight relevant factors which could be targeted for intervention in rehabilitation settings. Providing support groups for instance could help to limit negative influences of pain and impaired emotional functioning on patients' every-day lives. In order to strengthen the improvement of functioning, it could be beneficial to timely define and agree on a treatment targets and to ensure that the patient feels sufficiently informed about the injury and its consequences.

List Of Abbreviations

DGUV German Social Accident Insurance

ICD International Classification of Diseases

ICF International Classification of Functioning, Disability and Health

ISS Severity Score

NISS New Injury Severity Score

RTW Return to Work

WHO World Health Organization

WHODAS WHO Disability Assessment Schedule

Declarations

Ethics approval and consent to participate:

Ethic Committees of LMU Munich and the involved rehabilitation centres gave ethical approvals for the study. Participants gave written informed consent to participate in the study.

Consent for publication:

Not applicable

Availability of data and materials:

The data that support the findings of this study are available from the corresponding author, MC, upon reasonable request.

Competing interests:

The authors declare no conflict of interest.

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Authors' contributions:

JU performed the analysis and prepared the manuscript; SK facilitated the conceptualization of the project and data collection, provided input to the data analysis and reviewed the manuscript, SS was involved in the conceptualization of the project and reviewed the manuscript; MC was responsible for the conceptualization of the project and was involved in all steps of data collection and analysis and reviewed the manuscript.

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References

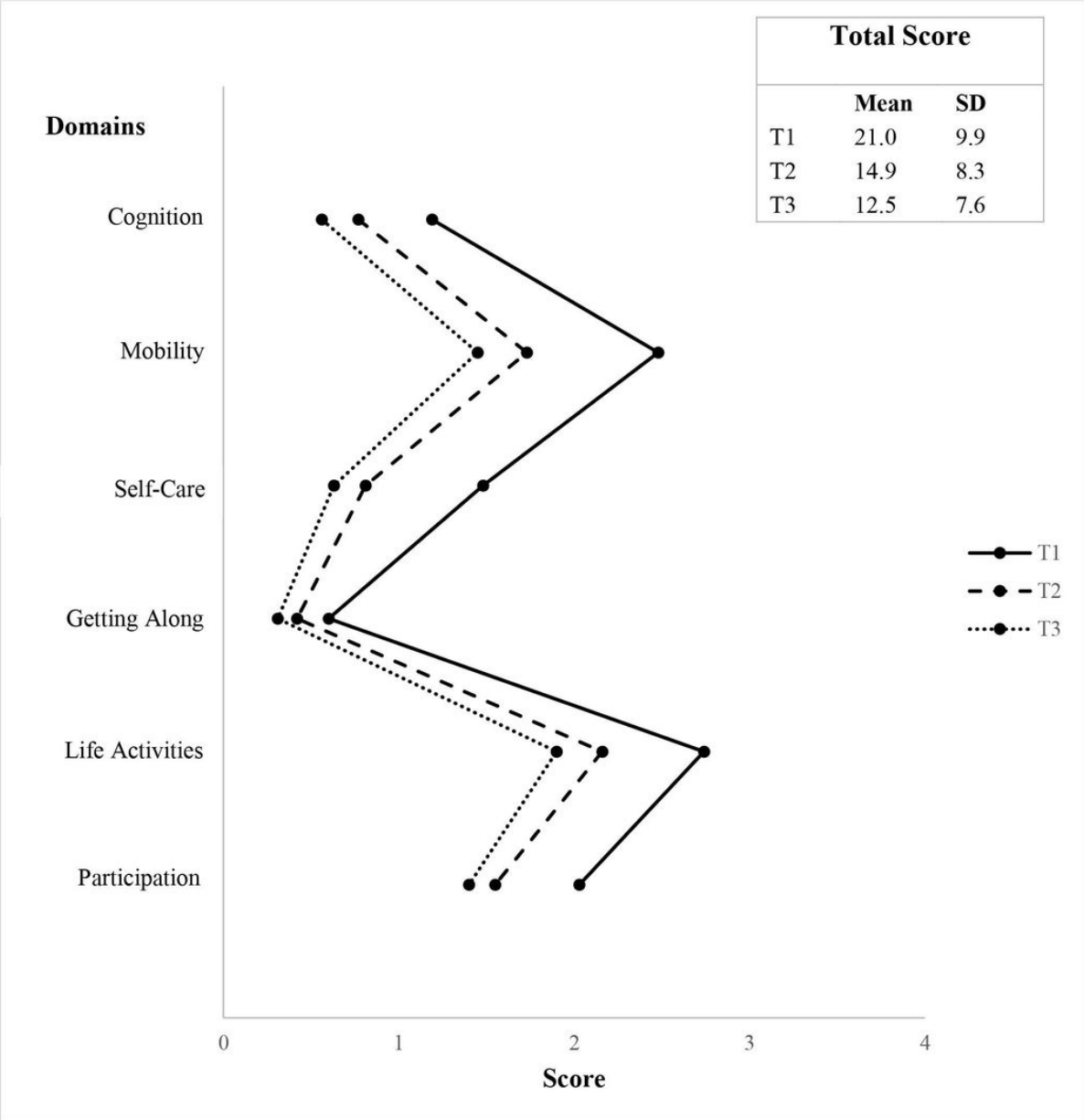
1. World Health Organization. World Report on Disability 2011 [Available from: https://www.who.int/disabilities/world_report/2011/report/en/.
2. Haagsma JA, Graetz N, Bolliger I, Naghavi M, Higashi H, Mullany EC, et al. The global burden of injury: incidence, mortality, disability-adjusted life years and time trends from the Global Burden of Disease study 2013. Inj Prev. 2016;22(1):3-18.
3. James SL, Castle CD, Dingels ZV, Fox JT, Hamilton EB, Liu Z, et al. Global injury morbidity and mortality from 1990 to 2017: results from the Global Burden of Disease Study 2017. Inj Prev Epub ahead of print [Internet]. 2020.
4. de Munter L, Polinder S, Lansink KW, Cnossen MC, Steyerberg EW, de Jongh MA. Mortality prediction models in the general trauma population: A systematic review. Injury. 2017;48(2):221-9.
5. Bouillon B, Neugebauer E. Outcome after polytrauma. Langenbecks Arch Surg. 1998;383(3-4):228-34.
6. Simmel S. [Rehabilitation after Multiple Trauma]. Die Rehabilitation. 2018;57(2):127-37. German.
7. Morsdorf P, Becker SC, Holstein JH, Burkhardt M, Pohlemann T. [Quality of life after multiple trauma]. Chirurg. 2014;85(3):208-14. German.
8. Soberg HL, Finset A, Roise O, Bautz-Holter E. The trajectory of physical and mental health from injury to 5 years after multiple trauma: A prospective, longitudinal cohort study. Arch Phys Med Rehab. 2012;93(5):765-74.
9. White C, Green RA, Ferguson S, Anderson SL, Howe C, Sun J, et al. The Influence of Social Support and Social Integration Factors on Return to Work Outcomes for Individuals with Work-Related Injuries: A Systematic Review. Journal of occupational rehabilitation. 2019;29(3):636-59.
10. Soberg HL, Roise O, Bautz-Holter E, Finset A. Returning to work after severe multiple injuries: Multidimensional functioning and the trajectory from injury to work at 5 years. J Trauma. 2011;71(2):425-34.
11. Simmel S, Buhren V. [Surviving multiple trauma--what comes next? The rehabilitation of seriously injured patients]. Unfallchirurg. 2009;112(11):965-74. German.
12. Merbitz NH, Westie K, Dammeyer JA, Butt L, Schneider J. After critical care: Challenges in the transition to inpatient rehabilitation. Rehabilitation psychology. 2016;61(2):186-200.
13. Holbrook TL, Anderson JP, Sieber WJ, Browner D, Hoyt DB. Outcome after major trauma: discharge and 6-month follow-up results from the Trauma Recovery Project. J Trauma. 1998;45(2):315-24.
14. World Health Organization. International classification of functioning, disability, and health : ICF: Version 1.0. Geneva : World Health Organization; 2001.
15. Neugebauer E, Bouillon B, Bullinger M, Wood-Dauphinee S. Quality of life after multiple trauma--summary and recommendations of the consensus conference. Restor Neurol Neurosc. 2002;20(3, 4):161-7.

16. Moock J, Kohlmann T, Zwingmann C. Patient-reported outcomes in rehabilitation research: instruments and current developments in Germany. J Public Health. 2006;14(6):333-42.
17. Lavallee DC, Chenok KE, Love RM, Petersen C, Holve E, Segal CD, et al. Incorporating Patient-Reported Outcomes Into Health Care To Engage Patients And Enhance Care. Health affairs (Project Hope). 2016;35(4):575-82.
18. Nübling R, Kaluscha R, Krischak G, Kriz D, Martin H, Müller G, et al. [Outcome Quality in Medical Rehabilitation: Relationship Between "Patient-Reported Outcomes" (PROs) and Social Security Contributions]. Rehabilitation (Stuttg). 2017;56(1):22-30. German.
19. Ustun TB, Kostanjesek N, Chatterji S, Rehm J, World Health O. Measuring health and disability : manual for WHO Disability Assessment Schedule (WHODAS 2.0) / edited by T.B. Üstün, N. Kostanjsek, S. Chatterji, J.Rehm. Geneva: World Health Organization; 2010.
20. Abedzadeh-Kalahroudi M, Razi E, Sehat M, Lari MA. Measurement of disability and its predictors among trauma patients: A follow-up study. Arch Trauma Res. 2015;4(3):e29393.
21. Derrett S, Samaranayaka A, Wilson S, Langley J, Ameratunga S, Cameron ID, et al. Prevalence and Predictors of Sub-Acute Phase Disability after Injury among Hospitalised and Non-Hospitalised Groups: A Longitudinal Cohort Study. PLoS ONE. 2012;7 (9):e44909.
22. Derrett S, Wilson S, Samaranayaka A, Langley J, Wyeth E, Ameratunga S, et al. Prevalence and predictors of disability 24-months after injury for hospitalised and non-hospitalised participants: Results from a longitudinal cohort study in New Zealand. PLoS ONE. 2013;8(11):e80194.
23. Wyeth EH, Samaranayaka A, Lambert M, Tapsell M, Anselm D, Ellison P, et al. Understanding longer-term disability outcomes for Maori and non-Maori after hospitalisation for injury: results from a longitudinal cohort study. Public Health. 2018;176:118-27.
24. Wyeth EH, Samaranayaka A, Davie G, Derrett S. Prevalence and predictors of disability for Maori 24 months after injury. Aust N Z J Public Health. 2017;41(3):262-8.
25. O'Donnell ML, Grant G, Alkemade N, Spittal M, Creamer M, Silove D, et al. Compensation seeking and disability after injury: The role of compensation-related stress and mental health. J Clin Psychiatry. 2015;76(8):e1000-e5.
26. Saltychev M, Barlund E, Laimi K. Correlation between the pain numeric rating scale and the 12-item WHO Disability Assessment Schedule 2.0 in patients with musculoskeletal pain. Int J Rehabil Res. 2018;41(1):87-91.
27. Silva AG, Alvarelhao J, Queiros A, Rocha NP. Pain intensity is associated with self-reported disability for several domains of life in a sample of patients with musculoskeletal pain aged 50 or more. Disabil Health J. 2013;6(4):369-76.
28. Spittal MJ, Grant G, O'Donnell M, McFarlane AC, Studdert DM. Development of prediction models of stress and long-term disability among claimants to injury compensation systems: A cohort study. BMJ Open. 2018;8(4):e020803.
29. Soberg HL, Bautz-Holter E, Roise O, Finset A. Long-term multidimensional functional consequences of severe multiple injuries two years after trauma: A prospective longitudinal cohort study. J Trauma. 2007;62(2):461-70.
30. Lowe B, Wahl I, Rose M, Spitzer C, Glaesmer H, Wingenfeld K, et al. A 4-item measure of depression and anxiety: validation and standardization of the Patient Health Questionnaire-4 (PHQ-4) in the general population. J Affect Disord. 2010;122(1-2):86-95.
31. Cano-Vindel A, Munoz-Navarro R, Medrano LA, Ruiz-Rodriguez P, Gonzalez-Blanch C, Gomez-Castillo MD, et al. A computerized version of the Patient Health Questionnaire-4 as an ultra-brief screening tool to detect emotional disorders in primary care. J Affect Disord. 2018;234:247-55.

32. Beierlein C, Kovaleva A, Kemper CJ, Rammstedt B, editors. Allgemeine Selbstwirksamkeit Kurzskala (ASKU). Zusammenstellung sozialwissenschaftlicher Items und Skalen (ZIS). Version 1.0: ZIS - GESIS Leibniz Institut für Sozialwissenschaften; 2014.
33. Wagnild GM, Young H. Development and Psychometric Evaluation of the Resilience Scale. J Nurs Manag. 1993;1(2):165-17847.
34. Leppert K, Koch B, Brähler E, Strauß B. Die Resilienzskala (RS) – Überprüfung der Langform RS-25 und einer Kurzform RS-13. Klin Diagnostik u Evaluation. 2008;1:226-43.
35. Bush K, Kivlahan D, McDonell M, Fihn S, Bradley K. The AUDIT Alcohol Consumption Questions (AUDIT-C): an effective brief screening test for problem drinking. Ambulatory Care Quality Improvement Project (ACQUIP). Alcohol Use Disorders Identification Test. Arch Intern Med. 1998;158(16):1789-95.
36. Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, Conde JG. Research electronic data capture (REDCap) - a metadata-driven methodology and workflow process for providing translational research informatics support. J Biomed Inform. 2009;42(2):377-81.
37. Singer JD. Using SAS PROC MIXED to fit multilevel models, hierarchical models, and individual growth models. J Educ Behav Stat. 1998;23(4):323-55.
38. Statistical Analysis System (SAS). SAS Institute Inc.
39. Deutsche Gesetzliche Unfallversicherung (DGUV) und Sozialversicherung für Landwirtschaft Forsten und Gartenbau (SVLFG). Verletzungsartenverzeichnis. 2014.
40. ICD-10-GM Version 2019, Systematisches Verzeichnis, Internationale statistische Klassifikation der Krankheiten und verwandter Gesundheitsprobleme, 10. Revision, Stand: 21.September 2018. Köln: Deutsches Institut für Medizinische Dokumentation und Information (DIMDI) im Auftrag des Bundesministeriums für Gesundheit (BMG) unter Beteiligung der Arbeitsgruppe ICD des Kuratoriums für Fragen der Klassifikation im Gesundheitswesen (KKG); 2018.
41. Davie G, Samaranayaka A, Derrett S. The role of pre-existing comorbidity on the rate of recovery following injury: A longitudinal cohort study. PLoS ONE. 2018;13(2):e0193019.
42. Baker SP, o'Neill B, Haddon Jr W, Long WB. The injury severity score: a method for describing patients with multiple injuries and evaluating emergency care. J Trauma Acute Care Surg. 1974;14(3):187-96.
43. Osler T, Baker SP, Long W. A modification of the injury severity score that both improves accuracy and simplifies scoring. J Trauma. 1997;43(6):922-5; discussion 5-6.
44. Lugo LH, Garcia HI, Cano BC, Arango-Lasprilla JC, Alcaraz OL. Multicentric study of epidemiological and clinical characteristics of persons injured in motor vehicle accidents in Medellin, Colombia, 2009-2010. Colomb Med. 2013;44(2):100-7.
45. O'Donnell ML, Holmes AC, Creamer MC, Ellen S, Judson R, McFarlane AC, et al. The role of post-traumatic stress disorder and depression in predicting disability after injury. Med J Aust. 2009;190(7 SUPPL.):S71-S4.
46. Grant GM, O'Donnell ML, Spittal MJ, Creamer M, Studdert DM. Relationship between stressfulness of claiming for injury: Compensation and long-term recovery: A prospective cohort study. JAMA Psychiatry. 2014;71(4):446-53.
47. Papadakaki M, Ferraro OE, Orsi C, Otte D, Tzamalouka G, von-der-Geest M, et al. Psychological distress and physical disability in patients sustaining severe injuries in road traffic crashes: Results from a one-year cohort study from three European countries. Injury. 2017;48(2):297-306.
48. Levack WM, Weatherall M, Hay-Smith EJ, Dean SG, McPherson K, Siegert RJ. Goal setting and strategies to enhance goal pursuit for adults with acquired disability participating in rehabilitation. The Cochrane database of systematic reviews. 2015(7):Cd009727.

49. Rose A, Rosewilliam S, Soundy A. Shared decision making within goal setting in rehabilitation settings: A systematic review. Patient education and counseling. 2017;100(1):65-75.
50. TraumaRegister DGU®. Jahresbericht 2019 für den Zeitraum bis Ende 2018: Hoefer, C. Lefering, R.; 2019 [Available from: http://www.traumaregister-dgu.de/fileadmin/user_upload/traumaregister-dgu.de/docs/Downloads/Jahresbericht_2019.pdf.
51. ALLBUS Leibniz-Institut für Sozialwissenschaften. ALLBUS Allgemeine Bevölkerungsumfrage der Sozialwissenschaften. 2018.
52. Pirente N, Bouillon B, Neugebauer E, DGU APd. [Polytrauma Outcome Chart (POLO-Chart)]. Unfallchirurg. 2002;105(5):L423-L40. German.
53. Hasselhorn H-M, Freude G. Der Work-ability-Index: Ein Leitfaden: Wirtschaftsverl. NW, Verlag für Neue Wiss. Bremerhaven; 2007.
54. Robert Koch-Institut. [Questionnaire on the study "Gesundheit in Deutschland aktuell":GEDA 2014/15-EHIS]. J Health Monit. 2017;2(1):105-35. German.

Figures



[a] WHODAS: World Health Organization Disability Assessment Schedule (12-item version): Scores per domain and change over time (19).

Figure 1

Mean WHODASa 2.0 scores at admission (T1), discharge (T2) and 3-month follow-up (T3) according to the domains.