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Reliability and Validity of a Self-Report FIM™ (FIM-SR) in Persons with Amputation or Spinal Cord Injury and Chronic Pain

ABSTRACT

Masedo AI, Hanley M, Jensen MP, Ehde D, Cardenas DD: Reliability and validity of a self-report FIM™ (FIM-SR) in persons with amputation or spinal cord injury and chronic pain. Am J Phys Med Rehabil 2005;84:167–176.

Objective: To evaluate the reliability and validity of a self-report FIM™ (FIM-SR) in two samples of adults with disabilities.

Design: Participants in a clinical trial of amitriptyline for pain ($n = 84$ with spinal cord injury [SCI], $n = 38$ with amputation) provided responses to the study measures via telephone interview. Reliability was estimated using Cronbach's alpha and test–retest correlation coefficients, and validity was examined by comparing FIM-SR scores with the Craig Handicap Assessment and Reporting Technique (CHART) by comparing the CHART scores between the participants with SCI and amputation, and by comparing CHART scores between subjects with different levels of SCI.

Results: In the SCI sample, the FIM-SR demonstrated adequate reliability, and correlational analyses supported the validity of the FIM-SR motor scales. In addition, the FIM-SR motor scales discriminated subjects with different diagnoses (SCI *vs.* amputation) and injury levels (paraplegia *vs.* tetraplegia). The psychometric properties of the entire FIM-SR in the amputation sample and of the FIM-SR cognitive scales in the SCI sample were difficult to determine due to a ceiling effect in which these scale scores were skewed toward the top end of the range.

Conclusions: The FIM-SR motor scales and total FIM-SR score are reliable and valid measures of perceived functional independence in individuals with SCI. However, all of the FIM-SR scales in the amputation sample, and the FIM-SR cognitive scales in the SCI sample, seem to be less useful measures of functioning due to subjects reporting high levels of independence. The FIM-SR should be retested in amputation samples with more variable levels of functioning.

Key Words: FIM™ ™instrument, Reliability, Validity, Amputation, Spinal Cord Injury

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Standardized scales that measure functional limitations are useful for determining the rehabilitation needs of persons with disabilities. The FIM™ Instrument[1] was developed to evaluate rehabilitation progress and has been used successfully with numerous clinical populations, such as persons with stroke,[2–4] AIDS,[5] SCI,[5–7] hip fracture,[8] multiple sclerosis,[9] traumatic brain injury,[10,11] dementia,[12] and cancer.[13]

The original FIM instrument is completed by trained clinicians,[1] but a self-report version (FIM-SR) has the advantage of reducing the clinician time and effort required for administration. In addition, it is possible that patient perspectives on independence may differ from those of clinicians, and patient perceptions of their own level of independence may play an important role in efforts toward rehabilitation. A self-report version of the FIM instrument may therefore provide an important additional tool for assessing patient independence.[14]

One self-report version of the FIM motor scales (i.e., excluding the scales that assess independence in communication and social cognition), developed by Hoenig et al.,[15–17] has been used successfully in several samples of persons with disabilities, such as persons with SCI[16] and multiple sclerosis.[17] Another self-report version of the FIM instrument, which also includes the cognitive FIM items (called the FIM-SR), was developed by Grey and Kennedy.[14] Preliminary evidence has supported the reliability and validity of this self-report version of the FIM instrument in several disability groups, such as individuals with SCI[14] and neuromuscular disease.[18]

Despite promising preliminary research on the psychometric properties of self-report versions of the FIM instrument, many unanswered questions remain concerning the relative strengths and weaknesses of the FIM-SR. Although the FIM-SR may be easier to use than the clinician-scored FIM instrument in studies with limited resources, the FIM-SR may not be appropriate for all disability groups. More research is needed to establish the psychometric properties of the FIM-SR in disabled populations.

The current study sought to examine further the psychometric properties of the version of the FIM-SR by Grey and Kennedy[14] in a sample of individuals with SCI and a sample of individuals with acquired amputations and phantom limb pain using data from two clinical trials of amitriptyline for chronic pain.[19,20] We assessed reliability by using measures of both internal consistency and test–retest stability, and validity by (1) examining the associations between the FIM-SR and another measure of physical functioning, (2) examining the ability of the FIM-SR to discriminate between the two diagnoses (SCI and amputation), and (3) in the SCI sample, between levels of injury (tetraplegia *vs.* paraplegia).

Our hypotheses were as follows: (1) the FIM-SR would be a reliable measure in both samples; (2) validity would be supported by significant associations between the FIM-SR motor scales and another self-report measure of physical functioning; (3) the FIM-SR motor scales, but not the cognitive scales, would discriminate between the diagnostic groups (SCI and amputation); and (4) in the SCI sample, the FIM-SR motor scales, but not the cognitive scales, would discriminate between levels of injury (paraplegia and tetraplegia).

Objectives: On completion of this article, the reader should be able to (1) identify the characteristics of individuals and patient populations that can limit the utility of self-report measures for those individuals or populations, (2) list important psychometric strengths and weaknesses of a self-report version of the FIM™ instrument (FIM-SR) in two samples of persons with disabilities, and (3) articulate possible reasons for relatively low reliability and validity coefficients for some of the FIM-SR subscales.

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MATERIALS AND METHODS

Subjects

In the clinical trials, community residents with either SCI or amputation were approached through notices in newsletters and area clinics serving individuals with SCI or amputation and through mailing lists of patients treated for amputation at Harborview Medical Center (a regional trauma center) and patients treated for SCI at the University of Washington's Northwest Regional SCI System, a comprehensive, interdisciplinary service delivery model system funded in part by the National Institute on Disability and Rehabilitation Research, Department of Education.[19,20] Potential

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participants were asked to contact the investigators if they were interested in learning more about the study.

Eligibility criteria were essentially the same for both studies. Potential participants were included if they had: (1) either an amputation or SCI >6 mos before enrollment; (2) pain for ≥ 3 mos; and (3) average pain rating in the last month of ≥ 2 (for amputation) or ≥ 3 (for SCI) on a 0–10 scale. In both studies, individuals were excluded if they were <18 or >65 yrs of age, had a history of cardiovascular disease or abnormalities in a screening electrocardiogram, had seizures, were pregnant, were receiving any type of antidepressant medication, or were consuming more than two alcoholic drinks per day. The Institutional Review Board of Good Samaritan Hospital approved the SCI study, and the University of Washington Human Subjects Review Committee approved both studies. A total of 38 amputation subjects (18% of those eligible) and 84 SCI subjects (54% of those eligible) enrolled in the studies.

A more detailed description of the participants in each of these two randomized, double-blind studies can be found in their primary reports.[19,20] Briefly, in the amputation trial, there were 39 subjects who received one of the two medications (active placebo benztropine mesylate, $n = 19$; amitriptyline, $n = 19$); one of these subjects dropped out of the study completely, and four subjects started but did not complete the medication trial (three due to side effects and one due to beginning another antidepressant) but completed posttreatment measures and were included in the current study. Of the remaining 38 participants, the mean age was 44.58 yrs (SD = 11.38 yrs), and 91% were men. Mean time since amputation was 10.99 yrs (SD = 10.19 yrs), ranging from 6 mos to 33 yrs. Injury was the most frequent cause of amputation (73.7%), followed by infection (18.4%), gangrene (13.2%), vascular disease (13.2%), tumor (5.3%), and diabetes (5.3%); "other" was endorsed by 13.2%. Level of amputation was as follows: 2.6% hand, 7.9% above elbow, 7.9% hip, 31.6% transfemoral, 2.6% knee, 36.8% transtibial, 2.6% ankle, 2.6% foot, and 5.3% toes. One participant had both a left transtibial amputation and a right toe amputation; another had both right and left toe amputations. Average pretreatment phantom limb pain was 3.66 (SD = 2.32) on the 0–10 numeric rating scale.

In the SCI trial, there were 84 subjects who received either amitriptyline ($n = 44$) or an active placebo (benztropine mesylate, $n = 40$); one subject did not complete the medication trial due to side effects but provided posttreatment data and was included in the current study. The mean age was 41.43 yrs (SD = 10.02 yrs), and 80% were men. Mean time since injury was 13.96 yrs (SD = 9.36 yrs), ranging from 8 mos to 43 yrs. Neurologic level of injury was cervical for 53.6% of subjects, followed by thoracic for 38.1% and lumbar/sacral for 7.1%. Neuropathic (SCI) pain and mechanical spine pain were the most common primary pain problems; overuse pain and neuropathic pain were the most common secondary pain problems. Average pretreatment pain was 5.27 (SD = 1.79) on the 0–10 numeric rating scale.

Measures

FIM-SR

Pretreatment and posttreatment interviews included a self-report version of the FIM instrument[14] that contains 18 items summed to create the following six scales: self-care (e.g., feeding, grooming, and dressing), sphincter control (e.g., bladder and bowel management), mobility (e.g., transferring in and out or on and off of a bed, toilet, or tub), locomotion (e.g., walking, wheelchair use, use of stairs), communication (e.g., comprehension, expression), and social cognition (e.g., social interactions, problem solving, memory). Overall motor, cognition, and total summary scores were also be calculated. On each item, participants rated their level of independence on a variety of daily activities on a 1–7 scale, on which 1 = "total assistance is needed (i.e., do about 0% yourself)" and 7 = "you are completely independent." Participants were allowed to indicate if the item was not applicable to them. Scale scores are created by summing the responses to each item in that particular area of functioning so that possible scores range from the number of items in the scale to seven times the number of items (i.e., the total FIM-SR score ranges from 18 to 126).

Craig Handicap Assessment and Reporting Technique (CHART)

The CHART is a measure that assesses the extent to which respondents fulfill the roles typically expected of able-bodied persons.[21] The CHART asks respondents to quantify their activities and daily lives in various ways. For this study, we chose to examine the two scales of the CHART related to physical functioning, which are quantified as follows: physical independence (hours per day that care is required) and mobility (hours per day out of bed and days per week out of the house). The physical independence scale measures an individual's ability to sustain a customary effective independent existence. The mobility scale assesses an individual's ability to move about effectively in his or her surroundings. The other three scales of the CHART (occupation, social integration, and

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economic self-sufficiency) were not included in the current study because they do not relate as directly to the functional abilities assessed by the FIM-SR but, rather, pertain more to social and occupational roles. The CHART total score was included as an overall measure of participants' level of handicap. Each scale score is calculated using a weighting process so that most able-bodied persons would receive the maximal attainable score of 100 points, and lower scores indicate a greater degree of handicap. The CHART has demonstrated excellent test–retest reliability (ranging from 0.80 to 0.95 for subscale, and 0.93 for overall, CHART scores over a 1-wk period).[21] Validity has been demonstrated by the generally high correspondence between self-reported ratings and ratings of the person by proxies (family members or friends) and by the ability of the CHART to discriminate among groups of persons rated by rehabilitation professionals as having either high or low levels of handicap.[21]

Procedures

We analyzed data from two completed trials of amitriptyline for the treatment of chronic pain in persons with disabilities (either SCI[19] or amputation[20]). Procedures were essentially the same for both trials. Demographic information and baseline study measures, including the FIM-SR and the CHART, were completed via telephone interviews before randomization. Subjects in both trials were then randomly assigned to receive either amitriptyline or an active placebo (benztropine mesylate) that could produce dry mouth, a common side effect of amitriptyline; participants were asked to take study medications daily for 6 wks. The FIM-SR and the CHART were again given via telephone interviews at posttreatment. Research staff blind to subject treatment assignment conducted all telephone interviews. The amitriptyline trials were not found to be efficacious for pain or pain-related disability, and no differences in FIM-SR or CHART scores were found between treatment and placebo groups.[19,20] Therefore, the treatment and placebo groups could be combined in our analyses, and we could be reasonably sure that any changes in FIM-SR and CHART scores from pretreatment to posttreatment were not due to treatment effects.

Data Analysis

To assess reliability, we examined internal consistency (Cronbach's alpha) coefficients at both pretreatment and posttreatment, and test–retest coefficients (correlations of pretreatment and posttreatment scale scores), for all scales in both samples. Convergent construct validity was evaluated by examining the associations of the FIM-SR motor scales and a measure of handicap, the CHART.[21] To further assess validity, we examined the ability of the FIM-SR at pretreatment to discriminate between diagnostic groups and, in the SCI sample, the ability of the FIM-SR at pretreatment to discriminate between levels of injury. For both of these sets of analyses, we conducted an omnibus multivariate analysis of variance (with all nine scales as the dependent variables) to determine if there were group differences overall, followed by univariate t tests to help understand any overall significant group differences. For scales with unequal variances, we used separate (as opposed to pooled) variances in the univariate analyses.

RESULTS

Reliability

Pretreatment and posttreatment mean and standard deviation values are presented in Table 1. The internal consistency coefficients (Cronbach's alpha) for each of the FIM-SR scales at both pretreatment and posttreatment are presented in Table 2. In both samples, the internal consistency reliability (ICR) for the FIM-SR was higher at posttreatment (second administration); several explanations are possible: low sample sizes (especially in the amputation sample) may have contributed to variable coefficients, individual participants may have answered items more consistency in the second administration due to a possible learning effect, or greater variability in item responses across participants may have increased reliability coefficients. An examination of the mean and standard deviation values (Table 1) shows that there was indeed greater variability at posttreatment (e.g., in the cognitive scales in the SCI sample and the motor scales in the amputation sample), but we cannot determine why this was the case.

In the SCI sample, the self-care, sphincter control, and mobility scales and the motor and total summary scales demonstrated excellent ICR at both time points. ICR was lower for the communication and social cognition scales and the cognitive summary scale at pretreatment, but it was improved at posttreatment. ICR was weak in the locomotion scale at both time points, which may be due, in part, to the fact that the two items of the locomotion scale are not necessarily related; 76% of the participants with SCI in the current sample chose the maximum score for independence in walking/wheelchair use, whereas 55% chose the minimum value of independence in use of stairs. Moreover, the correlation between these two items was low and negative ($r = -0.09$) in the SCI sample. For the SCI sample, the (pretreatment to posttreatment) test–retest correlations for most of the scales related to motor function (self-care, sphincter control, mobility, and motor summary

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TABLE 1 Mean (standard deviation) values at pretreatment and posttreatment and differences in self-report FIM™ (FIM-SR) scale scores at pretreatment as a function of disability group (spinal cord injury [SCI] vs. amputation [AMP])

		Pretreatment			Posttreatment	
FIM-SR Scale	Possible Range	SCI n = 84	AMP n = 38	t (AMP vs. SCI)	SCI n = 84	AMP n = 38
Self-care	6–42	33.57 (12.73)	40.68 (2.47)	−4.92[a]	32.87 (13.14)	41.24 (2.11)
Sphincter	2–14	10.61 (4.83)	14.00 (0.00)	−6.44[a]	10.58 (4.81)	13.94 (0.23)
Mobility	3–21	15.24 (7.57)	20.34 (1.02)	−6.06[a]	15.24 (7.56)	20.11 (2.34)
Locomotion	2–14	9.07 (2.65)	12.21 (2.17)	−6.89[a]	9.07 (2.65)	12.87 (2.04)
Communication	2–14	13.77 (0.72)	13.61 (0.75)	1.18	13.60 (1.45)	13.68 (0.78)
Social cognition	3–21	20.46 (1.37)	20.00 (1.83)	1.40	20.05 (2.19)	20.05 (1.49)
Motor	13–91	68.49 (25.55)	87.24 (4.14)	−6.54[a]	67.75 (26.15)	85.76 (13.26)
Cognitive	5–35	4.24 (1.85)	33.61 (2.35)	1.46	33.65 (3.47)	33.73 (1.98)
Total	18–126	103.86 (24.26)	120.84 (4.80)	−6.67[a]	101.40 (27.26)	122.06 (6.61)

[a] $P < 0.001$.

scale) and for the FIM-SR total summary scale were also excellent. The test–retest coefficients for one of the motor scales, locomotion, and all of the cognitive scales were lower but in the acceptable range. An examination of the distribution of scores in the SCI sample identified both a restricted range and a ceiling effect for only the cognitive subscales, communication and social cognition, with 88% and 76% of the SCI sample reporting the maximum possible score in those areas, respectively.

In the amputation sample, the ICR indices varied from low to moderate for most of the scales at pretreatment but improved at posttreatment so that the self-care, mobility, and social cognition scales, and the summary scores, were in the acceptable range. In addition, ICR for the sphincter control scale at both time points could not be computed because the score was constant; all participants with amputation reported the highest level of independence in this area. Of the motor scales, the test–

TABLE 2 Internal consistency indices (Cronbach's alphas; pretreatment and posttreatment) and test–retest reliability coefficients of self-report FIM™ (FIM-SR) scales in both spinal cord injury (SCI) and amputation (AMP) samples

	Internal Consistency				Test–Retest Coefficients	
	SCI (n = 84)		AMP (n = 38)			
FIM-SR Scale	Pre	Post	Pre	Post	SCI n = 84	AMP n = 38
Self-care	0.97	0.97	0.57	0.70	0.90[b]	0.73[b]
Sphincter	0.98	0.96	—[a]	—[a]	0.91[b]	—[a]
Mobility	0.97	0.98	0.32	0.93	0.89[b]	0.24
Locomotion	−0.14	0.20	0.15	0.58	0.64[b]	0.58[b]
Communication	0.65	0.95	0.30	0.55	0.54[b]	0.58[b]
Social cognition	0.39	0.67	0.71	0.61	0.71[b]	0.06
Motor	0.97	0.97	0.55	0.88	0.91[b]	0.38[c]
Cognitive	0.63	0.91	0.75	0.69	0.75[b]	0.20
Total	0.95	0.94	0.57	0.87	0.89[b]	0.47[b]

[a] Cannot be computed because the Sphincter scale scores were constant in the AMP sample.
[b] $P < 0.005$.
[c] $P < 0.01$.

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TABLE 3 Concurrent validity of motor subscales and total scale of the self-report FIM™ (FIM-SR) using physical independence, mobility, and total scores of Craig Handicap Assessment and Reporting Technique (CHART), in the spinal cord injury (SCI, n = 84) and amputation (AMP, n = 38) samples

	CHART Subscales and Total Scale					
	Physical		Mobility		Total Score	
FIM-SR Scale	SCI	AMP	SCI	AMP	SCI	AMP
Self-care	0.52[a]	−0.08	0.32[a]	−0.12	0.27[b]	0.20
Sphincter	0.52[a]	—[c]	0.32[a]	—[c]	0.30[a]	—[c]
Mobility	0.46[a]	0.21	0.26[b]	−0.10	0.24[b]	−0.04
Locomotion	0.13	0.17	0.26[b]	0.13	0.23[b]	0.13
Motor	0.51[a]	0.09	0.33[b]	0.18	0.29[b]	0.39[b]
Total score	0.49[a]	0.02	0.30[a]	0.37[a]	0.26[a]	0.54[a]

[a] $P < 0.01$.
[b] $P < 0.05$.
[c] Cannot be computed because the Sphincter scale scores were constant in the AMP sample.

retest coefficients for the self-care and locomotion scales in the amputation sample were in the acceptable range but weaker for the motor summary scale and the mobility scale. Of the cognitive scales, the test–retest coefficient for the communication scale was in the acceptable range, whereas test–retest coefficients for the social cognition and the cognitive summary scales were weak and nonsignificant.

An examination of the distribution of scores in the amputation sample identified both a restricted range and a ceiling effect for all subscales, indicating that large proportions of participants reported high levels of independence in each domain. The following proportions of participants with amputation reported the maximum possible score in the six areas: self-care, 74%; sphincter control, 100%; mobility, 84%; locomotion, 82%; communication, 90%; and social cognition, 79%. Both the ICR and test–retest coefficients were difficult to interpret due to the skewed distributions of all scale scores in the amputation sample.

Associations Between the FIM-SR Scale Scores and CHART Scores

To examine the convergent construct validity at baseline of the FIM-SR motor scales and FIM-SR total scale, these scale scores were correlated with the physical functioning scales of the CHART (the physical independence and mobility scales), and with the total CHART score, which provides an overall measure of handicap (Table 3). Correlations between FIM-SR cognitive scales and the CHART scales were not examined due to our observation of a restricted range and ceiling effect for most of the cognitive scale scores in both samples.

As predicted, in the SCI sample, almost all of these correlations were moderate and statistically significant. Only the locomotion scale did not correlate significantly with the physical independence scale of the CHART. The pattern of significant correlations with the CHART provides support for the motor scales of the FIM-SR (with the exception of locomotion) as valid measures of physical functioning in the SCI sample.

However, the results for the amputation sample did not support our predictions; most of these coefficients were weak and nonsignificant, except for the correlations between the FIM-SR motor summary score and the CHART total score and for the FIM-SR total score with both the CHART mobility and the total scale scores. As in the reliability analyses, sphincter control scale correlations could not be computed because scores were constant in the amputation sample.

Differences in the FIM-SR as a Function of Diagnosis

Differences in mean FIM-SR scales as a function of diagnosis are presented in Table 1. The omnibus multivariate analysis of variance for differences in the nine scale scores was significant ($F_{(7,114)} = 7.65$, $P < 0.001$). In univariate analyses, separate variances were used (due to unequal variances) for all of the scales except communication. As can be seen, and as predicted, participants with SCI reported significantly lower scores on the FIM-SR self-care, sphincter control, mobility and locomotion scales and on the overall motor and total summary scores, compared with participants with amputations. In contrast, no significant differences between diagnostic groups were found on the FIM-SR communication, social cognition, and overall cognitive scale scores.

Differences in the FIM-SR as a Function of Level of Injury

The differences in the FIM-SR scale scores as a function of the level of injury in the SCI sample are

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TABLE 4 Differences in the self-report FIM™ (FIM-SR) scale scores as a function of level of spinal cord injury (paraplegia vs. tetraplegia) in the spinal cord injury sample

FIM-SR Scale	Paraplegia Mean (SD) n = 38	Tetraplegia Mean (SD) *n* = 45	*t*
Self-care	41.45 (0.95)	26.78 (14.26)	−6.88[a]
Sphincter	13.37 (0.88)	8.24 (5.56)	−6.09[a]
Mobility	19.50 (3.15)	11.53 (8.34)	−5.93[a]
Locomotion	9.58 (2.50)	8.58 (2.71)	−1.74
Communication	13.84 (0.59)	13.71 (0.82)	−0.82
Social cognition	20.42 (1.22)	20.51 (1.50)	0.30
Motor	83.89 (5.01)	55.13 (28.60)	−6.63[a]
Cognitive	34.26 (1.72)	34.22 (2.00)	−0.10
Total	75.37 (4.50)	57.44 (18.14)	−6.40[a]

[a] $P < 0.001$.

presented in Table 4. The omnibus multivariate analysis of variance for differences in the nine scale scores was significant ($F_{(7,75)} = 6.17$, $P < 0.001$). In univariate analyses, separate variances were used (due to unequal variances) for the following scales: self-care, sphincter control, mobility, motor, and total. As predicted, the FIM-SR self-care, sphincter control, mobility, motor, and total scales scores were significantly lower in SCI participants with tetraplegia compared with participants with paraplegia. The only motor scale that did not differ according to level of injury was the locomotion scale, which may lack reliability based on its low internal consistency, presented above. Also as predicted, the FIM-SR communication and social cognition scales and the cognitive summary scale did not differ significantly as a function of the level of injury in the SCI sample.

DISCUSSION

In this study, we examined the psychometric proprieties of a self-report version of the FIM instrument (the FIM-SR)[14] by examining measures of reliability, convergent construct validity, and ability to discriminate between type of disability condition (SCI and amputation samples) and, in the SCI sample, between levels of injury (paraplegia or tetraplegia). The current findings provide support for the reliability and validity of the FIM-SR (in particular, the FIM-SR motor scales) for assessing functional independence in persons with SCI and pain but do not support this measure for assessing independence in persons with acquired amputation.

The psychometric properties of all six subscales of the FIM-SR in the amputation sample, and the two cognitive subscales in the SCI sample, were difficult to determine due to the fact that these subscales demonstrated a restricted range and a ceiling effect, in which most respondents reported scores at the top end of the range. A restricted range has the effect of making reliability and validity coefficients less accurate reflections of the true psychometric properties of a scale. Because they contain more items, and hence more variability, the summary scale scores (motor, cognitive, and total) are likely to have stronger psychometric properties (e.g., higher reliability and validity coefficients, on average). It should be noted that, for the most part, reliability and coefficients for the summary scales were adequate in both samples.

It is clear, however, that the FIM-SR has limited utility for this group of persons with amputation, given that most respondents reported very high levels of independent functioning. Consistent with these results, Muecke et al.[22] examined the use of the original FIM instrument with persons with lower limb amputations, concluding that the FIM instrument was not particularly good at predicting rehabilitation outcomes in this population. Our findings suggest that the FIM-SR may not provide much useful information when used with community samples of persons with amputation, such as ours, who may have been living with amputations for several years. However, it is possible that clinician or proxy ratings of functional independence in this group would be different com-

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pared with self-report, given that studies have found proxies tending to report higher levels of disability compared with self-ratings.[23–25] For example, one study found that almost 20% of wheelchair users did not report they had a disability, despite the fact that wheelchair use has become a widely recognized symbol for disability.[23] Persons with amputation may rate themselves as functionally independent and, perhaps, not disabled, despite the use of a prosthesis or the need to take extra time on certain tasks.

The FIM-SR may be more useful in subpopulations of persons with amputation who have more variable functioning, such as those with new amputations, comorbid conditions, or multiple pain problems. For example, a previous study found that pain in each of three pain sites (phantom limb, residual limb, and back) uniquely contributed to pain interference with functioning in a sample of individuals with acquired amputation.[26] Future research should examine, in a larger sample, the ability of the FIM-SR motor scales to discriminate among individuals with different levels of amputation or different types of pain.

In the SCI sample, the FIM-SR demonstrated excellent reliability for the overall total score and for all but one of the motor scales, locomotion, whose low reliability is consistent with similar findings in a study of persons with neuromuscular disease.[18] The FIM locomotion scale may have low reliability because it actually assesses three different aspects of locomotion that are not necessarily related: walking and wheelchair use (both incorporated in a single item) and use of stairs.[18] Thus, when using this measure to examine treatment outcomes in persons with SCI, it might make the most sense to examine each item separately rather than to use the composite locomotion scale score.

In the SCI sample, the FIM-SR communication and social cognition scales and the cognitive summary scale showed lower internal consistency coefficients at pretreatment (although they improved at posttreatment) and lower test–retest coefficients, again due to a restricted range and ceiling effect. These results are also consistent with previous studies. In a sample of persons with neuromuscular disease, for example, reliability indices for these scales were also lower than the other FIM-SR scales.[18] Similarly, in a previous study of the FIM instrument in an SCI sample,[14] the communication scale correlations between clinician and self-ratings were weak and nonsignificant due to a ceiling effect in both types of ratings (see also Hall et al.[27]).

Regarding validity, our results show that the FIM-SR motor scales and the total summary score demonstrate good convergent construct validity in the SCI sample, as evidenced by significant associations with the scale scores of the CHART. These findings supporting the construct validity of the FIM-SR motor scales are consistent with previous research with the version of the self-report FIM instrument by Hoenig et al.,[15] which excludes the two subscales related to cognition. With an SCI sample, their self-report FIM instrument demonstrated significant associations between the FIM-SR total score and several objective criteria, such as hours of personal assistance, the number of affected limbs, the amount of motor impairment, and the amount of combined limb-motor impairment.[16] In a study of persons with SCI or multiple sclerosis, their self-report FIM instrument demonstrated excellent predictive validity for healthcare utilization as measured by the frequency of hospitalization, hospital lengths of stay, and discharge destination.[17]

Although the evidence supported the psychometric properties of the FIM-SR motor scales in the SCI sample, a restricted range and ceiling effect was observed for the scores of the FIM-SR cognitive scales. Persons with SCI are not as likely as some other disability populations to have cognitive deficits, and for those who do have cognitive deficits, such deficits may not necessarily be apparent from self-report measures such as the FIM-SR. In research with other medical conditions, the relationship between self-reported cognitive problems and objective neuropsychologic assessment remains unclear.[28,29] Future studies should examine the validity of the FIM-SR cognitive scales in other populations in which the independence of cognitive functioning might be more affected and more variable (as with some individuals with cerebral palsy, multiple sclerosis, or brain injury). There may be situations in which some measure of patient perception of functioning would be useful; for example, in settings in which patients with cognitive deficits are encouraged to better understand their limitations. In such situations, the present findings suggest that the FIM-SR cognitive summary score may be adequately reliable for this purpose in samples of patients with SCI. Even when rated by clinicians, however, the FIM instrument cannot be used as a substitute for comprehensive neuropsychologic assessment.[30]

Our results indicated that FIM-SR scales are sensitive to expected differences between SCI and amputation in their patterns of disability. Additional support for the validity of the FIM-SR in persons with SCI is found in the scales' ability to discriminate between different levels of SCI. As predicted, the motor scales reflected less functional independence when the individuals had a high level of injury (tetraplegia) compared with a lower level

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of injury (paraplegia). Following our predictions, the cognitive scales were not significantly different between persons with tetraplegia compared with paraplegia, indicating that both groups were reporting similar levels of functional independence in cognitive and communication daily activities.

There are several limitations to the current study that should be noted. First, both of the measures used in this study (CHART, FIM-SR) were self-assessments obtained via telephone interview. Therefore, some of the variance of the associations between the FIM-SR and the validity criterion (CHART) may be due to shared method variance. Future research could clarify this issue by examining the association between the FIM-SR scales and more objective measures of patient independence. Related to our self-report methodology, studies of other health issues have found that different methods of self-report can produce subtly different results (e.g., studies of medication adherence[31] or health symptoms[32]). We have found that telephone interviews result in more complete data collection; however, we do not know if our results can fully generalize to paper administration of the FIM-SR.

Regarding validity, this study was not able to fully examine the validity of the FIM-SR cognitive scales because we did not have a related criterion measure of cognition and communication. In addition, the other psychometric properties of the cognitive scales were more difficult to examine due to the ceiling effect on these scales in both samples. However, preliminary (albeit limited) evidence for validity of the cognitive scales can be seen in the fact that no significant differences were found between diagnostic groups or, for the SCI sample, between levels of injury, as predicted. Additional research comparing the FIM-SR cognitive scales with other measures of cognition and communication in samples with greater variability is necessary to provide stronger evidence of their validity and utility. The validity of FIM-SR in this study was only tested in samples of individuals with both a disability (SCI or acquired amputation) and chronic pain, which may limit generalizability to samples without pain. Concerning SCI, however, a previous study supported the psychometric properties of the FIM-SR in a sample of patients with SCI who did not necessarily have chronic pain.[14]

Lastly, test–retest measures were taken before and after a trial of amitriptyline, and we do not have test–retest data over a period in which no treatment occurred. Amitriptyline was not found to be effective in either trial for reducing pain or demonstrating significant improvement in any secondary outcome measure;[19,20] however, it is possible that there were pretreatment-to-posttreatment differences for some individuals or differential responses to the FIM-SR and the CHART. It would be helpful for the psychometric properties of the FIM-SR to be retested in a sample of people with amputations not undergoing treatment.

As noted by Grey and Kennedy,[14] the FIM-SR can be most useful when given careful prior thought about its purpose and relevance in a study or clinical setting. Despite the limitations of the current study, our findings provide strong support for the reliability and validity of the FIM-SR motor scales and positive (but limited) support for the validity of the FIM-SR cognitive scales for assessing functional independence in persons with SCI. These findings provide clinicians and researchers who work with persons with SCI another option for assessing perceived independence in functioning. The availability of a self-report measure of functional independence may be particularly useful in situations in which there are limited resources for obtaining observational measures of functioning or in which a measure of patient perceptions of independence is particularly important. The findings also indicate that the FIM-SR may be less useful and valid for assessing functional independence in individuals who have been living with acquired amputation for 6 mos or longer due to the high levels of independence they report, although it remains possible that this measure could be more useful in the early stages of adjustment to amputation.

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