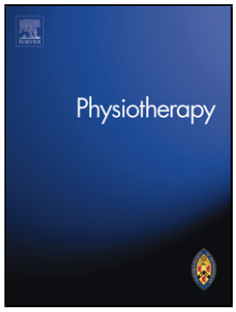

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Advocacy for use of the modified Iowa Level of Assistance Scale for clinical use in patients after hip replacement: an observational study

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Abstract

Objectives To test the internal consistency and item difficulty of the modified Iowa Level of Assistance Scale (mILAS).

Design Retrospective observational study.

Setting Two orthopaedic wards of two general hospitals.

Participants Following elective primary unilateral total hip replacement surgery, all participants performed mILAS activities that were scored daily to assess their recovery of activities during hospitalisation.

Main outcome measures The internal consistency and the level of assistance needed by the patient (item difficulty) of the mILAS were calculated using data from Hospital X (*n*=255). A cross-validation was performed using data from Hospital Y (*n*=224).

Results The internal consistency of the mILAS was acceptable on all three postoperative days (α=0.84 to 0.97). Cronbach's α and Rasch analysis revealed a misfit of stair climbing with the other items of the mILAS. The item difficulty of the mILAS items changed over the first two postoperative days. During the first three postoperative days, the sit to supine transfer was generally the most difficult item to achieve, and the sit to stand transfer was the least difficult item to achieve as rated by physiotherapists. The cross-validation analysis revealed similar results.

Conclusions The mILAS is a clinically sound measurement tool to assess the ability of patients to perform five functional tasks safely during hospitalisation. Stair climbing appears to be the easiest item to complete, and the sit to supine transfer is generally the most difficult after surgery.

Keywords: Total hip replacement; Inpatients; Activities of Daily Living; Recovery of activities; Clinimetrics

<A>Introduction

The Iowa Level of Assistance Scale (ILAS) was developed as a tool to monitor functional recovery for hospitalised patients, including patients immediately following total hip replacement (THR) surgery [1]. The original ILAS assessed patients' independence with five functional tasks, but since its development in 1995, several scoring changes have been proposed and certain functional tasks have been added or removed from the scale [2–6]. The modified ILAS (mILAS) is now commonly used in many hospital settings, and offers potential advantages for monitoring patients following THR as it incorporates a sit to supine transfer. This particular task is often difficult for patients to perform in the early postoperative period, especially considering the movement restrictions (limited hip flexion and rotation) often imposed after THR. However, the mILAS has yet to be examined for its ecological validity or psychometric properties in patients following THR.

The aim of this study was to formally assess the performance of the mILAS as a tool for monitoring early recovery following THR by: (1) examining construct validity via internal consistency analysis of the mILAS items across two different large-scale data sources; and (2) determining the level of assistance needed by the patient (item difficulty) of mILAS items over the course of hospitalisation. This approach was designed such that mILAS performance was established using one data source, and confirmation was sought by validating the results against a different data source. A secondary aim of this study was to describe mILAS scores for patients following THR to provide patients and healthcare professionals with essential information regarding early recovery of functional mobility.

<A>Methods

<B>*Patient characteristics and demographics*

This retrospective study was performed using data from two large general hospitals in a routine care setting for people undergoing THR. All data for this study were extracted by SZ/GvdS by electronic interprofessional medical record review. At the time of care, patient characteristics were documented by various healthcare professionals: before surgery, an anaesthetist, a physiotherapist and a nurse assessed the surgical risk and functional status of all patients undergoing primary THR [5]. The documented date of birth was used to calculate patient age. Similarly, body mass index (kg/m^2) was calculated from the documented height and weight. The Society of Anesthesiologists score, assessed by the anaesthetist, was extracted as a proxy of the patients' fitness for surgery [7]. The Charnley score (A/B/C) [8] and the timed up and go test [9], typically assessed by the physiotherapist, were recorded as measures of patient functioning. Explorative analyses were performed on consecutive data (*n*=225) from Hospital X (April 2014 to February 2015; of the 287 consecutive patients, seven did not undergo surgery and 55 had no postoperative mILAS data), and confirmative analyses were performed using consecutive data (*n*=224) from Hospital X (March 2009 to December 2010; of the 271 consecutive patients, 47 had no postoperative mILAS data). Patients that gave informed consent were included if they were aged ≥18 years and had undergone unilateral primary THR surgery. No exclusion criteria were used. Data from regular patient files built up during routine day-to-day care in both clinical settings were used. According to 'X' law, the study did not fall within the remit of the medical ethics committee. However, both hospital policies demanded local ethical review of all scientific studies (JT/ds/16.0635 and 16-107/JS/AB). The study was performed in accordance with the Declaration of Helsinki.

<B>mILAS data collection

During hospitalisation, the mILAS was used daily to assess the capability of patients to perform five functional milestones safely (supine to sit, sit to supine, sit to stand, walking and stair climbing). These milestones are necessary for an individual to function independently at home. The amount of assistance required and the type of assistive devices used were recorded by physiotherapists. All mILAS items were scored from zero to six for the amount of assistance required [see Appendix 1 (online supplementary material) for scoring details]. The total score reflects the sum of all five functional milestones, and ranges from zero to 30 points. Higher scores indicate that a person needs more assistance. The sequence of performing the individual mILAS items was not standardised; the position and/or location of the patient at the start of the therapy session was the decisive factor. For example, if the patient was sitting on a chair, the first item to assess was the sit to stand transfer. All participating physiotherapists at both hospitals were trained in executing and scoring the mILAS uniformly in a formal training session before they implemented use of the mILAS as part of usual care [see Appendix 2 (online supplementary material) for additional information regarding clinical care pathway and experience of the physiotherapists]. Stair climbing was only assessed and scored for patients who needed to be able to climb stairs at their preferred discharge destination. For patients who did not have to climb stairs, this item was not tested and was therefore rated with a score of six points.

<B>Statistical analyses

Descriptive statistics (frequencies, proportions, means, standard deviations and percentages) were calculated as appropriate for all patient characteristics (Table 1). Complementary to the descriptive statistics of the mILAS scores, the recovery curves of all individual patients over

the first three days were visualised by individual trajectory plots. For internal consistency analysis, the data sources were divided into exploratory and confirmatory datasets.

<insert Table 1 near here>

<C>Exploratory analysis

Data collected consecutively from Hospital X were used for initial examination of internal consistency of mILAS scores. These data were collected for 225 patients undergoing THR between April 2014 and February 2015 (Table 1). Cronbach's α and the change in this statistic upon deletion of a single mILAS item were calculated to assess the internal consistency of the mILAS, and to explore the contribution of each mILAS item to the total internal consistency. Cronbach's α values between 0.70 and 0.95 are considered to be acceptable [10].

To assess the level of difficulty of the individual mILAS items, the Rasch partial credit model was used for ordered categorical data. Using this approach, each mILAS item was allowed to have its own unique rating scale structure [11]. Prior to the item response theory analysis, the authors checked if all rating categories (0 to 6) of the mILAS were being used effectively and consistently according to the criteria of Linacre [12]. If a rating category failed to meet these criteria, merging with neighbouring categories was considered. After possible rating scale optimisation, the fit of individual items to the latent trait was analysed by the infit and outfit mean-square statistics. Values between 0.5 and 1.7 were considered to be indicative of acceptable fit [13]. Thereafter, Wright person-item maps were used to examine the distribution of item difficulty levels against the patients' levels of functioning during the first three days of hospitalisation.

<C>Confirmatory analysis

A cross-validation of internal consistency and Rasch item difficulty levels was conducted to confirm the findings of the exploratory analysis. A separate data source (Hospital Y) was used for this analysis, including 224 patients undergoing THR surgery between March 2009 and December 2010 (Table 1). All statistics were performed using R Version 3.3.1 or Winsteps Version 3.65.0.

<A>Results

<B>Exploratory analysis

Analysis of the scoring options revealed that Options 2, 3, 4 and 5 were not compliant with the preset criteria (at least 10 observations per category), and were recoded to maximise statistical performance and clinical meaningfulness of the mILAS (Table 2). Therefore, the response options were reduced from 7 to 3, merging Options 2 (minimal), 3 (moderate), 4 (maximal) and 5 (failed), and recoding Option 6 (not tested) to missing (recoded scoring: 0, 1, 2, 2, 2, 2, missing). The response options used for statistical analysis were 0 (independent), 1 (supervision) and 2 (with help).

<insert Table 2 near here>

The data collected on the first three postoperative days revealed internal consistency of the mILAS of 0.94, 0.88 and 0.95 (days 1, 2 and 3, respectively; Table 3). The internal consistency of the mILAS minus one item consistently revealed a lower Cronbach's α (-0.01 to 0.07), except for deletion of stair climbing which resulted in a higher α than for the total mILAS on days 2 and 3 (0.11 and 0.04, respectively).

<insert Table 3 near here>

Rasch analysis demonstrated adequate fit over the first three days, except for the mILAS items 'walking' (Day 1) and 'stair climbing' (Day 3), which did not fit with the partial credit model based on their outfit statistics (Table 4).

<insert Table 4 near here>

The level of difficulty of mILAS items is presented in Appendix 4 (see online supplementary material) as a distribution of the functional ability of participants and item difficulty of the mILAS items, as rated by the physiotherapist, for Days 1 to 3 after THR surgery. The item difficulty changed between Days 1 and 3, whereby, in particular, the mILAS item 'walking' was increasingly less difficult on Days 2 and 3 compared with the other items. The sit to stand transfer was the least difficult item on all three postoperative days, and the sit to supine transfer was the most difficult item on Days 2 and 3.

<B>Confirmative analysis

External cross-validation revealed similar results for internal consistency (Cronbach's α 0.86 to 1.0, except for stair climbing which could not be assessed based on the low frequencies reported in the confirmatory dataset on Days 1 to 3) and item difficulty levels (sit to supine transfer was most difficult, sit to stand transfer was least difficult).

<A>Discussion

The aim of this retrospective observational study was to assess the internal consistency and item difficulty of the mILAS in routine clinical practice across two large hospitals. In the

exploratory analysis, the internal consistency of the mILAS was acceptable on all three postoperative days. However, both Cronbach's α and Rasch analysis revealed that stair climbing may measure a different construct compared with the other mILAS items. The item difficulty of some mILAS items changed over the first two postoperative days. However, during the first three postoperative days, the sit to supine transfer was generally the most difficult item to achieve, and the sit to stand transfer was the least difficult item to achieve as rated by physiotherapists. The confirmatory analysis, conducted in a dataset from a different hospital, revealed similar results.

The internal consistency analysis revealed a misfit between stair climbing and the other items of the mILAS. This misfit may be caused by the variance in difficulty (assistance needed by the patient) of the independent mILAS items. The analysis revealed a skewed distribution of outcomes for stair climbing, which was the easiest item to complete for the majority of patients. During stair climbing, all patients used infrastructural assistance of a guardrail, and the timing of the measurement was at the end of the inpatient rehabilitation period. Based on these results, one might consider that stair climbing should be omitted from the mILAS because it is too easy to complete. However, it is an item that is highly relevant for patients who need to perform this activity from their first day at home. Therefore, it is suggested that stair climbing should not be omitted from the mILAS, but there is a need for awareness that its inclusion may be problematic from a purely psychometric point of view. Therefore, stair climbing might not be so easy when measured in a different population of patients (e.g. patients after abdominal surgery or neurologic diseases).

The recorded measurement of an instrument is linked inextricably to the context in which the measurement is performed [14]. In this study, the mILAS was measured within the context of two hospitals, where patients likely tended to rely on assistance from caregivers. An important question is whether the mILAS score would be the same in a different

environment, where assistance is less readily available. Although it is encouraging that the results were similar in two different hospitals, concerns over ecological validity should be borne in mind when interpreting the results of this study. It is suggested that healthcare professionals should keep this in mind during hospitalisation. Patients should be allowed to try their best before receiving help, and help should only be provided when necessary, rather than when it is expected by the patient.

For research and statistical purposes, the scoring rules of the mILAS could be altered as suggested by Benedetti *et al.* [15]. Based on the current findings, it is suggested that the six scoring options should be reduced to three scoring categories. However, this suggestion is based on the performance of mILAS scores when aggregated for statistical purposes. Use of the mILAS in a clinical setting could involve other considerations, where six scoring levels could prove relevant for the patient and (informal) caregiver. For example, the difference between minimal and maximal assistance could help individuals choose the proper help/assistance at home, although they are less meaningful for statistical purposes. Therefore, it is recommended that the scoring options of the mILAS should not be reduced in clinical practice.

These data for patients following THA surgery suggest that there is variability over time in internal consistency and item difficulty of the mILAS items. For example, internal consistency was lower on Day 2 compared with Days 1 and 3 (see Table 3), and the difficulty for walking item changed on Day 2 compared with Day 2 (see Appendix 4, online supplementary material). This new information could be useful for patients to form expectations for their recovery of activities, and for healthcare professionals to optimise clinical care pathways to the needs of the patients.

Strengths of this study include the use of data from regular clinical care with multiple physiotherapists involved in mILAS data collection. Additionally, use of a confirmatory

sample should increase confidence in the generalisability of the findings. However, this study also had some limitations. First, the inter-/intrareliability of the mILAS could not be assessed with these data. Additional work in this area could be valuable. This lack of inter-/intrarater reliability should be kept in mind when interpreting the results. Second, the dataset used for the confirmatory cross-validation originated from 2009 to 2010. Although this dataset is older, it revealed similar results, suggesting a stable outcome over time in spite of temporal or geographic differences. Third, during the study period, no fast-track regime was implemented, although this has recently increased in popularity for THR patients across many health systems [16]. Additionally, all patients in these datasets were mobilised on the day after surgery. This should be kept in mind when interpreting the results.

<A>Conclusion

The mILAS is a clinically sound measurement tool to assess the ability of patients to perform five functional tasks safely during hospitalisation. Stair climbing seems to be the easiest item to complete, and sit to supine transfer is the most difficult item to complete on Days 2 and 3, indicating that the latter item adds to the practical measurement range of the scale.

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Conflict of interest: None declared.

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Table 1
Patient characteristic of the exploratory and confirmatory datasets

		Hospital X (*n*=225)			Hospital Y (*n*=224)		
		n	Mean (median)	SD (range)	*n*	Mean (median)	SD (range)
Age (years)		225	71.2	9.9	224	69.0	8.9
TUG (seconds)		213	14.27	10.17	215	10.8	4.9
Length of stay (days)		225	(3)	(2 to 20)	224	(4)	(3 to 14)
		n	%		n	%	
Sex	Male	81	36.0		75	33.5	
	Female	144	74.0		149	66.5	
BMI (kg/m^2)	<25	82	36.6		60	26.8	
	≥25	142	63.4		164	73.2	
ASA score	1	34	15.1		42	22.5	
	2	152	67.6		136	72.7	
	3	38	16.9		9	4.8	
	4	1	0.4		0	0	
Charnley score	A	187	83.5		128	57.9	
	B/C	37	16.5		93	42.1	

ASA, American Society of Anesthesiologists; BMI: body mass index; SD, standard deviation; TUG, timed up and go test.

Table 2
Percentage of patients within each rating category of the modified Iowa Level of Assistance Scale (mILAS) items during the first three days after total hip replacement surgery

	Percentage of patients by mILAS score[a]							Overall score		
	0	1	2	3	4	5	6	Mean	SD	Skew
Day 1										
Supine to sit	24	21	37	5	2	0	11	1.82	1.74	1.26
Sit to supine	23	20	34	5	1	0	17	2.10	1.98	1.01
Sit to stand	27	36	24	3	1	1	8	1.47	1.62	1.70
Walking	8	51	21	3	1	2	15	2.04	1.87	1.35
Stair climbing	0	0	0	0	0	0	0	6.00	0.00	-
Day 2										
Supine to sit	68	12	18	2	0	0	1	0.57	0.94	1.85
Sit to supine	62	12	23	2	0	0	2	0.74	1.17	2.14
Sit to stand	75	15	7	2	1	0	1	0.42	0.93	3.20
Walking	65	24	7	1	1	1	2	0.56	1.06	3.00
Stair climbing	16	3	0	0	0	1	80	4.88	2.30	-1.57
Day 3										
Supine to sit	78	10	11	0	0	0	2	0.42	1.02	3.49
Sit to supine	72	11	15	0	0	0	2	0.53	1.07	2.89
Sit to stand	86	11	3	0	0	0	1	0.22	0.72	5.44
Walking	81	16	2	0	0	0	1	0.26	0.72	5.20
Stair climbing	82	7	0	0	0	0	11	0.75	1.92	2.28

SD, standard deviation; skew, skewness.

[a]0, independent; 1, standby; 2, minimal; 3, moderate; 4, maximal; 5, failed; 6, not tested.

Table 3

Internal consistency (Cronbach's alpha) of the modified Iowa Level of Assistance Scale (mILAS) during the first three days after total hip replacement surgery

	Raw	Std	Δ Std
Day 1			
mILAS	0.94	0.94	0
mILAS without supine to sit	0.92	0.92	-0.02
mILAS without sit to supine	0.93	0.93	-0.01
mILAS without sit to stand	0.91	0.91	-0.03
mILAS without walking	0.94	0.94	0
mILAS without stair climbing	0.94	0.94	0
Day 2			
mILAS	0.91	0.88	0
mILAS without supine to sit	0.84	0.81	-0.07
mILAS without sit to supine	0.86	0.82	-0.06
mILAS without sit to stand	0.85	0.81	-0.07
mILAS without walking	0.86	0.82	-0.06
mILAS without stair climbing	0.97	0.97	0.11
Day 3			
mILAS	0.96	0.95	0
mILAS without supine to sit	0.93	0.93	-0.02
mILAS without sit to supine	0.93	0.93	-0.02
mILAS without sit to stand	0.93	0.93	-0.02
mILAS without walking	0.93	0.93	-0.02
mILAS without stair climbing	0.99	0.99	0.04

Raw, raw score; Std, standardised; Δ Std, difference in internal consistency of the mILAS without one item vs internal consistency score of the total mILAS score.

Table 4

Summary statistics of the item response theory (partial credit model) analysis

	Difficulty	SE	Infit Mnsq (Z-std)	Outfit Mnsq (Z-std)
Day 1				
Sit to supine	-0.01	0.23	0.60 (-3.0)	0.66 (-1.4)
Supine to sit	0.29	0.21	0.78 (-1.5)	0.66 (-1.3)
Sit to stand	1.56	0.24	1.01 (0.1)	0.85 (-0.4)
Walking	-1.84	0.29	1.37 (2.1)	4.51 (4.8)
Stair climbing	-	-	-	-
Day 2				
Sit to supine	-1.25	0.21	1.01 (0.1)	1.22 (0.8)
Supine to sit	-0.42	0.20	0.50 (-3.7)	0.58 (-2.0)
Sit to stand	1.31	0.24	0.70 (-2.0)	0.63 (-2.1)
Walking	0.36	0.24	1.60 (3.6)	1.54 (3.0)
Stair climbing	-	-	-	-
Day 3				
Sit to supine	-0.85	0.30	1.07 (0.4)	1.10 (0.4)
Supine to sit	0.10	0.28	0.69 (-1.5)	0.53 (-1.4)
Sit to stand	1.86	0.36	0.70 (-1.3)	0.60 (-1.2)
Walking	1.80	0.36	1.27 (1.4)	1.33 (1.4)
Stair climbing	-2.91	1.31	2.22 (2.1)	4.27 (1.8)

Mnsq, mean square; SE, standard error; std, standard.