ORIGINAL ARTICLE

Validity and reliability study of the Turkish version of Spinal Cord Independence Measure-III

H Unalan¹, TO Misirlioglu¹, B Erhan², M Akyuz³, B Gunduz², E Irgi¹, HE Arslan², A Baltaci³, S Aslan³, D Palamar¹, A Kutlu⁴, J Majlesi⁵, U Akarirmak¹ and SS Karamehmetoglu¹

Study design: This is a multicenter, prospective study.

Objectives: The objective of this study was to assess the validity and reliability of the Turkish version of Spinal Cord Independence Measure-III (SCIM-III).

Setting: This study was conducted in rehabilitation centers of three hospitals in Turkey.

Methods: Two-hundred and four ($n=204$) consecutive patients with spinal cord injury (SCI) were included in the study. Each patient was examined by two physicians. Neurologic impairment was measured according to the American Spinal Injury Association (ASIA) Impairment Scale (AIS) 2000 revised criteria. Backward and forward translation of SCIM-III was performed by native speakers in both languages. To measure the validity of SCIM-III, the scores were compared with patients' AIS grades, total motor scores and the Health Survey Short Form-36 (SF-36) subscale scores. SCIM-III was analyzed for test–retest reliability by the same rater on 49 patients during the follow-up evaluations.

Results: Total agreement values between raters changed between 75.9 and 100%. Kappa values were all above 0.6, and they were statistically significant. The Pearson's correlation values between the raters were very high and statistically significant. The Cronbach's α -values for the two consecutive raters were 0.865 and 0.896. Test–retest reliability was assessed by paired samples t -test, and no significant difference was observed. SCIM-III and SF-36 physical ($r=0.339$, $P<0.005$) and general health scores ($r=0.200$, $P<0.005$) showed correlation. All subscales of the SCIM-III, with the exception of self-care, had significant differences in comparison with the AIS grades. SCIM-III total and total motor scores showed correlation ($r=0.585$, $P<0.001$).

Conclusion: The Turkish version of SCIM-III was found to be valid and reliable.

Spinal Cord (2015) **53**, 455–460; doi:10.1038/sc.2014.249; published online 10 February 2015

INTRODUCTION

The Spinal Cord Independence Measure (SCIM) is a tool that is specifically designed for the patients with spinal cord injury (SCI). SCIM has been shown to be a valid tool in measuring the level of functioning in activities of daily living in patients with SCI.¹ Considering its high worldwide utility in patients with SCI, National Institute on Disability and Rehabilitation Research has stressed the need to continued research on SCIM-III with the aim of further assessment of recovery in performing tasks in the acute/subacute phases of SCI, and also the need to metric research in order to establish norms for recovery by the extent of natural neurological recovery.² As a result, SCIM-III has been translated into various languages with subsequent validity and reliability assessment studies.^{3–8} We designed this prospective multicenter study to investigate the validity and reliability of the Turkish version of SCIM-III.

MATERIALS AND METHODS

The study venue was three separate rehabilitation hospitals. Approval was obtained from the ethical committees of each rehabilitation hospitals before commencement of the study. Backward and forward translation was performed by native speakers in both languages according to the established procedures.⁹

1. Translation into Turkish: First, SCIM-III was translated from English into Turkish with the purpose of retaining the original concept. Expressions that fit the original cultural and clinical characteristics were used. Two native English speakers with 16–20 years of experience in Turkish who were not familiar with SCIM-III accomplished English to Turkish translation. Every translation was carried out independently, and afterward comparisons and discussions led to an agreed-upon common version. The last step was creating a common adaptation of the Turkish version by the translators.
2. Back-translation from Turkish into English: Two native Turkish speakers with 13–21 years of training and work experience in the United States of America separately produced an English version of SCIM-III aiming to correct difficulties, inconsistencies and mistakes in the Turkish version. Probable conceptual equivalence, cultural diversities and vocabulary differences were appreciated while not excluding any item. Upon analyzing and comparing the two translated versions, an agreement upon the final version was reached.
3. Review of the Turkish translation: A committee comprising three clinicians with 5–20 years of experience in SCI reviewed the final version. The dimensions of the scale were analyzed by comparing with the English version. No change seemed to be required. As a result, the final Turkish version of SCIM-III was approved. It was named as Turkish version of the SCIM-III.⁹

¹Department of Physical Medicine and Rehabilitation, Istanbul University, Cerrahpasa Medical Faculty, Istanbul, Turkey; ²Department of Physical Medicine and Rehabilitation, Istanbul PMR Training and Research Hospital, Istanbul, Turkey; ³Department of Physical Medicine and Rehabilitation, Ankara PMR Training and Research Hospital, Ankara, Turkey; ⁴Department of Neurology, Kocaeli University, School of Medicine, Kocaeli, Turkey and ⁵Istanbul Medicana Hospital, Istanbul, Turkey
Correspondence: Dr TO Misirlioglu, Department of Physical Medicine and Rehabilitation, Koc University Hospital, Topkapi, Istanbul, Turkey.
E-mail: tozeklim@gmail.com

Two-hundred and four ($n=204$) consecutive patients with SCI were included in the study. The inclusion criteria were as follows:

- Traumatic or nontraumatic spinal cord lesion
- American Spinal Injury Association (ASIA) Impairment Scale (AIS) of either A, B, C or D
- Absence of concomitant impairments that would interfere with function such as lack of cooperation that would render the survey impossible and
- Absence of concomitant traumatic brain injury, fractures and so on.

The patients were assessed according to the standards of ASIA 2000 revised criteria.¹⁰ Six raters (two at each hospital), experienced in SCI, evaluated the patients using the Turkish version of SCIM-III. SCIM-III items were scored according to the observation of the patient performance by two physiatrists. All the raters were blinded to the procedure. Fifteen to thirty minutes were allowed between the ratings of each two different raters for the assessment of inter-rater reliability. Test-retest (intra-rater) reliability was assessed by rating the patients with AIS grade A with a disease duration of at least 1 year at the time of follow-up (1 month) evaluations. Regardless of completeness of the SCI, the majority of recovery takes place during the initial 9–12 months.¹¹ As a result, the clinical conditions of the follow-up group would not be expected to change during this period. Validity was measured by comparing SCIM-III scores with patients' AIS grades, total motor scores and Health Survey Short Form-36 (SF-36) subscale scores. SF-36 was administered by interview method just immediately after the first observational rating of SCIM-III.

Assessments

The original SCIM aims to describe the ability of the patients with SCI to accomplish activities of daily living and also make functional assessments of this population prone to changes on the course of recovery and/or in the long-term life period.¹ Since the first publication of the SCIM in 1997, two more versions named SCIM-II and SCIM-III were developed.^{1,4,12–14} SCIM-III is the latest version comprising 19 items in three subscales: (1) self-care (six items, range 0–20), (2) respiration and sphincter management (four items, range 0–40) and (3) mobility (nine items, range 0–40). Each item bears grades from two to nine. Mobility subscale of SCIM-III is subdivided into 'room and toilet' and 'indoors and outdoors'. The total score may range between 0 and 100. Higher score indicates that the patient is capable of accomplishing the activities of daily living with less assistance, aids or health compromise. SCIM-III is administered by observation. A self-report version of SCIM-III (SCIM-SR) has been recently published.¹⁵ Versions of the SCIM have been shown to be valid and reliable in multicenter studies with satisfying psychometric properties.^{3–8} Comparatively, the SCIM-III represents the most sensitive, reliable and valid measurement of global disability for individuals with SCI.^{1,4,12–14}

The ISNCSCI (International Standards for Neurological Classification of SCI) has endorsed a standardized neurological examination as the most accurate way to document impairment in a person with an SCI.¹⁰ The information from this examination helps determine the sensory and motor neurologic level of injury, using separate sensory and motor index scores to classify the impairment. The AIS, developed by the ISNCSCI, classifies SCI into five categories of severity, named A–E. The absence of all sensory and motor function in the most distal sacral segments is classified as AIS category A or having a complete SCI. An AIS grade E designates a normal sensory and motor function. A patient with an incomplete SCI is classified into any AIS category B through E according to the degree of motor and sensory loss. Total motor score is the sum of grades for the key muscle groups of the upper and lower extremities defined by the ASIA protocol. Five key muscle groups have been defined for each of the upper or lower extremities. Muscle strength examination grades the strength between zero and five for each key muscle group. Motor score could vary between 0 and 50 for each of the upper or lower extremities with a total range between 0 and 100.

The SF-36 is the most commonly used generic index of health-related quality of life.^{16,17} Its applicability for assessing health-related quality of life among persons with SCI has also been shown.¹⁸ SF-36 provides a comprehensive psychometrically sound and efficient way to measure status from the patient's point of view by scoring standardized questions. The questionnaire is composed

Table 1 Demographic and clinical characteristics

n	Mean age at injury ($\pm$ s.d.)	Mean duration of injury (months)	Male (%)	Female (%)	Traumatic (%)	Nontraumatic (%)	Tetraplegia (%)	Paraplegia (%)	AIS A (%)	AIS B (%)	AIS C (%)	AIS D (%)	AIS E (%)	Complete	Incomplete
All the group	39.7 $\pm$ 13.7	75.4 $\pm$ 85.2	144 (70.5)	60 (29.4)	165 (80.8)	39 (19.1)	66 (32.3)	138 (67.6)	104 (50.9)	29 (14.2)	35 (17.1)	36 (17.6)	0	104 (50.9)	100 (49.0)
The subgroup	38.4 $\pm$ 14.3	60.0 $\pm$ 55.3	29 (59.1)	20 (40.8)	45 (91.8)	4 (8.1)	18 (36.7)	31 (63.2)	49 (100)	0	0	0	0	49 (100)	0

Abbreviation: AIS, American Spinal Injury Association Impairment Scale.

Table 2 Inter-rater reliability—percent agreement between raters and kappa values (*n* = 204)

Task	Total agreement (%)	Kappa values
Feeding	90.1	0.762
Bathing—upper body	79.9	0.730
Bathing—lower body	82.8	0.764
Dressing—upper body	85.7	0.805
Dressing—lower body	82.3	0.765
Grooming	87.2	0.703
Respiration	100	1
Bladder—sphincter	81.8	0.776
Bowel—sphincter	84.3	0.728
Use of toilet	78.4	0.705
Mobility in bed	80.8	0.685
Transfer—bed/wheelchair	89.2	0.827
Transfer—wheelchair/toilet/tub	83.8	0.755
Mobility indoors	79.9	0.744
Moderate distances	84.3	0.762
Mobility outdoors	75.9	0.683
Stair management	91.1	0.769
Transfer—wheelchair/car	83.3	0.741
Transfer—ground/wheelchair	91.1	0.792

Table 3 Inter-rater reliability—Pearson's correlation and paired samples *t*-test between raters (*n* = 204)

SCIM-III subscales	Mean	s.d.	r	P-value ^a	t	P-value ^b
Self-care-1 ^c	11.35	6.27	0.961	<0.001	1.408	0.161
Self-care-2 ^c	11.18	6.23				
Respiration and sphincter-1 ^c	22.66	9.32	0.938	<0.001	1.848	0.066
Respiration and sphincter-2 ^c	22.24	9.20				
Mobility in the room-1 ^c	6.58	3.66	0.956	<0.001	-0.130	0.897
Mobility in the room-2 ^c	6.59	3.56				
Mobility in/outdoors-1 ^c	9.31	7.64	0.944	<0.001	0.164	0.870
Mobility in/outdoors-2 ^c	9.28	7.62				
Total score-1 ^c	49.67	23.02	0.972	<0.001	1.347	0.180
Total score-2 ^c	49.16	22.63				

Abbreviations: *r*, correlation value; SCIM-III, Spinal Cord Independence Measure-III; *t*, paired samples *t*-test value.

^a*P*, significance level of *r*.

^b*P*, significance level of *t*.

^c1, first rater; 2, second rater.

of 36 items, eight subscales that aggregate 2–10 items each and two summary measures that aggregate the scales. The scales are physical functioning, role limitations owing to physical problems (role-physical), bodily pain, general health, vitality, social functioning, role limitations owing to emotional problems (role-emotional) and mental health. The summary measures are physical compound summary and mental compound summary. Scores for subscales range from 0 to 100, with higher scores indicating a better health status. The Turkish version of the SF-36 was approved by the Medical Outcome Study-Trust, the originator of the SF-36. This approved version was validated in a study in Turkey and was found to be valid and reliable.^{19–20} The SF-36 Health Survey has been widely used in SCI studies and in health status research in a wide array of diseases and disorders.^{18,21,22}

Statistical analyses

To assess the validity and reliability of the Turkish version of SCIM-III, several steps of analysis were conducted:

Table 4 Test–retest reliability—paired samples *t*-test (*n* = 49)

SCIM-III subscales	Mean	s.d.	t	df	P-value
Self-care	0.204	2.541	0.562	48	0.577
Respiration and sphincter	-0.510	4.482	-0.797	48	0.429
Mobility in the room	-0.061	1.197	-0.358	48	0.722
Mobility in/outdoors	0.408	1.999	1.429	48	0.159
SCIM total scores	-0.122	7.432	-0.115	48	0.909

Abbreviations: SCIM-III, Spinal Cord Independence Measure-III; *t*, paired samples *t*-test value.

Table 5 Internal consistency (Cronbach's coefficient α) within SCIM-III subscales

	α -values	
	First rater, <i>n</i> = 204	Second rater, <i>n</i> = 204
Self-care subscales ^a	0.916	0.911
Feeding	0.911	0.905
Bathing upper body	0.891	0.844
Bathing lower body	0.900	0.892
Dressing upper body	0.895	0.889
Dressing lower body	0.904	0.901
Grooming	0.903	0.899
Respiration and sphincter management subscale ^a	0.574	0.584
Respiration	0.648	0.661
Bladder management	0.351	0.381
Bowel management	0.430	0.397
Use of toilet	0.430	0.453
Mobility in the room and toilet subscale ^a	0.774	0.754
Mobility in bed	0.921	0.912
Transfers bed/wheelchair	0.636	0.596
Transfers wheelchair/toilet/tub	0.6681	0.663
Mobility indoors and outdoors subscale ^a	0.898	0.899
Mobility indoors	0.855	0.857
Mobility moderate distance	0.842	0.843
Mobility outdoors	0.856	0.861
Stairs management	0.883	0.886
Transfers wheelchair/car	0.864	0.897
Transfers ground/wheelchair	0.917	0.914
SCIM-III total ^b	0.828	0.832
Self-care	0.777	0.780
Respiration and sphincter management	0.798	0.800
Mobility in room and toilet	0.788	0.776
Mobility indoors and outdoors	0.773	0.795

Abbreviation: SCIM-III, Spinal Cord Independence Measure-III.

^a α if item is deleted.

^b α if subscale is deleted.

(a) Inter-rater reliability of the SCIM-III was analyzed using:

- the percentage of total agreement between the paired raters
- kappa coefficients of SCIM tasks and Pearson's correlation
- paired *t*-test of SCIM subscales¹²

(b) Test–retest reliability was assessed at follow-up evaluation at the end of 1 month. The scores were analyzed with paired samples *t*-test.

Table 6 Validity analysis—Pearson's correlations between SF-36 and SCIM-III subscales and total scores

	n = 204	Self-care	Respiration and sphincter management	Mobility in room and toilet	Mobility indoors and outdoors	Total
<i>SF-36 subscales</i>						
Role limitations owing to physical health	<i>r</i>	0.166*	0.189**	0.153*	0.221**	0.225**
	<i>P</i>	0.018	0.007	0.030	0.002	0.001
Role limitations owing to emotional health	<i>r</i>	0.035	0.199**	0.072	0.171*	0.160*
	<i>P</i>	0.617	0.005	0.312	0.015	0.023
Energy/fatigue	<i>r</i>	0.132	0.119	0.102	0.096	0.123
	<i>P</i>	0.061	0.093	0.147	0.172	0.082
Emotional well-being	<i>r</i>	0.027	0.157*	0.023	0.086	0.093
	<i>P</i>	0.704	0.025	0.742	0.221	0.188
Social functioning	<i>r</i>	0.103	0.295**	0.189**	0.259**	0.267**
	<i>P</i>	0.146	0.001	0.007	0.001	0.001
Pain	<i>r</i>	−0.049	0.028	−0.009	0.066	0.011
	<i>P</i>	0.492	0.696	0.894	0.350	0.871
Physical functioning	<i>r</i>	0.457**	0.311**	0.339**	0.537**	0.484**
	<i>P</i>	0.001	0.001	0.000	0.001	0.001
General health	<i>r</i>	0.147*	0.172*	0.145*	0.219**	0.200**
	<i>P</i>	0.036	0.014	0.040	0.002	0.004
Physical health	<i>r</i>	0.259**	0.264**	0.229**	0.377**	0.339**
	<i>P</i>	0.001	0.001	0.001	0.001	0.001
Mental health	<i>r</i>	0.089	0.280**	0.135	0.232**	0.235**
	<i>P</i>	0.206	0.001	0.055	0.001	0.001

Abbreviations: SCIM-III, Spinal Cord Independence Measure-III; SF-36, Health Survey Short Form-36.

* $P < 0.05$; ** $P < 0.005$.

- (c) The internal consistency of the SCIM-III was measured by the Cronbach α -coefficient.
- (d) Pearson's correlation was used to determine the validity of the SCIM-III. The relationship between the SCIM-III, total motor and SF-36 subscale scores was analyzed. One-way analysis of variance was used to perform the comparisons of the SCIM-III scores and AIS grades (discriminant validity).

All statistical analyses were performed using SPSS statistical software for Windows, version 14.0.

We certify that all applicable institutional and governmental regulations concerning the ethical use of human volunteers were followed during the course of this research.

RESULTS

The total number of recruited patients was 204, with an age range between 18 and 80 years. The mean duration of injury was between 2 and 540 months. Demographic and clinical data for all participants and the subgroup of patients who participated in the retesting of the SCIM-III are provided in Table 1.

Reliability

Inter-rater reliability. Inter-rater reliability was evaluated on 204 patients and was analyzed using percent agreement between raters and kappa values. Total agreement values between raters changed between 75.9 and 100%, with one item (respiration) having full agreement of 100% (Table 2).

Analysis of the correlations between two raters' subscale scores revealed strikingly high and statistically significant Pearson's correlation values. However, there was no significant difference between the mean values of subscales when tested with paired samples *t*-test (Table 3).

Test-retest reliability

Among the 104 patients with AIS grade A, only 49 patients who had an SCI duration of longer than 1 year were included in the study. No significant difference was found between the follow-up scores and the scores received at admission (Table 4).

Internal consistency

The Cronbach's α -values for the two raters were 0.865 and 0.896. The items were analyzed individually for the α -value of the subscale upon removal of the item. Elimination of most of the items in each of the subscales decreased the α -coefficient of the subscale, except for respiration, mobility in bed and transfers ground/wheelchair (Table 5).

Validity

SCIM-III and SF-36. Validity of SCIM-III was assessed by comparing the scores with the patients' SF-36 scores. Analyzing the correlations between total SCIM-III score and SF-36 physical health revealed a Pearson's correlation of 0.339 ($P < 0.005$; Table 6). With the exception of energy/fatigue, emotional well-being and pain, all the subscales of SF-36 showed significant but low correlations with the SCIM subscales (Table 6).

SCIM-III and AIS. The SCIM-III subscale and total scores were compared with the AIS grades of the patients using one-way analysis of variance. Excluding self-care, all the subscales were found to have significant differences compared with the AIS grades. A parallel increase in all the subscales and the total score for the AIS grade and the SCIM-III scores were observed. This indicates the dependency of the patient's SCIM-III score on the AIS grade (Table 7).

SCIM-III and complete/incomplete injury. SCIM-III scores of patients with complete and incomplete SCI were compared. Patients with

incomplete SCI were found to score significantly better on all the subscales of SCIM-III (Table 8).

SCIM-III and total motor scores. Total motor scores and total SCIM-III scores were found to have significant correlation upon using Pearson's correlation ($r=0.585$; $P<0.001$).

DISCUSSION

The results of this multicenter study support the validity and reliability of the Turkish version of SCIM-III.

The inter-rater reliability was assessed on all the patients (204) by using percent agreement between raters and kappa values. Total

agreement values between raters changed between 75.9 and 100% (Table 2). The reason for the respiration being the sole item with an agreement rate of 100% might be owing to the patient characteristics. None of the patients had an injury leading to respiratory problems.

Taking each subscale separately to measure the internal consistency revealed that only 'respiration and sphincter management' did not reach the accepted limit of 0.70 (Table 5). In the previous validity studies of SCIM-III, this subscale showed Cronbach's α -values that were only slightly above the limit.³⁻⁶ The increase in the subscales' α -coefficient after elimination of the respiration, mobility in bed and transfers ground/wheelchair items implies that these tasks may have a weak relationship with the other items in their subscales. This finding was also similar to the ones of the first SCIM-III study.¹²

Despite the obvious discriminative ability of the SCIM-III in patients with different severity of SCI (AIS A, B, C and D), nonsignificant differences in self-care items were found (Table 7). It has been previously shown that the self-care category reflects upper extremity function and capacity.²³ The reason for the nonsignificant differences in self-care items could be explained by the number of tetraplegic cases in our study. There were only 66 tetraplegics (out of 204 patients) who would display dependency in self-care.

Most of the SCIM-III validation studies have used functional independence measure as a general health scale.^{1,4,12-14} It obviously is a trademark instrument that has been administered by Uniform Data System for Medical Rehabilitation. However, in comparison with SF-36, functional independence measure is quite a complex instrument that requires a certain period of training beginning with studying an extensive manual.² This requirement would be an obstacle in this study, because none of the investigators had certification for the use of functional independence measure. As a result, SF-36 was used to obtain uniform and standardized scores.

The parameters that displayed the highest correlation between SCIM-III and SF-36 were physical functioning, physical health, role limitations owing to physical health and general health (Table 6). Considering the fact that SCIM-III is not capable of measuring mental health, pain and energy/fatigue, limitations stemming from this shortcoming would not be measurable. However, social functioning and mental health categories of SF-36 had significant but low correlations with the respiration and sphincter management, and mobility subscales of SCIM-III. These could be the result of the effects of the respiration and sphincter management, and mobility reflected on the social life.

Another Turkish version of SCIM-III has been studied at the same time period with this study on a lower number of patients and published during the progress of the present study. The mentioned

Table 7 Validity analysis—one-way analysis of variance between AIS grades and SCIM-III scores

SCIM-III subscales	AIS	n	Mean	s.d.	F	P-value
Self-care	A	104	10.21	6.313	2.209	0.088
	B	29	11.29	6.067		
	C	35	11.76	5.337		
	D	36	13.19	6.744		
	Total	204	11.15	6.264		
Respiration and sphincter management	A	104	19.13	7.761	12.655	0.001
	B	29	21.96	8.212		
	C	35	24.59	9.801		
	D	36	28.81	9.429		
	Total	204	22.17	9.210		
Mobility in room and toilet	A	104	5.76	3.784	5.697	0.001
	B	29	6.43	3.605		
	C	35	7.15	2.945		
	D	36	8.42	2.612		
	Total	204	6.56	3.564		
Mobility indoors and outdoors	A	104	6.92	5.380	31.802	0.001
	B	29	7.04	6.167		
	C	35	8.29	5.340		
	D	36	18.50	9.198		
	Total	204	9.23	7.637		
Total	A	104	41.87	19.255	15.950	0.001
	B	29	46.36	21.063		
	C	35	51.76	20.142		
	D	36	68.94	23.598		
	Total	204	48.98	22.650		

Abbreviations: AIS, American Spinal Cord Injury Association Impairment Scale; SCIM-III, Spinal Cord Independence Measure-III.

Table 8 Validity analysis—one-way analysis of variance between complete/incomplete lesion and SCIM-III scores

SCIM-III subscales	Complete (n = 104)/incomplete (n = 100)	Mean	s.d.	F	P-value
Self-care	Complete	10.20	6.375	4.907	0.001
	Incomplete	12.13	6.025		
Respiration and sphincter management	Complete	19.28	7.759	22.348	0.001
	Incomplete	25.11	9.669		
Mobility in room and toilet	Complete	6.96	5.426	19.955	0.001
	Incomplete	11.55	8.810		
Mobility indoors and outdoors	Complete	5.81	3.799	9.394	0.001
	Incomplete	7.32	3.149		
Total	Complete	42.09	19.374	20.973	0.001
	Incomplete	56.01	23.659		

Abbreviation: SCIM-III, Spinal Cord Independence Measure-III.

study found SCIM-III to be sensitive to the SCI patient characteristics.⁷ In the present study, we included more patients ($n=204$) and preferred a different outcome scale. Nevertheless, we believe that more studies would render SCIM-III a test with more validity and reliability leading to more practical fields for its use, and more validation studies would yield more positive results, making SCIM-III a more valuable measurement tool. Similarly, the multi-national work group recommends the latest version of the SCIM (SCIM-III) to be exposed to continuing refinement and validation to being subsequently implemented as the primary functional recovery outcome measure for SCI worldwide.² We suggest that more studies to be conducted on different reliability and validity measures of the SCIM-III on different populations of SCI patients.

The limitation of this study may be the one originating from the inherent characteristics of SCIM-III. Ideally, direct observation of the patient by a team member experienced in assessment and treatment in the domain covered by the subscale is necessary. However, whenever direct observation of the task such as sphincter management is impossible, consultation with the nursing staff and caregivers is advised.²⁴ The items were scored by the interview method when we were not able to observe the task directly. This method has been reported to slightly decrease the scoring precision of SCIM.^{25,26}

CONCLUSION

The Turkish version of SCIM-III is a valid and reliable measurement tool for the functional assessment of SCI patients in Turkey.

DATA ARCHIVING

There were no data to deposit.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

ACKNOWLEDGEMENTS

We thank Ramazan Bas who is the president of the Spinal Cord Paralytics Association of Turkey, and all its members.

- 1 Catz A, Itzkovich M, Agranov E, Ring H, Tamir A. SCIM-spinal cord independence measure: a new disability scale for patients with spinal cord lesions. *Spinal Cord* 1997; **35**: 850–856.
- 2 Anderson K, Aito S, Atkins M, Biering-Sørensen F, Charlifue S, Curt A *et al*. From the 2006 NIDRR SCI measures meeting functional recovery measures for spinal cord injury: an evidence-based review for clinical practice and research. *J Spinal Cord Med* 2008; **31**: 133–144.
- 3 Anderson KD, Acuff ME, Arp BG, Backus D, Chun S, Fisher K *et al*. United States (US) multi-center study to assess the validity and reliability of the Spinal Cord Independence Measure (SCIM III). *Spinal Cord* 2011; **49**: 880–885.
- 4 Catz A, Itzkovich M, Tesio L, Biering-Sørensen F, Weeks C, Laramée MT *et al*. A multi-center international study on the Spinal Cord Independence Measure, version III: Rasch psychometric validation. *Spinal Cord* 2007; **45**: 275–291.
- 5 Invernizzi M, Carda S, Milani P, Mattana F, Fletzer D, Iolascon G *et al*. Development and validation of the Italian version of the Spinal Cord Independence Measure III. *Disabil Rehabil* 2010; **32**: 1194–1203.
- 6 Glass CA, Tesio L, Itzkovich M, Soni BM, Silva P, Mecci M *et al*. Spinal Cord Independence Measure, Version III: applicability to the UK spinal cord injured population. *J Rehabil Med* 2009; **41**: 723–728.
- 7 Kesiktas N, Paker N, Bugdayci D, Sencan S, Karan A, Muslumanoglu L. Turkish adaptation of Spinal Cord Independence Measure-version III. *Int J Rehabil Res* 2012; **35**: 88–91.
- 8 Zarco-Periñan MJ, Barrera-Chacón MJ, García-Obrero I, Mendez-Ferrer JB, Alarcon LE, Echevarria-Ruiz de Vargas C. Development of the Spanish version of the Spinal Cord Independence Measure version III: cross-cultural adaptation and reliability and validity study. *Disabil Rehabil* 2014; **36**: 1644–1651.
- 9 Guillemin F, Bombardier C, Beaton B. Cross-cultural adaptation of health-related quality of life measures: literature review and proposed guidelines. *J Clin Epidemiol* 1993; **46**: 1417–1432.
- 10 American Spinal Injury Association/International Medical Society of Paraplegia. *International Standards for Neurologic and Functional Classification of Spinal Cord Injury, Revised 2000*. ASIA: Chicago, IL, USA, 2002.
- 11 Burns AS, Marino RJ, Flanders AE, Flett H. Clinical diagnosis and prognosis following spinal cord injury. *Handb Clin Neurol* 2012; **109**: 47–62.
- 12 Itzkovich M, Gelernter I, Biering-Sørensen F, Weeks C, Laramée MT, Craven BC *et al*. The Spinal Cord Independence Measure (SCIM) version III: reliability and validity in a multi-center international study. *Disabil Rehabil* 2007; **29**: 1926–1933.
- 13 Catz A, Itzkovich M, Steinberg F, Philo O, Ring H, Ronen J *et al*. The Catz-Itzkovich SCIM: a revised version of the Spinal Cord Independence Measure. *Disabil Rehabil* 2001; **23**: 263–268.
- 14 Itzkovich M, Tripolski M, Zeilig G, Ring H, Rosentul N, Ronen J *et al*. Rasch analysis of the Catz-Itzkovich spinal cord independence measure. *Spinal Cord* 2002; **40**: 396–407.
- 15 Fekete C, Eriks-Hoogland I, Baumberger M, Catz A, Itzkovich M, Lüthi H *et al*. Development and validation of a self-report version of the Spinal Cord Independence Measure (SCIM III). *Spinal Cord* 2013; **51**: 40–47.
- 16 How to Score the SF-36 Short Form Health Survey. *International Resource Center Health Care Assessment*. The Health Institute: Boston, MA, USA, 1994.
- 17 McHorney CA, Ware JE, Lu JF, Sherbourne CD. The MOS 36-item Short Form Health Survey (SF-36): III. Tests of data quality, scaling assumptions and reliability across diverse patient groups. *Med Care* 1994; **32**: 40–66.
- 18 Forcheimer M, McAweeney M, Tate DG. Use of the SF-36 among persons with spinal cord injury. *Am J Phys Med Rehabil* 2004; **83**: 390–395.
- 19 Demirsoy C. *The MOS-SF-36 Health Survey: A Validation Study with a Turkish Sample*. Unpublished Master's Thesis. University of Bosphorus: Istanbul, Turkey, 1999.
- 20 Unalan H, Gencosmanoglu B, Akgun K, Karamehmetoglu S, Tuna H, Ones K *et al*. Quality of life of primary caregivers of spinal cord injury survivors living in the community: controlled study with short form-36 questionnaire. *Spinal Cord* 2001; **39**: 318–322.
- 21 Lucke KT, Coccia H, Goode JS, Lucke JF. Quality of life in spinal cord injured individuals and their caregivers during the initial 6 months following rehabilitation. *Qual Life Res* 2004; **13**: 97–110.
- 22 Hays RD, Hahn H, Marshall G. Use of the SF-36 and other health-related quality of life measures to assess persons with disabilities. *Arch Phys Med Rehabil* 2002; **83**: S4–S9.
- 23 Rudhe C, van Hedel HJ. Upper extremity function in persons with tetraplegia: relationships between strength, capacity, and the spinal cord independence measure. *Neurorehabil Neural Repair* 2009; **23**: 413–421.
- 24 Catz A, Itzkovich M. Spinal Cord Independence Measure: comprehensive ability rating scale for the spinal cord lesion patient. *J Rehabil Res Dev* 2007; **44**: 65–68.
- 25 Catz A, Itzkovich M, Steinberg F, Philo O, Ring H, Ronen J *et al*. Disability assessment by a single rater or a team: a comparative study with the Catz-Itzkovich Spinal Cord Independence Measure. *J Rehabil Med* 2002; **34**: 226–230.
- 26 Itzkovich M, Tamir A, Philo O, Steinberg F, Ronen J, Spasser R *et al*. Reliability of the Catz-Itzkovich Spinal Cord Independence Measure assessment by interview and comparison with observation. *Am J Phys Med Rehabil* 2003; **82**: 267–272.