

ORIGINAL REPORT

DEVELOPMENT AND VALIDATION OF IMPACT-S, AN ICF-BASED QUESTIONNAIRE TO MEASURE ACTIVITIES AND PARTICIPATION

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Objective: IMPACT-S is the screener part of the ICF Measure of Participation and ACTivities questionnaire. IMPACT-S consists of 33 items in 9 scales, reflecting the 9 activity and participation chapters of the International Classification of Functioning, Disability and Health (ICF). The reliability and validity of IMPACT-S as an independent brief measure of activities and participation was examined.

Design: Repeated administration of a postal questionnaire.

Patients: Road accident victims were recruited through several Dutch hospitals and rehabilitation centres. A total of 276 patients participated and 197 took part in both measurements.

Methods: Examination of test-retest reliability, reproducibility and construct validity. The World Health Organization Disability Assessment Schedule II (WHODAS-II) was included as criterion measure for concurrent validity.

Results: Types of main injury were fractures (38%), traumatic brain injury (37%), spinal cord injury (13%), whiplash (9%) and other (3%). Mean time after injury was 2.2 years. Internal consistency of IMPACT-S was satisfying for all 9 domains (0.75–0.89) and excellent for the total score (0.96). Test-retest reliability was good at item level (0.44–0.72), domain level (0.72–0.92) and total score (0.94). Strong correlations (0.61–0.88) between IMPACT-S and corresponding WHODAS-II scores were found.

Conclusion: IMPACT-S is a reliable and valid generic measure of activity limitations and participation restrictions that fits the ICF.

Key words: validation studies, disabled persons, questionnaires, reproducibility of results, outcome assessment.

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INTRODUCTION

The International Classification of Functioning, Disability and Health (ICF) provides the most recent and comprehensive model of functioning and disability and is especially relevant for the field of rehabilitation medicine (1–3). According to the ICF, a person's functioning and disability is conceived as

a dynamic interaction between health conditions (diseases, disorders, injuries, traumas, etc.) and contextual factors (4). "Functioning" encompasses body functions and structures and activities and participation. "Activity" is the execution of a task or action by an individual and represents the individual perspective of functioning. "Participation" refers to the involvement of an individual in a life situation and represents the social perspective of functioning. Disability is complementary to functioning and encompasses impairments in function or structure, activity limitations and participation restrictions. At the conceptual level, the ICF distinguishes between activity and participation, but in the taxonomy, the listing of categories of functioning, no such distinction is made. The Activity and Participation parts of the ICF cover all areas of daily life and have a hierarchical structure of 9 chapters, 21 subchapters, further called "domains", 118 2-digit categories and approximately 400 3- and 4-digit categories (4).

Several studies are available in which items of outcome measures have been linked to ICF categories to enlighten their contents and to facilitate comparisons between instruments (5–8). Although it was not the primary aim of these studies, they showed that none of the available measures completely and accurately reflect the ICF chapters and domains. Moreover, most scale scores and total scores are heterogeneous, consisting of items that are linked to different ICF chapters. This also applies to all measures that were based on the predecessors of the ICF. The Craig Handicap Assessment and Reporting Technique (9) and the London Handicap Scale (10) were based on the International Classification of Impairments, Disabilities and Handicaps (ICIDH) (11). The Impact on Participation and Autonomy (12) and the World Health Organization Disability Assessment Schedule (WHODAS) (13) were based on the ICIDH-2 (14). Life Habits was based on the Disability Creation Process, the Quebec proposal for the revision of the ICIDH (15). The ICF, however, is conceptually different from both ICIDH and ICIDH-2, if only by merging the previously separate classifications of disabilities/activities and handicaps/participation. Finally, so-called "ICF Core Sets" have been developed that are selections of ICF categories for several diagnoses and settings (16, 17). However, these were not designed for use as measures and have not been validated as such.

Because of this lack of a measure that accurately reflects the ICF at the start of our study (2002), IMPACT (ICF Measure of

Participation and ACTivities) was developed. It was designed as a generic measure because it should be useful to describe functioning and disability independent of health condition. It was developed as a self-report measure because it should be useful in large-scale epidemiological and outcome studies. IMPACT should be brief to be included in a battery of questionnaires, but also allow a detailed assessment of disability as regards one or more domains. For this reason, IMPACT was designed as a 2-level instrument. Level 1, the screener part, covers all ICF activity and participation chapters with a limited number of items and can also be used as an independent measure (IMPACT-S) of activity limitations and participation restrictions in one or more domains. IMPACT-S results in one scale score for each ICF chapter, summary scores for Activities, Participation and a total IMPACT-S score. Level 2 consists of a series of modules that can be administered if applicable. After briefly explaining the development of IMPACT, this paper describes the testing of IMPACT-S as Level 2 is still in the developmental phase (18, 19).

The aim of this study was to test the reliability (internal consistency and test-retest reliability) and validity (construct and concurrent validity) of IMPACT-S.

Development of IMPACT-S

At the start of the developmental process, choices had to be made about: (i) how to handle the conceptual distinction between Activity and Participation, (ii) the optimum level of detail, and (iii) which of the qualifiers proposed in the ICF to use.

Distinguishing between Activities and Participation. No less than 4 methods are described in the ICF guide to distinguish between activities and participation (4). The method chosen was to designate some domains as activities and others as participation, not allowing any overlap (20). Some chapters namely reflect primarily task execution and other chapters reflect primarily social integration (21). Some overlap is inevitable, as some categories reflect both activities and participation (21), but for reasons of simplicity we chose to classify each of the 9 chapters of the ICF, and thereby all items in these chapters, as either activities or participation. Activity chapters thus are: (1) Learning and applying knowledge; (2) General tasks and demands; (3) Communication; (4) Mobility and; (5) Self-care. Participation chapters are: (6) Domestic life; (7) Interpersonal interactions and relationships; (8) Major life areas; (9) Community, social and civic life.

Level of detail. Every measure, especially a screener, is a compromise between size and level of detail of its results. For screening and most research purposes, it is important to keep the number of items within reasonable limits. More or less arbitrarily, we decided that a measure consisting of 118 items, one item for each of the 118 2-digit categories, would be too long to be practical. On the other hand, the 9 chapters were considered too heterogeneous to be covered with one item for each chapter. The level of 21 ICF subchapters or domains was chosen as the optimum trade-off between size and level

of detail and precision. Initially, we aimed to develop one item for every domain. However, in the process of developing IMPACT-S items, several chapters and domains were considered too heterogeneous to be covered by one item. For example, the chapter "self-care" is not subdivided and covers very different categories, so that 3 items were developed to cover this chapter. In the mobility chapter, the domain "carrying, moving and handling objects" was also considered too heterogeneous and 4 items were developed to cover this domain. On the other hand, 2 domains, "education" and "work/occupation", were merged into one item because education will be applicable only to a minority of participants in most studies. IMPACT-S therefore consists of 33 items in 9 scales, each scale corresponding to an ICF chapter. Table I shows the connection between the chapters and domains of the ICF and the items of IMPACT-S.

Qualifiers. In the ICF, all categories can be scored as capacity, describing task execution in a standardized environment, or as performance, describing what an individual does in his or her current environment (4). The performance qualifier was obviously most relevant for IMPACT-S. To rate activity limitations and participation restrictions, a 5-point difficulty scale was described in the ICF, from "none" to "complete" difficulty. In this scale "none" is equivalent to 0–4% performance and "mild difficulty" is equivalent to 5–24% performance etc. (4). This use of percentages was considered unnecessarily complicated and prone to error in a self-report measure and therefore a simplified 3-level scoring was used. The ICF terminology of activity limitations and participation restrictions was used in the wording of the activity and the participation items, respectively: No limitation/restriction at all; Minor limitation/restriction (performance with use of an aid, slower, or with difficulty) and Major limitation/restriction (cannot be performed at all or cannot be performed without help from others). Two out of the 33 items, education/work and religious/spiritual life, might not be applicable to all participants. We instructed them to use the "no limitation" category if these items were not applicable to their situation.

Pilot testing by patients and experts. The first draft of IMPACT-S was administered to a small group of road accident victims with different diagnoses ($n=11$) and to a panel of rehabilitation professionals (18). The aims of this pilot study were to test whether IMPACT-S was judged as complete, relevant, acceptable and understandable by potential subjects and experts. The road accident victims were asked to complete the screener in the presence of a researcher and were afterwards interviewed orally. The professionals responded to a postal questionnaire. Overall, both patients and professionals evaluated IMPACT-S positively. It was found to be useful as a screener and to have a logical and clear structure. Patients also indicated that it covered all relevant aspects of daily life. Some patients reported that completing level 1 was confronting because it showed the many different disabilities that one may experience after trauma, but did not judge this negatively.

Table I. Structure, items and item scores of IMPACT-S at the first measurement (n = 275)

ICF chapter	ICF domains ^{1,2,3}	IMPACT-S Questions	No limitations, %	Minor limitations, %	Major limitations, %	
1. Learning and applying knowledge	1a	1. Purposeful sensory experiences	61	28	11	
	1b	2. Basic learning	63	29	7	
	1c	3. Applying knowledge	42	42	16	
2. General tasks and demands	2	4. Task execution in quiet circumstances	72	23	5	
		5. Task execution in stressful circumstances	49	34	18	
3. Communication	3a	6. Communicating, receiving	71	26	3	
	3b	7. Communicating, producing	63	34	3	
	3c	8. Use of communication devices and techniques	69	27	4	
4. Mobility	4a	9. Changing and maintaining body position	29	45	26	
		Carrying, moving and handling objects				
	4b	10. Lifting and carrying objects	37	29	34	
		11. Moving objects using lower extremities	47	31	22	
		12. Fine hand use	72	18	10	
		13. Gross movements of hand and arm	59	29	12	
		14. Walking and moving	38	36	26	
		15. Moving around using transportation	46	35	19	
		4c	16. Washing and dressing	60	32	8
		4d	17. Caring for body parts and toileting	71	22	7
		5. Self-care	5	18. Eating, drinking, maintaining good health	58	34
19. Acquisition of necessities	67			20	13	
20. Household tasks	48			32	20	
6. Domestic life	6c	Carrying for household objects and assisting others				
		21. Caring for household objects	51	28	22	
		22. Assisting others	75	18	7	
7. Interpersonal interactions and relationships	7a	23. General interpersonal interactions	71	25	4	
	7b	Particular interpersonal relationships				
		24. Formal relationships	79	18	4	
		25. Informal and family relationships	75	20	5	
		26. Intimate relationships	65	23	12	
8. Major life areas	8a + 8b	27. Education, work and employment	55	28	16	
	8c	Economic life				
		28. Basic economic transactions	83	12	5	
		29. Managing long-term financial situation	72	18	10	
		30. Community life	65	26	9	
9. Community, social and civic life	9	31. Recreational and leisure	43	37	19	
		32. Religious and spiritual life	80	14	6	
		33. Citizenship	85	10	4	

IMPACT-S: the screener part of the ICF Measure of Participation and ACTivities; ICF: International Classification of Functioning, Disability and Health.

¹The 23 domains of the ICF are numbered as 1a, 4c, etcetera to show the connection with each chapter.

²Some domains are covered by one IMPACT item. Other chapters (2, 5, 9) and domains (4b, 6c, 7b, 8c) are covered by more than one item and the table shows the concept covered by each item.

³Two deviations from the ICF domain list were made: a) The item covering domain 3c consists only of handling communication devices. The other part of this domain, starting and maintaining conversation, was omitted because this is also covered by the domains 3a and 3b (active and passive communication). b) The sub-domains 8a (education) and 8b (work and employment) were merged to avoid large numbers of missing values.

Based on the comments of patients and professionals, the instructions were clarified, sentences in several items were shortened, additional examples were given in several items and 2 pairs of items were merged: changing body posture and maintaining body posture, and grooming and toileting.

METHODS

Participants

Survivors of road accidents were selected through 10 acute care hospitals and rehabilitation centres. Inclusion criteria were: admitted to hospital or rehabilitation centre after a road accident; age between 18 and 70 years; between 6 and 36 months after road accident. Persons without any residual disability at discharge were excluded. This information was retrieved from medical files.

Procedure

Participants were invited by post to join the study. If interested, they were posted the first questionnaire including IMPACT-S and WHO-DAS. Four weeks after they returned the first questionnaire, they were posted the second questionnaire including IMPACT-S only. The study protocol was approved by the medical ethics committee of the Rehabilitation Foundation Limburg and the Institute for Rehabilitation Research (SRL/iRv).

Instruments

IMPACT-S has already been described. Participants were instructed to rate only disabilities due to the road accident. IMPACT-S scores were summarized into 9 scale scores, 2 sub-total scores for Activities and Participation, and one IMPACT-S total score. All summary scores were averaged item scores, converted into 0–100 scales. Higher IMPACT-S scores reflect better functioning (or less disability).

The 36-item version of the WHODAS II (13, 22) was used as reference measure to evaluate concurrent validity of IMPACT-S. It consists of 36 items in 6 domains: understanding and communicating; getting around; self-care; getting along with others; household and work activities; and participation in society. Subjects are asked how much difficulty they have in, for example, getting dressed, maintaining a friendship, getting all the housework done, etc. All questions are answered on a 5-point scale: none, mild, moderate, severe, extreme/cannot do. All domain scores and the total WHODAS II score are averaged item scores that are transformed into a 0–100 scale, higher scores indicating more disability. Studies to test sensitivity to change and predictive validity of the WHODAS II were conducted in 14 countries worldwide (23). The WHODAS II was validated in a group of rehabilitation patients (24) and has been used earlier in severe trauma patients (25).

Statistical analyses

Following de Vet et al. (26), we distinguished between statistics on reliability and on agreement. Reliability statistics assess whether subjects can be distinguished from each other, despite measurement error that is related to the variability between subjects. Agreement statistics assess how close results of repeated measurements are, by estimating the error in repeated measurements.

Internal consistency reliability of IMPACT-S was examined using Cronbach's alpha. For group comparisons, an alpha of at least 0.70 is "sufficient", an alpha of 0.80 or higher is "good" and an alpha of 0.90 is "excellent" (27).

Test-retest reliability of item scores was examined by computing Kappa of item scores at both measurements. A Kappa value below 0.40 indicates "poor" agreement, between 0.40 and 0.60 "fair" agreement and above 0.60 "excellent agreement" (28). Agreement between scale and domain scores were examined using intra-class correlations (ICC). ICC values should be at least 0.75 (29).

Agreement between both measurements was examined by testing differences between IMPACT-S scores at both measurements for significance with paired *t*-tests and expressing these differences in effect sizes. An effect size of 0.2 is considered small, 0.5 moderate and 0.8 large (30). The Smallest Detectable Difference (SDD) was computed as ± 1.96 SDdiff (standard deviation of the difference score), which indicates the minimum difference between scores exceeding chance (31).

Construct validity of IMPACT-S was examined by computing Spearman correlations between scale and total scores. Positive correlations between scales were expected and it was expected that activity scales would correlate more highly with other activity scales than with participation scales and vice versa. Furthermore, 2 principal components analyses (PCA) were performed, first using the 9 scales and second using the 33 items as variables. A 2-dimensional solution reflecting activities and participation would confirm the proposed distinction in activity and participation scales. Oblimin rotation was used because some association between activities and participation was expected.

Concurrent validity was tested by computing Spearman correlations between IMPACT-S and WHODAS-II scales. Scales measuring similar concepts should show correlations above 0.60 and should be more strongly correlated with each other than scales measuring different concepts (32).

RESULTS

Participants

A total of 834 participants were invited to join the study, 275 took part in the first measurement (response 33%) and data for both measurements were complete for 197 participants, a drop-out of 28.4% between the first and second measurement. The mean age was 40.4 (SD 15.8) years, 65.9% were male and 58.8% were employed or in full-time education. The main

Table II. Score distributions of IMPACT at both measurements at start of the study (T1) and after 4 weeks (T2)*

	T1 Mean (SD) (n=275)	T2 Mean (SD) (n=197)
Knowledge	71.8 (27.6)	74.5 (28.1)
General tasks	74.6 (30.0)	75.3 (28.8)
Communication	82.1 (22.8)	82.9 (25.3)
Mobility	62.7 (29.3)	62.5 (30.1)
Self-care	77.8 (26.7)	78.3 (26.2)
Domestic life	70.3 (31.2)	69.3 (30.6)
Interpersonal	82.0 (23.4)	84.3 (22.2)
Major life areas	78.7 (27.4)	79.7 (27.3)
Community life	76.5 (24.5)	79.0 (23.4)
Activities	71.3 (22.3)	71.9 (23.0)
Participation	76.7 (22.8)	78.0 (22.5)
IMPACT total	74.0 (22.6)	75.4 (21.9)

*All scores are on a 0–100 scale

IMPACT: ICF Measure of Participation and ACTivities questionnaire; SD: standard deviation.

types of injury were fractures (37.7%), traumatic brain injury (37.0%), spinal cord injury (12.8%), whiplash (9.3%) and other (2.7%). Some of the respondents (13.0%) had additional injuries. Most respondents (88.6%) had been admitted to an acute care hospital for a mean period of 4.6 (SD 4.0) days and 61.0% had been treated in a rehabilitation facility. Mean time after injury was 2.2 years (SD 0.9).

IMPACT-S scores

At the first measurement, the percentage of participants scoring "no limitation/restriction" on individual items varied between 29% and 83%, the percentage scoring "some limitations/restrictions" varied between 13% and 45%, and the percentage scoring "serious limitations/restrictions" varied between 3% and 34%. The distribution of responses are displayed in Table I. The number of missing values per item varied between 1 for most activity items and 11 (4%) for the education and employment item.

IMPACT-S summary scores at both measurements are displayed in Table II.

All mean scores were in the upper half of the 0–100 scale, indicating favourable levels of functioning. Most limitations were seen for Mobility and Communication. Interpersonal relationships appeared least affected.

Reliability

Internal consistency reliability figures were sufficient or good for all scale scores and were excellent for the Activities, Participation and IMPACT-S total scores (Table III). Test-retest reliability figures are also shown in Table III. All Kappa values for agreement between item-scores were above the desired threshold. Intra-class correlations were good for all scales, except for the General tasks scale, which figure of 0.72 was slightly below the desired 0.75. Test-retest reliability figures of the Activities, Participation and IMPACT-S total scores were excellent.

Table III. Internal consistency and test-retest reliability of IMPACT-S

	Cronbach's alpha T1/T2 (n=275/ n=197)	Mean Kappa (range) (n=197)	ICC T1 and T2 (95% BI) (n=197)
Knowledge	0.74/0.80	0.63 (0.61–0.65)	0.87 (0.83–0.90)
General tasks	0.77/0.75	0.48 (0.45–0.52)	0.72 (0.65–0.78)
Communication	0.78/0.85	0.52 (0.44–0.61)	0.75 (0.68–0.80)
Mobility	0.89/0.91	0.66 (0.57–0.72)	0.92 (0.90–0.94)
Self-care	0.81/0.85	0.56 (0.47–0.63)	0.81 (0.76–0.85)
Domestic life	0.87/0.89	0.59 (0.57–0.62)	0.86 (0.82–0.89)
Interpersonal	0.79/0.80	0.58 (0.54–0.67)	0.86 (0.81–0.89)
Major life areas	0.75/0.80	0.58 (0.54–0.62)	0.81 (0.76–0.86)
Community life	0.76/0.79	0.47 (0.44–0.54)	0.78 (0.72–0.83)
Activities	0.92/0.93	0.59 (0.44–0.72)	0.93 (0.91–0.95)
Participation	0.92/0.93	0.56 (0.44–0.67)	0.90 (0.87–0.92)
IMPACT-S total	0.96/0.96	0.58 (0.44–0.72)	0.94 (0.92–0.95)

IMPACT-S: the screener part of the ICF Measure of Participation and ACTivities; Mean Kappa: mean of Kappa values of all items within the domain; ICC: intra-class correlations; BI: between item-score; T1: measurement at start of the study; T2: after 4-weeks.

Agreement

Differences between IMPACT-S scores at both measurements are displayed in Table IV. Mean differences were very small. The SD of the difference scores, however, were relatively large. As a result, the SDD figures showed that large score differences are needed to exceed chance. The Activities score of IMPACT-S, the Participation score of IMPACT-S and the IMPACT-S total score showed smaller SDDs and thereby better agreement than the 9 scale scores.

Construct validity

The correlations between all 9 scales were moderate to strong (0.34–0.75) and all were strongly related to both the Activities and Participation scores (Table V). The correlations between activity scales (mean 0.51) and between participation scales (mean 0.58) were in the same range as correlations between activity and participation scales (mean 0.54). Instead, a weak clustering between the Knowledge, General tasks, Commu-

Table IV. Agreement between IMPACT-S scores on both measurements (n = 197)

	Difference T1–T2 (SD)	Effect size	SDD
Knowledge	-2.3 (14.4)*	-0.08	28.2
General tasks	-0.5 (22.2)	-0.02	43.5
Communication	-1.6 (17.5)	-0.07	34.3
Mobility	-1.6 (11.8)	-0.05	23.1
Self-care	-2.3 (16.6)	-0.09	32.5
Domestic life	-0.2 (16.5)	-0.01	32.3
Interpersonal	-1.6 (12.1)	-0.07	23.7
Major life areas	0.8 (16.8)	-0.03	32.9
Community life	-2.4 (15.6)*	-0.10	30.6
Activities	-1.8 (8.4)*	-0.08	16.5
Participation	-1.0 (10.2)	-0.04	20.0
IMPACT-S total	-1.4 (7.7)*	-0.06	15.4

*p<0.05.

Effect size=(T1–T2)/((SDT1+SDT2)/2).

SDD = 1.96*SDdiff (=SD of the difference score).

T1: measurement at start of the study; T2: after 4-weeks; IMPACT-S: the screener part of the ICF Measure of Participation and ACTivities.

nication and Relationships scales and between the Mobility, Self-care, Domestic life and Community life scores can be inferred from Table V. The correlation between the Activities and Participation scores (0.86) was very strong.

The principal components analysis of the 9 scale scores resulted in 2 components with an eigenvalue above 1.0. A strong first component had an eigenvalue of 5.6 and explained 63.0% of the variance. A weak second component had an eigenvalue of 1.1 and explained 12.9% of the variance. Communalities were between 0.74 and 0.86, also indicating substantial common variance. After Oblimin rotation, the 2 components did not reflect the activities – participation distinction. One component included Knowledge, General tasks, Communication, Relationships and Major life areas and the other factor included Mobility, Self-care, Domestic life and Community life. A second principal components analysis using all 33 items as variables revealed a 4-factor solution, again with a strong first factor and weak other factors and again not reflecting the activities-participation distinction. A subsequent forced

Table V. Spearman correlations between IMPACT-S domains, sub-total and total scores (n = 275)

	1	2	3	4	5	6	7	8	9	10	11
1. Knowledge	–										
2. General tasks	0.68	–									
3. Communication	0.66	0.68	–								
4. Mobility	0.34	0.44	0.38	–							
5. Self-care	0.35	0.47	0.39	0.75	–						
6. Domestic life	0.44	0.52	0.46	0.78	0.73	–					
7. Relationships	0.58	0.66	0.63	0.50	0.52	0.59	–				
8. Major life areas	0.55	0.60	0.50	0.37	0.42	0.49	0.63	–			
9. Community life	0.39	0.49	0.42	0.68	0.56	0.73	0.57	0.47	–		
10. Activities total	0.65	0.72	0.65	0.89	0.80	0.82	0.69	0.56	0.70	–	
11. Participation total	0.57	0.67	0.57	0.74	0.69	0.89	0.80	0.72	0.84	0.86	–
IMPACT-S total	0.64	0.72	0.63	0.86	0.78	0.87	0.76	0.65	0.78	0.97	0.95

All correlations are significant (p<0.001).

IMPACT-S: the screener part of the Impact on Participation and ACTivities questionnaire.

Table VI. Spearman correlations between IMPACT-S and WHODAS-II ($n = 275$)

WHODAS II IMPACT-S	Understanding/ communicating	Getting around	Self-care	Getting along	Life activities	Participation in society	WHODAS total
Knowledge	0.71	0.22	0.34	0.49	0.52	0.55	0.58
General tasks	0.64	0.38	0.43	0.55	0.64	0.62	0.68
Communication	0.64	0.27	0.36	0.51	0.51	0.54	0.58
Mobility	0.31	0.78	0.56	0.50	0.66	0.67	0.72
Self-care	0.32	0.65	0.65	0.50	0.61	0.63	0.67
Domestic life	0.36	0.65	0.59	0.49	0.71	0.67	0.72
Relationships	0.60	0.42	0.48	0.70	0.65	0.68	0.72
Major life areas	0.53	0.36	0.42	0.60	0.61	0.63	0.65
Community life	0.38	0.60	0.47	0.51	0.68	0.69	0.70
Activities total	0.57	0.70	0.62	0.63	0.78	0.79	0.85
Participation total	0.55	0.63	0.59	0.66	0.81	0.81	0.86
IMPACT-S total	0.59	0.70	0.63	0.68	0.82	0.82	0.88

All correlations were negative but the minus-signs were omitted.

All correlations are significant ($p < 0.001$). Expected strong correlations shown in bold.

IMPACT-S: the screener part of the ICF Measure of Participation and ACTivities; WHODAS-II: World Health Organization Disability Assessment Schedule II.

2-factor solution was similar to the 2-factor solution of the scale scores.

Concurrent validity

Correlations between IMPACT-S and WHODAS II scores are displayed in Table VI. Correlations between corresponding scales were all strong (0.64–0.78; bold in Table VI) and stronger than correlations between non-corresponding scales. These results indicate excellent concurrent validity.

DISCUSSION

IMPACT-S was developed as a new self-report measure of functioning and disability that corresponds to the ICF, a classification that has gained worldwide acceptance. This study showed good reliability and validity of IMPACT-S in persons with various disabilities due to road accidents.

Distinction between Activities and Participation

In the development process of IMPACT-S we distinguished between Activities and Participation domains (5, 20). However, a very strong correlation of 0.86 between both components was found. The total IMPACT-S score showed excellent internal consistency and strong correlations with all scale scores. We therefore conclude that the Activity and Participation scores were not supported by the results of this study and that it is preferred to use the total IMPACT-S score in addition to the 9 scale scores. These results deviate from those of Jette et al. (20) who used exploratory factor analyses with orthogonal rotation on 48 physical functioning items out of one questionnaire ($n = 150$) to find 2 activity scales and one participation scale. However, even though orthogonal rotation should result in independent factors, the 2 resulting activity scales were both strongly associated with the participation scale (0.69 and 0.74) (20). The ICF is a theoretical and not an empirical classification, and therefore not all distinctions made might be found in empirical studies. Moreover, it is not possible to group the 9

ICF chapters in activity and participation without any overlap (21), which might also explain the strong correlations found in this study. It appears that, at least in this study group, our proposed differentiation between activities and participation is refuted and the relationship between both concepts remains a topic of investigation (20).

Application of IMPACT-S

IMPACT-S is designed as a generic measure that can be used regardless of the health condition of the person involved. With IMPACT-S, data can be collected on long-term activity limitations and participation restrictions. It is hoped that this will lead to better insight in the personal and social consequences of various health conditions. In care settings, IMPACT-S can lead to information on healthcare needs and evaluation of outcomes of healthcare.

Comparison of IMPACT-S with other measures

The main reason for developing IMPACT-S was the lack of a measure that accurately reflects the ICF classification at the start of the study. Older handicap or participation measures (9–15) were not based on the ICF and only partly reflect the structure of the ICF, as explained in the introduction section. Correlations with corresponding WHODAS-II scales were between 0.65 and 0.78, showing concurrent validity, but also showing that both measures are not identical. In the course of our study, a few interesting ICF-based participation measures were published that were carefully developed and showed good psychometric properties (33–36). Farin et al. (33) developed a questionnaire called MOSES that is based on the ICF chapters mobility, self-care and domestic life. All 3-digit ICF categories from these 3 chapters were represented by a total of 95 items. After Rasch analyses on data from a large patient group, 58 items were retained in 12 uni-dimensional scales. Each scale has a global entry question and if the subjects indicated a problem, he was asked between 3 and 7 subsequent questions. The 12 scales are not combined into chapter scores or a total

score. MOSES covers only 3 of the 9 ICF chapters and its 12 different scores make it less practical for research purposes. The Participation Scale (34) is a generic participation measure. The scale was developed using an exhaustive process in which an item pool of 166 items from observations and interviews was ultimately reduced to 18 items. For each item, restriction severity and problem perception are asked. The instrument reveals one total score reflecting participation restriction. The Participation Scale is a promising brief measure, but it fails the possibility of providing a profile according to the ICF chapters. Two other questionnaires, the Activity Measure for Post-Acute Care (AM-PAC) and the Participation Measure for Post-Acute Care (PM-PAC) were designed to measure activity and participation outcomes of rehabilitation services provided in outpatient or home-care settings (35, 36). AM-PAC is a series of 6 10-item short-forms measuring functioning on 3 domains: physical & movement, personal care & instrumental, and applied cognition, each in 2 situations, inpatient and community (36). AM-PAC loosely corresponds to chapters 1–6 of the ICF. PM-PAC was also developed from a large database of existing and newly written items and consists of 51 items in 9 scales, covering chapters 3, 4 and 6–9 of the ICF (35). ICF chapters 1 and 2 were considered covering only activities and were thereby not included in PM-PAC. Chapter 5, self-care, is not covered because one item in the domestic life domain refers to self-care, namely the item “providing personal care to yourself and others” (35). A combination of AM-PAC and PM-PAC could cover all Activity and Participation chapters of the ICF but as they are now, there is considerable overlap between both measures.

To ensure a close connection to the ICF, IMPACT-S was developed from the ICF instead of from a large item pool, followed by item reduction guided by statistical analyses. The developers of MOSES combined both approaches, whereas PM-PAC and the Participation Scale were developed from large item pools of items from various existing measures and newly written items. MOSES and IMPACT-S thereby are more closely related to the ICF than both other measures. However, because MOSES only covers 3 out of 9 ICF chapters, IMPACT-S provides the best representation of the ICF so far.

Limitations of this study

One limitation of this study was the large non-response, which might have biased the results. Participation in this study implied repeated responding to the same questionnaire, what might have lowered the response. Level of disability in this study group was however only slightly below the figures found in another study of severe trauma patients using the WHODAS- II (25). Secondly, the validity of IMPACT-S is now only demonstrated in a group with various physical disabilities due to road accidents. Studies in other patient groups are recommended to establish the validity of IMPACT-S for use in other diagnostic groups. Thirdly, IMPACT was developed and validated in The Netherlands. An English-language version is available and its close connection to the ICF facilitates the use of other language versions as the ICF is available in many languages. Studies to

examine the usefulness of IMPACT-S in clinical practice are ongoing. Finally, the sample size of this study did not allow for modern scale analyses, based on item response theory. Such analyses will be performed in future studies.

CONCLUSION

In conclusion, IMPACT-S proved a reliable and valid measure of activity limitations and participation restrictions. IMPACT-S appears to be a useful addition to other instruments derived from the ICF, such as the ICF Checklist and the various ICF Core Sets (1, 16, 17). It is the only measure available that accurately reflects the ICF chapters and it appears to be a promising outcome measure in rehabilitation research.

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Information about IMPACT[®] is available at TNO Quality of Life: GertJan.Wijlhuizen@tno.nl

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