Psychometric properties of the Dutch Short Musculoskeletal Function Assessment (SMFA) questionnaire in severely injured patients

C.C.H.M. van Delft-Schreurs MSc, Trauma Centre Brabant, St. Elisabeth Hospital

k.v.delft@elisabeth.nl

M.A.C. van Son MSc, Department of Surgery, St. Elisabeth Hospital & CoRPS, Department of Medical and Clinical Psychology, Tilburg University,

m.a.c.vanson@tilburguniversity.edu

M.A.C. de Jongh PhD, Trauma Centre Brabant, St. Elisabeth Hospital

m.d.jongh@elisabeth.nl

T. Gosens PhD, Department of Orthopaedics and Traumatology, St. Elisabeth Hospital

t.gosens@elisabeth.nl

M.H.J. Verhofstad PhD, Department of Trauma Surgery, Erasmus Medical Centre, Rotterdam

m.verhofstad@erasmusmc.nl

J. de Vries PhD, Department of Medical Psychology, St. Elisabeth Hospital & CoRPS, Department of Medical and Clinical Psychology, Tilburg University

jo.d.vries@elisabeth.nl

Corresponding author:
Ms. Katinka van Delft-Schreurs
Trauma Centre Brabant, St. Elisabeth hospital Tilburg
PO-Box 90151, 5000 LC Tilburg, The Netherlands
tel. +31 13 539 2934
e-mail: k.v.delft@elisabeth.nl

Abstract

In this cross-sectional study the psychometric properties are examined of the adapted Dutch translation of the Short Musculoskeletal Function Assessment (SMFA) questionnaire in severely injured patients (ISS>15).

Patients and Methods: Patients (N = 173) completed the SMFA, the World Health Organization Quality of Life assessment instrument-BREF (WHOQOL-BREF), the Dutch Impact of Event Scale (IES), the Hospital Anxiety and Depression Scale (HADS) and the Cognitive Failure Questionnaire (CFQ). The Abbreviated Injury Score and the Injury Severity Score were established to determine the injured body area and the severity of the injuries. Exploratory factor analysis (method: PAF) was performed. Correlations were calculated between our SMFA factors and scores on the WHOQOL-BREF, IES, HADS and CFQ. The SMFA scores of the factors Upper and Lower were compared between subgroups of patients with and without injuries in respectively the upper extremities and the lower extremities. For responsiveness analysis, data were compared with the baseline SMFA measurement of a reference group.

Results: A three-factor structure was found: Lower extremity dysfunction, Upper extremity dysfunction, and Emotion. Strong correlations between the SMFA and the other questionnaires were found. Patients with injury of the lower extremities had significantly higher scores on the factor Lower extremity dysfunction than patients without injury of the lower extremities ($p=0.017$). In none of the factors, a significant difference in mean scores was found between patients with and without injury of the upper extremities. Severely injured patients had significantly higher SMFA scores than the reference group ($p<0.001$).

Conclusion: The adapted Dutch translation of the SMFA showed good psychometric properties in severely injured patients. It appeared to be useful to get a general overview of patients' health status (HS) as well as patients' quality of life (QOL).

Keywords

SMFA, Injury, Psychometrics, Factor structure, Validity, Responsiveness

Introduction

Patients who survive a severe injury often have several types of long lasting disabilities. This often has serious social and economic consequences.[1] This is not only caused by objective functional limitations. Subjective factors seem to be involved in the recovery process as well. So it is relevant to pay also attention to the patients' experiences about their functioning. For this purpose, health status (HS) and health related quality of life (HRQOL) questionnaires have been designed. In HS studies patients are asked about their experiences concerning functioning on a physical, psychological and social domain. (HR)QOL studies, have added the factor satisfaction with this functioning to this concept.

There is a growing interest to investigate HS and HRQOL of severely injured trauma survivors, but it is difficult to examine this adequately in those patients with body region specific questionnaires, because they often have injuries in multiple body regions. Therefore, generic questionnaires, like the EuroQol Group's EQ-5D instrument (EQ-5D) and the Short-Form-36 (SF-36), are mostly used to measure HS in severely injured patients.

However, HS questionnaires like the EQ-5D and the SF-36 have been designed to examine limitations concerning functioning. No attention is paid to patients' satisfaction with functioning, although this is the core of the definition of QOL according to the World Health Organization Quality of Life Group (WHOQOL group).[2] The Short Musculoskeletal Function Assessment (SMFA), a generic questionnaire that is also frequently used to determine functional limitations, pays attention to HRQOL. It has been designed to measure the HS and HRQOL of patients with a broad range of musculoskeletal injuries and disorders and consists of two parts: a functional index and a bothersome index. The bothersome index, in which patients are asked how much they are bothered by their physical limitations, pays attention to the aspect satisfaction with functioning. Therefore, we used the SMFA as part of a larger study in which the (HR)QOL of severely injured patients was investigated.[3, 4] In the questions

of the functional index, patients are asked for their physical limitations. This index is grouped into four categories: daily activities, emotional status, function of arm and hand, and mobility.[5]

The SMFA has been translated in several languages and found to be valid in several studies. However, in the studies in which a factor analysis was performed, the properties of the translated SMFA did not meet original a priori the structure of the conventional Function and Bother index.[6-9]

In addition, the SMFA has not yet been examined in severely injured patients (ISS>15), a trauma population that often suffers from multiple injuries including brain injury. Moreover, because this concerns a specific subpopulation of trauma patients, those patients were excluded in some former SMFA validation studies.[5, 9]

Furthermore, former validation studies were focused on HS[7-9] instead of (HR)QOL.

The purpose of this study was to examine the structure and psychometric properties of the adapted Dutch translation of the SMFA questionnaire in severely injured patients.[6] We hypothesized that the Dutch translation of the SMFA was valid in our study population and that it measured HS with the Function index and HRQOL with the Bother index.

Patients and Methods

Patients

A retrospective cohort of severely injured patients (Injury Severity Score (ISS) >15), who were hospitalized in the St. Elisabeth Hospital (Tilburg, The Netherlands) between 2006 and 2009 could take part in this cross-sectional study. The patients were asked to participate if they were 18 years or older at the start of the study, still alive, had a traceable postal address and were able to answer a questionnaire set in Dutch, that was sent by postal mail in 2010. The patients were included if the questionnaires were completed and returned and written informed consent was obtained.

Measures

The AIS 1990 update 98[10] and ISS were used to determine the injured body region and severity of the injuries. The AIS classifies each injury by body region on a scale from 1 (minor) to 6 (non-survivable).[10] The ISS is the sum of the square of the AIS for the most serious injuries in three different ISS body regions and yields scores for the overall severity of the injury from 1 to 75.[11, 12]

The patients were divided into seven subgroups based on the Abbreviated Injury Scale (AIS) and ISS. The first two groups consisted of patients with an injury of the upper or the lower extremities, respectively, regardless of the severity of those injuries or concomitant injuries. Within these two groups, patients with isolated injury of the upper or lower extremities were at least considered to have an injury with a moderate severity (AIS .2) in the upper or lower extremities respectively, and no severe injuries (AIS $\leq$ .3) in other body regions. Besides, two groups consisted of patients without an injury of the upper of lower extremities, regardless of the severity of the injuries or concomitant injuries.

In addition, three groups were defined to investigate the difference in scores between patients with and without brain injury. Patients with isolated brain injury were defined as patients with at least a serious injury (AIS > .2) of the internal organs of the head. Patients with brain injury combined with other injuries had complementary injuries in other body regions. Patients without brain injury had no serious injury (AIS > .2) of the internal organs of the head.

Questionnaires

A general questionnaire consisting of questions on socio-demographics and the accident had to be completed. Demographic data (age, gender, household composition, education, being at work), characteristics of the accident (traffic, at work, at home, sports, attempted suicide), and medical data (injury, duration of hospitalization and ICU treatment) were extracted from the trauma registry.

SMFA

The SMFA, designed to assess HS and HRQOL of patients with a broad range of musculoskeletal injuries and disorders, had been translated in an earlier study and six double-barrelled items of the American English SMFA[5] had been divided into two separate questions.[6] After these adaptations, the Function index contained 39 items and the Bother index 14 items. Both indices use a five-point Likert scale with scores ranging from 1 (not at all/never/none) to 5 (unable to do/always/extremely). After summing the responses and score transformation according to the original American English SMFA[5], the indices range from 0 to 100. Higher scores indicate a lower HS and lower HRQOL. The adapted Dutch version of the SMFA has been validated in patients with a fracture in the upper or lower extremity.[6]

Quality of life

The Dutch version of the World Health Organization Quality of Life assessment instrument-BREF (WHOQOL-BREF) was used to measure quality of life (QOL).[13, 14] It consists of two questions about QOL and general health and 24 questions within the domains Physical health (7), Psychological health (6), Social relationships (3), and Environment (8). Each question has a five-point response scale. The domain scores indicate an individual's perception of their QOL in each particular domain. Higher scores indicate a higher QOL. The reliability and validity of the WHOQOL-BREF are good.[15, 16]

Psychological problems

The Hospital Anxiety and Depression Scale (HADS)[17] was used to screen for anxiety (7 questions) and depressive symptoms (7 questions). The HADS has a four-point response scale (0-3) and has been validated. The homogeneity and test-retest reliability of the total scale and the subscales are good.[18]

The Dutch version of the Impact of Events Scale (IES)[19] was used as an indicator for a post-traumatic stress disorder (PTSD). Psychometric properties have been examined and the questionnaire proved reliable and valid.[20] The IES consists of 15 items. For every statement, the respondent answers on a 4-point scale whether this was present – with 0 (not at all), 1 (rarely), 3 (sometimes), or 5 (often) - during the past seven days.

The Cognitive Failure Questionnaire (CFQ) was used to assess subjective cognitive complaints. The CFQ is a questionnaire with 25 questions about deficits in memory, absent-mindedness, or slips of action and it has a 5-point response scale.[21] The questionnaire has been translated and found to be valid.[22]

Statistical analysis

Independent sample t-tests were used for continuous variables and Chi-square tests for categorical variables to compare the group of non-respondents with the respondents.

Exploratory factor analysis (method principal axis factoring (PAF)) with oblique rotation was used to analyze the underlying factor structure of the adapted SMFA. Suitability for PAF was assessed with the Kaiser–Meyer–Olkin measure, with 0.5 being the minimum acceptable value, and with Bartlett's test of sphericity. Kaiser's criterion and Cattell's scree plot were used to extract the number of factors. An iterative process was performed in which items with factor loadings with less than 0.2 differences between the three different factors were removed during initial iterative process. During the latter steps of this process factors with a difference less than 0.1 between two factors were removed. Cronbach's alpha coefficients (α) were calculated for each newly identified factor. An alpha of at least 0.70 was considered acceptable. Floor and ceiling effects were determined and values of skewness and kurtosis were calculated to get an indication for violation of the normality assumption.

Because of violation of the normality assumption, non-parametric tests were performed to calculate the correlation coefficients (rho) between the SMFA factors, WHOQOL-BREF domains, HADS, IES and CFQ. For responsiveness analysis, data were compared with baseline SMFA values of a reference group with a non-parametric Mann-Whitney U test.

To determine responsiveness, baseline values from 351 patients who had clearly been instructed to provide their pre-injury scores in a former study[6], were used as a reference group. The mean factor values of this group were compared with the mean values of the severely injured patients.

The age and gender of the reference group and the severely injured patients were compared with an independent sample t-test and a Chi-square test, respectively. Besides, SMFA scores

of the factors Upper extremity dysfunction and Lower extremity dysfunction were compared between subgroups of patients with and without injuries in respectively the upper extremities and the lower extremities with non-parametric tests. An ANOVA was performed to determine whether a difference in the SMFA scores of new factors could be determined in subgroups of patients with isolated brain injury, patients with brain injury combined with other injuries and patients without brain injury.

The data were analyzed using IBM SPSS statistics 19 software (SPSS Chicago, IL, USA; version 19.0). The significance level was 0.05 for all of the tests used.

Results

Characteristics of the patients

Patient selection has been described extensively elsewhere.[3, 4] Briefly, 173 severely injured patients (response rate: 62%) returned the questionnaires between 1.3 and 4.4 years after the injury.

Most patients were males (69%), with a mean age of 46 (SD 19) years, and a median ISS of 21. The most common injury was intracranial injury (61%). Those patients were divided in two groups: patients with isolated brain injury (68 patients) and patients with brain injury combined with other injuries (37 patients). Serious intracranial injury (AIS>3) was present in 52% of the cases. Ten patients had isolated injury of the upper extremities and 18 patients had isolated injury of the lower extremities.

Dimensionality

Results from the Kaiser-Meyer-Olkin measure (0.903) and Bartlett's test of sphericity showed that data were appropriate for exploratory factor analysis (Table 1). The three-factor solution (R^2 = 64%) was most interpretable. Seventeen items (5, 6, 9, 10, 15, 17, 18, 22, 24, 26, 28, 32, 33, 40, 44, 45 and 46) have been removed during the iteration process. The factor analyses resulted in the following three factors 1: Lower extremity dysfunction (15 items); factor 2: Upper extremity dysfunction (11 items) and factor 3: Emotion (10 items). Table 2 presents the factor loadings. Cronbach alphas were > 0.90 for the three factors (see table 3).

Score distribution and missing data

The assumption of normality was violated for the factor Upper extremity dysfunction. Ceiling scores were present in 43% of the patients for the factor Upper extremity dysfunction. For the other components no notable floor and ceiling effects were found (see table 3).

Overall, the percentage of missing data ranged from 1.7 to 10.4%. Sixteen patients did not return the last page of the questionnaires. Apart from those missing values, questions about sexual activity, questions about activities for which use of lower extremities is required, such as kneeling down, getting up, using the legs or the back, and questions about working, sporting and doing chores around home were missing most often (6-8 times).

Validity

Correlation coefficients are shown in table 4. High correlations were found between the SMFA factors Lower extremity dysfunction and Upper extremity dysfunction with the WHOQOL-BREF Physical health domain (r = 0.70 & r = 0.58, respectively). High correlations were also found between the SMFA factor Emotion and the HADS, CFQ and all

WHOQOL-BREF domains, except for the domain Social relationship. The IES showed low correlations with the factors Upper extremity dysfunction and Lower extremity dysfunction.

When comparing patients with and without injury of the lower extremities, only significant higher scores were found in the factor Lower extremity dysfunction for patients with injury of the lower extremities. In none of the factors, a significant difference in mean scores was found between patients with and without injury of the upper extremities (see table 5).

Patients with brain injury indicated lower SMFA scores for the factors Upper extremity dysfunction and Lower extremity dysfunction, and higher SMFA scores for the factor Emotion than patients with other injuries (see figure 1). No significant difference in mean SMFA scores was found for patients with or without brain injury.

Responsiveness

Mean SMFA scores of the severely injured patients were significantly higher compared to baseline scores of the reference group for all new factors (see table 5). The reference group did not significantly differ from the group of severely injured patients with regard to age. There were significantly more males ($p<0.001$) among the severely injured patients (69%) than in the reference group (43%).

Discussion

The aim of this study was to examine the structure and psychometric properties of the adapted Dutch translation of the SMFA questionnaire[6] in severely injured patients.

A three-factor structure, with the factors Upper extremity dysfunction, Lower extremity dysfunction and Emotion, seemed to fit the data best. Furthermore, our adapted and translated Dutch SMFA was shortened with 17 items, which had no substantial factor loadings. Reininga *et al*. (2011), who excluded patients with brain injury, found a four factor structure.[9] Next to the factor Problems with daily activities, they also found the factors Upper extremity dysfunction, Lower extremity dysfunction and Mental and emotional problems. Our result is in agreement with the structure that was found in the three other studies in which the structure of a translated SMFA was determined.[6-8] They all found a three factor structure with, on the one hand, the more functioning related factors Lower extremity dysfunction and Upper extremity dysfunction and, on the other hand, a HRQOL related factor named: Daily life consequences, Lifestyle alterations or Bother. A future study should repeat the same factor analysis in another dataset with SMFA scores of severely injured patients to further validate the three factor structure.

Van Son *et al.* (2014), who validated the Dutch version of the SMFA in patients with an isolated fracture of the upper or lower extremity, found similar factors as found in the present study[6]. Because the patients in that study could not be regarded as a homogenous group, it was suggested to develop separate SMFA modules for those groups. However, especially in the factors Upper extremity dysfunction and Emotion we found the same factors and even more or less the same questions per factor in our patient population with mixed injuries. So, we assume that our structure could be suitable for patients with isolated injury of upper or lower extremities as well. However, this should be investigated further.

To investigate the clinical relevance, the SMFA-scores of the three factors were compared with scores on several other questionnaires in different groups of patients. A high correlation between the factor Emotion and the scores of the WHOQOL-BREF, HADS and CFQ verified the factor Emotion. The correlation between de factor Emotion and the IES was quite low. This may be due to the fact that the questions in the IES are referred to experiences of the accident that happened 1.3 - 4.4 years ago. The other questionnaires had a short reference time. Thus, those questionnaires are probably more related to their lives after the accident and less related to feelings about the accident itself. Therefore, the way of thinking about the accident seems not really important for the experience of their living situation after the accident. However, this should be investigated further.

High correlations between the factors Upper extremity dysfunction and Lower extremity dysfunction, and the Physical domain of the WHOQOL-BREF supported those factors. Severely injured patients seldom suffer from isolated injuries and often have brain injuries. Therefore, for this patient population no gold standard was available for comparison of the SMFA-scores with physical limitation scores of other questionnaires. Therefore, the differences in the mean SMFA scores of patients with and without injury of the upper extremities or with and without injury of the lower extremities were compared with each other for the factors Upper extremity dysfunction and Lower extremity dysfunction. Since most patients had injuries in several body regions, there were only few patients with isolated injury of the upper or lower extremities. Unless the low number of patients with isolated injuries of the lower extremities (18 patients), significant higher scores of the factor Lower extremity dysfunction in patients with injury of the lower extremities were found. This grounds the clinical relevance of the factor Lower extremity dysfunction. No significant mean scores were found between patients with and without injury of the upper extremities. This can be due to the even lower number of patients with isolated injury of the upper extremities (10 patients).

Besides, the SMFA measurement was performed quite a long time after the injury. Patients might therefore already have been completely recovered from some of their injuries. A ceiling effect was found for the factor Upper extremity dysfunction, which supports this assumption for patients with injuries of the upper extremities.

In addition, long term physical limitations could be due to brain injury in severely injured patients. Half of the patients in the study population had brain injury. Therefore, these patients were compared with patients without brain injury. Patients with brain injury indicated lower SMFA scores for the factors Upper and Lower extremity dysfunction, and higher SMFA scores for the factor Emotion than patients without brain injuries. So patients with brain injury seem to suffer less from their physical limitations and experience more emotional problems, compared to polytraumatized patients without brain injury. Those differences were not found to be significant. This might be due to the small patient groups. However, because sequelae of severe brain injury could influence the SMFA scores, the exclusion of those patients, which occurred in some former studies,[5, 9] could be considered. As this concerns a large part of the severely injured patients, it might be better to include the patients and perform separate analyses for this group.

We expected that the Bother index would be highly related with the WHOQOL-BREF. In former validation studies, the SMFA showed high correlations with questionnaires measuring HS, like the SF-36. This study was the first to compare the SMFA with a QOL questionnaire.

Because the factor analysis revealed other factors than the Function index and the Bother index, the new factors were compared with the WHOQOL-BREF. The factor Emotion showed the highest correlation with all domains of the WHOQOL-BREF. This was as expected, because half of the questions in the factor Emotion were derived from the conventional Bother index, and none of the questions was directly related to the actual

physical limitations. Although half of the questions were derived from the conventional Function index, those questions were all related to the frequency of occurrence of problems with concentration and feelings that may have to do with the actual physical limitations.

Because the correlation between the factor Emotion and the domain Social relationships was low, social relations seem to be a less important factor for patients psychological health in severely injured patients. This should be investigated further.

The factor Lower extremity dysfunction was also expected to measure QOL, because one third of the questions of this factor was revealed from the conventional Bother index. This was indeed reflected in the high correlation coefficient between the factor Lower extremity dysfunction and the domain Physical health of the WHOQOL-BREF. So, QOL is not only measured in the SMFA factor Emotion, but also taken into account in the factor Lower extremity dysfunction. The correlation between the factor Lower extremity dysfunction and the Physical domain of the WHOQOL-BREF is good, although it is, as expected, lower than for the factors Upper extremity dysfunction and Emotion. If future studies aim to also measure QOL, it may be worth considering using the SMFA instead of a HS questionnaire.

Concerning responsiveness, no baseline values of the multiple injured study population were available. Such data are very difficult to achieve prospectively, since severely injured patients frequently are sedated a long time or communication is unreliable or impossible due to the trauma itself. The patients in this study were retrospectively asked to participate and could therefore only be asked for their current SMFA scores. Baseline scores of not multiple injured patients from a former validation study[6] were used as comparison. The trauma population of severely injured patients might be slightly different from that population, but their baseline scores are presumably comparable to pre-injury scores of patients who became less severely injured with a comparable age. Unless the quite long time that had already elapsed after the

accidents and the high ceiling effect for the factor Upper extremity dysfunction, the SMFA scores of the injured patients were increased for all factors compared to the scores of this reference group. Responsiveness therefore seems to be warranted.

The adapted SMFA was found to be a valid and reliable measure in severely injured patients. Besides, the questionnaire seems to pay attention to perceived QOL as well, since high correlations were found between the three factors of the SMFA and corresponding domains of the WHOQOL-BREF. So the adapted SMFA appears to be useful to get a general overview of patients' HS as well as patients' QOL.

Limitations:

No test-retest reliability was performed in this study. However, this has been performed with the same questionnaire in a former study and was found to be good.[6]

The EQ-5D and the SF-36 have frequently been used for comparison with SMFA-scores in former validation studies.[5-9] Because our study focused on QOL, the scores of the WHOQOL-BREF domains, and some psychological questionnaires were used for comparison. The same Dutch translation of the SMFA questionnaire has been compared with the physical related RAND 36-item Health Survey (RAND-36) subscales, a questionnaire almost equal to the SF-36[23], in a former validation study in patients with an isolated upper or lower extremity fracture. The questionnaire was found to be valid in those populations.[6]

Answers of the last ten questions of the conventional Bother index were missing in 12 patients. We assume that they accidentally did not receive the page with these questions, since they did return the other pages of the questionnaires. No multiple imputations were performed, since we needed to examine the relation between the provided answers to say

something about the questionnaire itself. Thus imputing is undesirable for a validation study. Besides, these missing values are randomly spread among the study population.

Conclusion

In agreement with results of some previous validation studies in other study populations, this Dutch version of the SMFA showed that a three factor solution seems to be a better solution in severely injured patients than the conventional bifocal index and that some questions could be omitted. The adapted Dutch translation of the SMFA with the factors Upper extremity dysfunction, Lower extremity dysfunction and Emotion showed good psychometric properties in severely injured patients and the factors were highly correlated with the corresponding domains of the WHOQOL-BREF

The adapted Dutch SMFA seems to be valid and useful to get a general overview of physical limitations and emotional problems of the group of severely injured patients.

It may be relevant to analyze SMFA-scores from patients with traumatic brain injury separately from patients without brain injury. However, this should be further investigated.

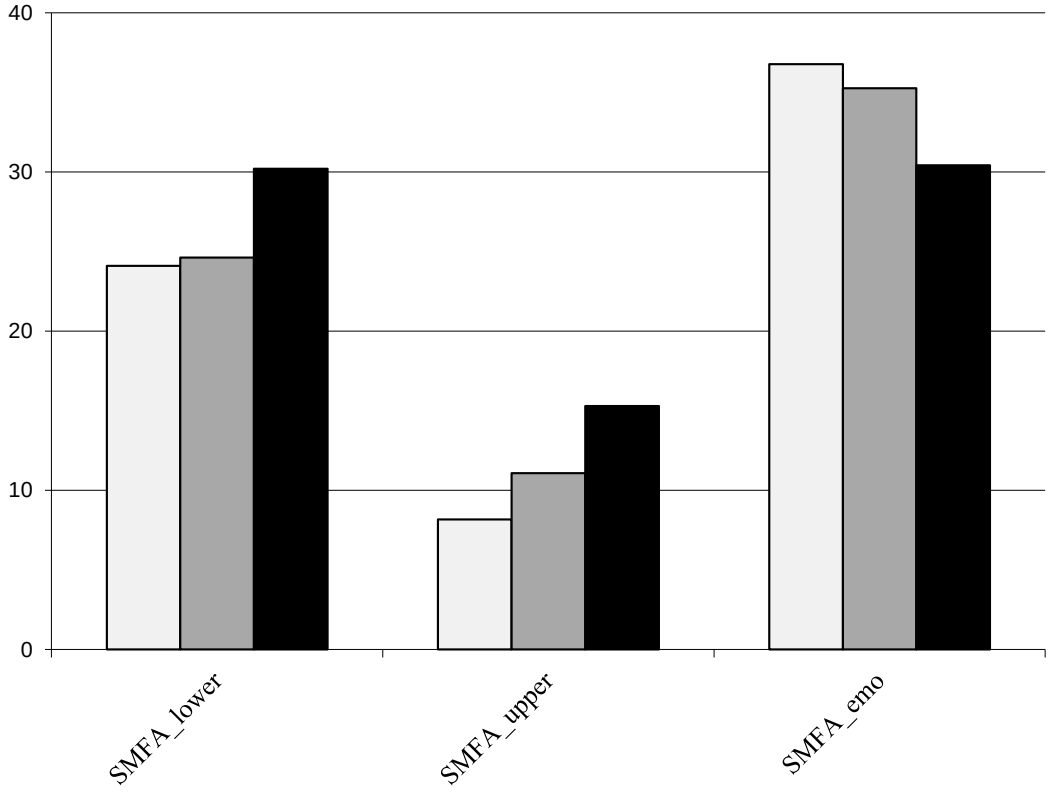

Figure 1: Comparison of the different new and conventional SMFA factors for subgroups of severely injured patients with different injuries. Higher scores indicate more problems. White: isolated brain injury (n=35), grey: brain injury combined with other injury (n=57), black: no brain injury, but with other injuries (n=53)

Table 1: Factor extraction: principal axis factoring

Indices for factor extraction	
Kaiser–Meyer–Olkin measure	0.903
Bartlett's test of sphericity	$\chi 2 = 7272.36$, $p<.0001$
Principal component analysis	Seven factors ($R^2 = 74.1$ %)
Cattell's scree plot	Three factor solution
Items removed during iterative process	17 items

Table 2: Factor loadings in a three-factor solution for severely injured patients.

	Upper extremity dysfunction	lower extremity dysfunction	Emotion
Difficulty to:…			
1 Get in or out a low chair	0.406	**0.735**	
2 Open bottles[a]	**0.695**	0.352	
3 Open jars[a]	**0.698**	0.349	
4 Shop groceries	**0.639**	0.355	0.380
7 Make a fist	**0.661**		
8 Use the bath, tub or shower	**0.733**	0.483	
11 Kneel down[a]	0.411	**0.696**	
12 Use buttons or zippers	**0.826**		
13 Cut own fingernails	**0.771**		
14 Get dressed	**0.731**	0.436	
16 Move after sitting or lying down	0.324	**0.778**	
19 Clean yourself after going to the bathroom	**0.773**	0.346	
20 Turn knobs or levers	**0.760**		
21 Write or type	**0.636**		0.310
23 Do your physical recreational activities	0.410	**0.630**	
25 Be sexual active	0.450	**0.611**	
27 Do heavy housework	0.461	**0.682**	0.325
Frequency…			
29 Walk with a limp	0.353	**0.741**	
30 Avoid using painful limb[a]		**0.750**	
31 Avoid using your back[a]		**0.663**	
34 Problems with concentration			**0.677**
35 Doing too much one day affecting what you do the next day			**0.619**
36 Acting irritated towards those around you			**0.691**
37 Being tired			**0.652**
38 Feeling disabled		**0.628**	0.430
39 Feeling angry or frustrated because of injury			**0.702**
Bothered by…			
41 Problems using legs[a]	0.345	**0.761**	
42 Problems using back		**0.729**	
43 Problems doing chores in and around home	0.423	**0.660**	0.404
47 Problems with important people in your life			**0.636**
48 Problems with thinking, concentration, or remembering			**0.689**
49 Problems coping with your injury or signs of wear		0.448	**0.678**
50 Problems doing usual work		0.443	**0.601**
51 Problems feeling dependent on others		0.375	**0.604**
52 Problems with stiffness[a]		**0.760**	0.396
53 Pain[a]		**0.642**	0.481

Substantial (>.6) factor loadings are marked bold.

Removed items with no substantial difference in factor loadings between the different factors during iterative process (items: 5, 6, 9, 10, 15, 17, 18, 22, 24, 26, 28, 32, 33, 40, 44, 45 and 46. They had a difference < 0.2 between the three factors in initial iteration process or a difference < 0.1 for two factors).

a = The original SMFA questions 2, 8, 27, 28, 35, 46 were divided into two questions.

Table 3: Descriptive statistics: mean SMFA scores (SD), skewness, kurtosis, floor and ceiling effects and internal consistency/reliability.

SMFA	Mean (SD) Skewness; kurtosis	Floor score (%)	Ceiling score (%)	Reliability (Cronbach's alpha)
Upper extremity dysfunction (n=164; 11 items)	12.1 (20.2) 2.263; 5.053	0.6	43.3	0.93
Lower extremity dysfunction (n=131; 15 items)	26.6 (24.9) 0.870; -0.271	0	9.2	0.96
Emotion (n=145; 10 items)	33.9 (20.9) 0.428; -0.518	0	2.8	0.90

Table 4: Spearman's correlation coefficients between SMFA subscales, WHOQOL-BREF domains, IES, HADS and CFQ.

	Lower extremity dysfunction		Upper extremity dysfunction		Emotion	
	r	p-value	r	p-value	r	p-value
WHOQOL-BREF						
General	-0.540	< 0.001	-0.371	< 0.001	-0.635	< 0.001
Physical health	-0.700	< 0.001	-0.576	< 0.001	-0.769	< 0.001
Psychological health	-0.514	< 0.001	-0.429	< 0.001	-0.690	< 0.001
Social relationships	-0.306	< 0.001	-0.245	0.002	-0.361	< 0.001
Environment	-0.531	< 0.001	-0.415	< 0.001	-0.614	< 0.001
IES	0.231	0.008	0.217	0.006	0.330	< 0.001
IES intrusion	0.255	0.003	0.244	0.002	0.351	< 0.001
IES avoidance	0.206	0.019	0.184	0.020	0.310	< 0.001
HADS						
HADS anxiety	0.323	< 0.001	0.265	0.001	0.600	< 0.001
HADS depression	0.559	< 0.001	0.476	< 0.001	0.704	< 0.001
CFQ	0.370	0.004	0.373	< 0.001	0.688	< 0.001

SMFA Short Musculoskeletal Function Assessment questionnaire, WHOQOL-BREF World Health Organization Quality of Life assessment instrument-Bref, IES Impact of Events Scale, HADS Hospital Anxiety and Depression Scale, CFQ Cognitive Failure Questionnaire, r Spearman's rho correlation coefficient.

Table 5: Mean SMFA scores, standard deviations and number of patients for the whole study population, different subgroups and a reference group.

	Mean SMFA (SD); n					
	Baseline score of patients before their accident*	Whole study population	Patients with injury of upper extremities	Patients without injury of upper extremities	Patients with injury of lower extremities	Patients without injury of lower extremities
Upper extremity dysfunction	7.4 (16.6); 310	12.1 (20.2); 164	12.3 (19.2); 50	12.0 (20.8); 114	12.0 (17.7); 49	12.2 (21.3); 115
Lower extremity dysfunction	15.7 (19.4); 288	26.6 (24.9); 131	30.1(25.3); 40	25.0 (24.7); 91	35.7 (27.5); 38	22.8 (22.9); 93**
Emotion	20.3 (15.9); 300	33.9 (20.9); 145	37.6 (20.9); 43	32.3 (20.8); 102	33.6 (20.4); 42	34.0 (21.3); 103

*Data from a former validation study in which patients were clearly instructed to provide pre-injury SMFA scores.[6] This group had a significantly lower mean SMFA score than the whole study population for all factors (non-parametric Mann-Whitney U-test: $p<0.001$)
**Comparing patients with and without injury of the lower extremities with a non-parametric Mann-Whitney U-test resulted only in a significant mean difference for the factor SMFA lower extremity dysfunction ($p=0.017$).

REFERENCES

1. Scholten AC, Haagsma JA, Panneman MJ, van Beeck EF, Polinder S. Traumatic brain injury in the Netherlands: incidence, costs and disability-adjusted life years. *PLoS One*. 2014;9:e110905.

2. The World Health Organization Quality of Life assessment (WHOQOL): position paper from the World Health Organization. *Soc Sci Med*. 1995;41(10):1403-1409.

3. van Delft-Schreurs CC, van Bergen JJ, de Jongh MA, van de Sande P, Verhofstad MH, De Vries J. Quality of life in severely injured patients depends on psychosocial factors rather than on severity or type of injury. *Injury*. 2013;S0020-S1383.

4. van Delft-Schreurs CC, van Bergen JJ, van de Sande P, Verhofstad MH, De Vries J, de Jongh MA. A cross-sectional study of psychological complaints and quality of life in severely injured patients. *Qual Life Res*. 2014;23(4):1353-1362.

5. Swiontkowski MF, Engelberg R, Martin DP, Agel J. Short musculoskeletal function assessment questionnaire: validity, reliability, and responsiveness. *J Bone Joint Surg Am*. 1999;81:1245-1260.

6. Van Son MA, Den Oudsten BL, Roukema JA, Gosens T, Verhofstad MH, De Vries J. Psychometric properties of the Dutch Short Musculoskeletal Function Assessment (SMFA) questionnaire in patients with a fracture of the upper or lower extremity. *Qual Life Res*. 2014;23(3):917-926.

7. Taylor MK, Pietrobon R, Menezes A et al. Cross-cultural adaptation and validation of the Brazilian Portuguese version of the short musculoskeletal function assessment questionnaire: the SMFA-BR. *J Bone Joint Surg Am*. 2005;87(4):788-794.

8. Guevara CJ, Cook C, Pietrobon R et al. Validation of a Spanish version of the Short Musculoskeletal Function Assessment Questionnaire (SMFA). *J Orthop Trauma*. 2006;20(9):623-629.

9. Reininga IH, El MM, Bulstra SK, Olthof MG, Wendt KW, Stevens M. Cross-cultural adaptation of the Dutch Short Musculoskeletal Function Assessment questionnaire (SMFA-NL): Internal consistency, validity, repeatability and responsiveness. *Injury*. 2011.

10. Association for the Advancement of Automotive Medicine (AAAM). *The Abbreviated Injury Scale 1990 Revision - Update 98.* 1998.

Ref Type: Generic

11. Baker SP, O'Neill B, Haddon W, Jr., Long WB. The injury severity score: a method for describing patients with multiple injuries and evaluating emergency care. *J Trauma*. 1974;14:187-196.

12. Baker SP, O'Neill B. The injury severity score: an update. *J Trauma*. 1976;16:882-885.

13. WHOQOL group. WHOQOL-Bref. 1996. Geneva, WHO.

Ref Type: Generic

14. Vries de J, Van Heck GL. De Nederlandse versie van de WHOQOL-Bref [The Dutch version of the WHOQOL-Bref]. 1996. Tilburg, Tilburg University.

Ref Type: Generic

15. O'Carroll RE, Smith K, Couston M, Cossar JA, Hayes PC. A comparison of the WHOQOL-100 and the WHOQOL-BREF in detecting change in quality of life following liver transplantation. *Qual Life Res*. 2000;9:121-124.

16. Trompenaars FJ, Masthoff ED, Van Heck GL, Hodiamont PP, De Vries J. Content validity, construct validity, and reliability of the WHOQOL-Bref in a population of Dutch adult psychiatric outpatients. *Qual Life Res*. 2005;14:151-160.

17. Snaith and Zigmond. Hospital Anxiety and Depression Scale (HADS) - experimentele Nederlandstalige versie ten behoeve van wetenschappelijk onderzoek. De officiële Engelstalige versie (en vertalingen) kunnen worden besteld via: nferNelson, Unit 28, Bramble Road, Techno Trading Centre, Swindon, Wiltshire, SN2 8EZ, U.K. (http://www.nfer-nelson.co.uk). 1994.

Ref Type: Generic

18. Spinhoven P, Ormel J, Sloekers PP, Kempen GI, Speckens AE, Van Hemert AM. A validation study of the Hospital Anxiety and Depression Scale (HADS) in different groups of Dutch subjects. *Psychol Med*. 1997;27:363-370.

19. Brom D, Kleber RJ. De Schokverwerkingslijst. *Nederlands tijdschrift voor psychologie*. 1985;40:164-168.

20. van der Ploeg E, Mooren TT, Kleber RJ, van der Velden PG, Brom D. Construct validation of the Dutch version of the impact of event scale. *Psychol Assess*. 2004;16:16-26.

21. Broadbent DE, Cooper PF, FitzGerald P, Parkes KR. The Cognitive Failures Questionnaire (CFQ) and its correlates. *Br J Clin Psychol*. 1982;21 (Pt 1):1-16.

22. Ponds RBMvJJ. De "Cognitive Failure Questionnaire" als maat voor subjectief cognitief functioneren. *Tijdschrift voor Neuropsychologie*. 2006;2:37-45.

23. Hays RD, Sherbourne CD, Mazel RM. The RAND 36-Item Health Survey 1.0. *Health Economics*. 1993;2(3):217-227.