Brazilian Journal of Physical Therapy 28 (2024) 101047

Brazilian Journal of Physical Therapy

https://www.journals.elsevier.com/brazilian-journal-of-physical-therapy

ORIGINAL RESEARCH

Development, reliability, and validity of the mobility assessment scale in hospitalized patients (HMob)

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Received 6 July 2023; received in revised form 3 November 2023; accepted 22 February 2024
Available online 7 March 2024

KEYWORDS
Diagnosis;
Hospital;
Mobility limitation;
Reliability;
Validity

Abstract
Background: Existing mobility scales for hospitalized patients do not include assessment of tasks for the right and left side, ability to transfer from sitting to lying and from standing to sitting, ability to climbing steps and pick up an object from the floor in the same instrument.
Objective: Evaluate the reliability and validity of the hospital mobility assessment scale (HMob) according to the Consensus-based standards for the selection of health measurement instruments (COSMIN).
Methods: Study conducted in three inpatient units (cardiology, neurology, and gastrohepatology) and one adult intensive care unit in a hospital. Patients of both sexes were included; age >18 years; collaborative and who obeyed commands, with different medical diagnoses and clinical release to leave their bed (provided by the doctor). Special populations such as those with burns and orthopedics were excluded.
Results: The sample consisted of 130 patients; 20 from the pilot study and 110 to assess the clinimetric properties of the HMob. Cronbach alpha coefficient was 0.949. Relative intra- (A1-A2) and inter-rater (A1-B; A2-B) reliability was excellent (A1-A2: ICC = 0.982, p-value < 0.0001; A1-B: ICC = 0.993, p-value < 0.0001; A2-B: ICC = 0.986, p-value < 0.0001.) The convergent criterion validity of HMob in relation to the ICU Functional Status Score was 0.967 (p-value < 0.0001) and for Functional Independence measure (MIF) was 0.926 (p-value < 0.0001).
Conclusion: The HMob scale showed excellent internal consistency, intra- and inter-rater reliability, and concurrent validity in the motor domain, which suggests that it can be used in daily practice to measure mobility in hospitalized patients.

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https://doi.org/10.1016/j.bjpt.2024.101047

Introduction

Mobility is defined as the ability to move independently and safely to perform activities and functional tasks, as well as participate in activities of daily living at home, at work, and in the community.[1] Hospitalization predisposes to a decline in this mobility,[2-5] especially in patients with more severe conditions or those who spend longer periods in a low level of activity.[6] This occurrence is associated with a higher risk of hospital readmission, long-term disability, and higher mortality one year after hospital discharge, making it important to measure mobility in the hospital environment.[2,7]

The purpose of mobility measurement is to accurately describe functional changes, stratify the risk of functional loss for each patient, direct interventions according to the degree of previous function, document the effectiveness of interventions, and compare to results in the literature.[2,3,8] Some functional scales have been described in the scientific community and there are currently several scales that propose to assess aspects of mobility of hospitalized patients.[9,10] However, none of them meets all the needs that help professionals in this task, in a feasible and objective way, while having strong measurement properties.[10,11] To develop a reliable scale for evaluating mobility assessment in hospitalized patients, it is necessary to validate the characteristics of this scale according to Consensus-based Standards of the selection of health Measurement Instruments (COSMIN).[12]

Existing scales do not include assessment of tasks performed for the right and left side, ability to transfer from sitting to lying and from standing to sitting, ability to climb steps and pick up an object from the floor using the same instrument, skills related to an adequate level of independence for activities of daily living. Thus, the aim of this study was to develop and evaluate the reliability and concurrent validity of the hospital mobility assessment scale (HMob). With the formulation of the new instrument, it is expected to monitor specific aspects of the mobility of hospitalized patients more precisely, with the potential to significantly contribute to the diagnosis and physical therapy prognosis of these patients.

Methods

This study was conducted in accordance with the COSMIN.[12,13] The research project was approved by the ethics committee of the Hospital Universitário Professor Edgard Santos (HUPES) of the Universidade Federal da Bahia (UFBA) with opinion number 5.512.119. All participants signed the informed consent form before participating in this study.

Study setting, population, and data collection

This study was conducted in three inpatient units (cardiology, neurology, and gastrohepatology) and an adult intensive care unit of a university hospital. The selected sample was patients hospitalized during the period from 2019 to 2022. Patients of both sexes were included; aged >18 years; collaborative and who obeyed commands; with different medical diagnoses; and with clinical release to leave their bed (provided by the doctor). Exclusion criteria were special populations such as burned and orthopedic patients or those who did not agree to participate in the study.

Study procedures

The scale was developed based on the mobility-related domains of the International Classification of Functioning, Disability and Health (ICF) and on previous scales on mobility, and was modified throughout phase 1 of the study and subsequently assessed by 5 specialist physical therapists with >10 years of expertise in hospital care. After final analysis, the instrument was submitted to Phase 2.[14] Fig. 1 describe all methodological procedures for the initial development and the reliability and validity assessment of the HMob scale.

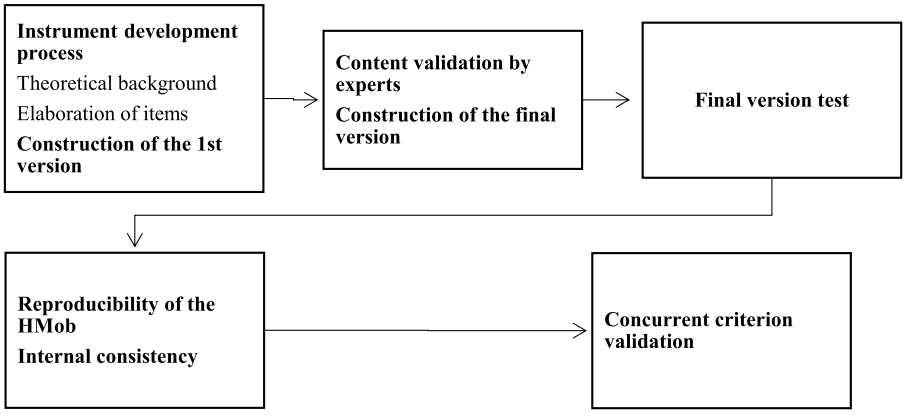

Fig. 1 Methodological procedures for the development and testing reliability and validity of the HMob scale.

The HMob scale consists of an alphanumeric scoring instrument divided in 3 blocks to more easily identify the patient's function:

- Block 1 (mobility in bed): rolling on the right and left side, moving from lying down to sitting (on the right and left side of the bed), remaining seated at the edge of the bed and returning to lying in bed (on the right and left side), evaluating the patient's performance for both sides, as well as the ability to return to bed after sitting. The score ranges from 0 to 42 points.
- Block 2 (bedside mobility): transfer activities to standing, stay in a standing position, transferring to sitting in a chair next to the bed, and sitting after standing. The score ranges from 0 to 24 points.
- Block 3 (mobility in space): ability to walk at least 5 m, climb steps 5 times, pick up a pen from the floor, and return to orthostasis after picking up the pen from the floor. The score ranges from 0 to 24 points.

The score ranges from 0 to 6 points for each item, with a score of 0 when the patient does not perform the activity and 6 when the patient performs the activity independently, with a total possible HMob score ranging from 0 to 90 points. In case of clinical restrictions preventing assessment of a given task, the acronym "CR," which indicates Clinical Restriction, was used. The complete description of the Hmob scale is in Table 1.

In phase 2, bedside mobility was assessed using the new instrument (HMob Scale) and the Functional Status Score for the Intensive Care Unit scale (FSS-ICU)[3] to determine concurrent criterion validity. Clinical and sociodemographic data were gathered from the medical records, muscle strength was measured using the Medical Research Council Score (MRC), and mobility prior to hospitalization was recorded using the Barthel index.[15,16]

The evaluators were composed of the hospital's physical therapists, physical therapy students, and the primary researcher, all previously trained in the application of the HMob Scale. To assess reliability, the HMob was applied by 2 independent evaluators, one of which evaluated the patient on two occasions for intra-examiner evaluation, with no contact between them during the measurement interval. Physical therapist A1 performed the Hmob (test 1) and physical therapist B performed the other assessment with the Hmob (test 2) to assess inter-rater reliability. One of the evaluators completed the 2nd evaluation (A2 re-test) during the opposite shift. Assessments were conducted in the morning before any rehabilitation session and in the afternoon, where patients may or may not have already undergone a rehabilitation session. Assessments were conducted at different times, but under similar conditions, to minimize bias in the assessment. The research hospital rooms are spacious and allow patients to be transferred to both sides, which minimizes measurement bias. The safety criteria adopted for interrupting the mobility evaluation were peripheral oxygen saturation (SpO2) $<92\%$; respiratory rate (RR) >35 breath per minute (bpm); report of dyspnea; use of accessory breathing muscles or paradoxical pattern; symptomatic postural hypotension; systolic blood pressure (SBP) <90 or >160 mmHg; heart rate (HR) <50 or >130 beats per minute (bpm); cardiac arrhythmia; and pain.[17]

Statistical analysis

Data were analyzed with SPSS Statistics version 22.0 (SPSS, Inc, Chicago, Ill). Content validity was assessed through the qualitative assessment of a committee of experts composed of four physical therapists (three PhDs and one specialist). Reliability and validity were the clinimetric properties analyzed on HMob. Interrater reliability of the Hmob was tested by the calculation of intraclass correlation coefficients (ICC) and internal consistency was assessed using Cronbach's coefficient α. Cronbach's coefficient α values between 0.81 and 1: almost perfect; 0.61 to 0.80: substantial; 0.41 to 0.6: moderate; 0.21 to 0.40: fair; 0 to 0.21: small.[18] To assess the relative intra- and inter-rater reliability, the ICC was used, with the following interpretation (0.76 to 1: excellent; 0.61 to 0.75: good; 0.4 to 0.6: fair; <0.4: poor).[19,20] To assess absolute reliability, Bland-Altmann was used to analyze the precision between the intra- and inter-examiner measurements. The concurrent criterion validity was assessed using Pearson's correlation analysis for the HMob scores and those obtained on the Functional Status Score for the Intensive Care Unit (FSS-ICU), a validated instrument that evaluates the same construct (mobility), as well as with the Functional Independence Measure (FIM), for the motor domain, which assesses functional independence.[18,21] Ceiling and floor effects were tested by frequency and considered present if 15% or more of the items reached the maximum or minimum scores on the instrument. A p-value <0.05 was considered statistically significant.

Results

The final version of the HMob consisted of the evaluation of 15 mobility-related tasks, which were divided into three blocks (mobility in bed, bedside, and space), with a score from 0 to 6 for each task. We identified excellent clinimetric properties of internal consistency, intra- and inter-rater reliability, and validity in relation to the FSS and MIF scales.

The testing of items in an independent sample was performed on 110 patients with a mean (standard deviation) age of 53.3 (14.6) years, most of whom had an admission diagnosis for a clinical (non-surgical) reason (77.6%). Table 2 shows the baseline characteristics of the patients included in this study. The mean previous functional independence measured prior to hospitalization by the Barthel index was 92.6 (17.4), with a mean muscle strength score (MRC) of 51.7 (11.0). There were 21 adverse events during the examiners' assessments (A1, B, A2), eight for A1 (4 hypotension and 4 hypertension events); 6 for A2 (1 hypotension, 2 hypertension, 1 pain, 1 dizziness, 1 respiratory distress); and 7 for B (2 hypertension, 2 pain, 3 respiratory distress). All adverse events improved after interruption of the assessment, with no worsening of cases or need for invasive interventions. Table 3 describes the data for muscle strength and mobility assessment scales. The description of the most frequent reason for admission and the characteristics of age, muscle strength, and mobility are provided in the Supplementary Material Online.

Internal consistency assessed by Cronbach's alpha coefficient was 0.949. Relative intra (A1-A2) and inter-examiner (A1-B; A2-B) reliability was excellent (A1-A2: ICC = 0.982,

Table 1 Full description of the Hmob scale.

BLOCK 1 - MOBILITY IN THE BED							
Task description	**0**	**1**	**2**	**3**	**4**	**5**	**6**
Roll over to the right - *Does the patient need help to roll over in bed to the right side?*	The patient does not perform any stage of the activity, regardless of whether the reason that makes it difficult is muscle weakness, sensory alteration, pain, or alteration of cardiorespiratory functions. If clinical restriction, do not score (write CR).	The patient requires great help from the evaluator to perform the activity. About 25 % of the movement is performed by the patient.	The patient requires moderate help from the evaluator to perform the activity. About 50 % of the movement is performed by the patient.	The patient requires little help from the evaluator to perform the activity. About 75 % of the movement is performed by the patient.	The patient performs the activity without assistance but requires guidance or verbal encouragement from the evaluator to roll.	The patient performs the activity but uses the bed rail or external object to roll over in bed.	The patient performs the activity independently, without the need to use the bed rail or other external object or verbal reinforcement.
Roll over to the left - *Does the patient need help to roll over in bed to the left side?*	The patient does not perform any stage of the activity, regardless of whether the reason that makes it difficult is muscle weakness, sensory alteration, pain, or alteration of cardiorespiratory functions. If clinical restriction, do not score (write CR).	The patient requires great help from the evaluator to perform the activity. About 25 % of the movement is performed by the patient.	The patient requires moderate help from the evaluator to perform the activity. About 50 % of the movement is performed by the patient.	The patient requires little help from the evaluator to perform the activity. About 75 % of the movement is performed by the patient.	The patient performs the activity without assistance but requires guidance or verbal encouragement from the evaluator to roll.	The patient performs the activity but uses the bed rail or external object to roll over in bed.	The patient performs the activity independently, without the need to use the bed rail or other external object or verbal reinforcement.
Transfer from Lying to Sitting Bedside (Right Side) - *Does the patient need assistance to sit to the right side of the bed from a lying position?*	The patient does not perform any stage of the activity, regardless of whether the reason that makes it difficult is muscle weakness, sensory alteration, pain or alteration of cardiorespiratory functions. If clinical restriction, do not score (write CR).	The patient requires great help from the evaluator to perform the activity. About 25 % of the movement is performed by the patient. Bilateral manual assistance may be required.	The patient requires moderate help from the evaluator to perform the activity. About 50 % of the movement is performed by the patient. Bilateral manual assistance may be required.	The patient requires little help from the evaluator to perform the activity. About 75 % of the movement is performed by the patient. Bilateral manual assistance may be required.	The patient performs the activity without assistance, but requires guidance or verbal encouragement from the evaluator to sit at bedside to the right side.	The patient performs the activity but uses the bed rail or an external object to sit at bedside.	The patient performs the activity independently, without the need to use the bed rail or other external object or verbal reinforcement.
Transfer from Lying to Sitting Bedside (Left Side) - *Does the patient need assistance to sit to the left side of the bed from a lying position?*	The patient does not perform any stage of the activity, regardless of whether the reason that makes it difficult is muscle weakness, sensory alteration, pain or alteration of cardiorespiratory functions. If clinical restriction, do not score (write CR).	The patient requires great help from the evaluator to perform the activity. About 25 % of the movement is performed by the patient. Bilateral manual assistance may be required.	The patient requires moderate help from the evaluator to perform the activity. About 50 % of the movement is performed by the patient. Bilateral manual assistance may be required.	The patient requires little help from the evaluator to perform the activity. About 75 % of the movement is performed by the patient. Bilateral manual assistance may be required.	The patient performs the activity without assistance, but requires guidance or verbal encouragement from the evaluator to sit at bedside to the left side.	The patient performs the activity but uses the bed rail or an external object to sit at bedside.	The patient performs the activity independently, without the need to use the bed rail or other external object or verbal reinforcement.

Table 1 (*Continued*)

BLOCK 1 - MOBILITY IN THE BED							
Staying seated - *Does the patient need assistance to stay seated at bedside?*	The patient does not perform any stage of the activity, regardless of whether the reason that makes it difficult is muscle weakness, sensory alteration, pain, or alteration of cardiorespiratory functions. If clinical restriction, do not score (write CR).	The patient requires great help from the evaluator to maintain the posture. About 25 % of posture maintenance is performed by the patient. Bilateral manual assistance may be required.	The patient requires moderate help from the evaluator to maintain the posture. About 50 % of posture maintenance is performed by the patient. Bilateral manual assistance may be required.	The patient requires little help from the evaluator to maintain posture. About 75 % of posture maintenance is performed by the patient.	The patient remains seated unassisted for at least 10 s, but requires guidance or verbal encouragement to maintain the posture.	The patient maintains the posture for at least 10 s without assistance from the evaluator, but uses the fixation of the upper limbs to remain seated.	The patient performs the activity independently, for at least 10 s, without the need for help with upper limbs or verbal reinforcement.
Return to lying position (from the right side of the bed) - *Does the patient need assistance returning to bed from a sitting position?*	The patient does not perform any stage of the activity, regardless of whether the reason that makes it difficult is muscle weakness, sensory alteration, pain, or alteration of cardiorespiratory functions. If clinical restriction, do not score (write CR).	The patient requires great help from the evaluator to perform the activity. About 25 % of the movement is performed by the patient. Bilateral manual assistance may be required.	The patient requires moderate help from the evaluator to perform the activity. About 50 % of the movement is performed by the patient. Bilateral manual assistance may be required.	The patient requires little help from the evaluator to perform the activity. About 75 % of the movement is performed by the patient. Bilateral manual assistance may be required.	The patient performs the activity without assistance, but requires guidance or verbal encouragement to return to bed on the right side.	The patient performs the activity but uses the bed rail or an external object to return to the bed on the right side.	The patient performs the activity independently, without the need to use the bed rail or other external object or verbal reinforcement.
Return to lying position (from the left side of the bed) - *Does the patient need assistance returning to bed from a sitting position?*	The patient does not perform any stage of the activity, regardless of whether the reason that makes it difficult is muscle weakness, sensory alteration, pain, or alteration of cardiorespiratory functions. If clinical restriction, do not score (write CR).	The patient requires great help from the evaluator to perform the activity. About 25 % of the movement is performed by the patient. Bilateral manual assistance may be required.	The patient requires moderate help from the evaluator to perform the activity. About 50 % of the movement is performed by the patient. Bilateral manual assistance may be required.	The patient requires little help from the evaluator to perform the activity. About 75 % of the movement is performed by the patient. Bilateral manual assistance may be required.	The patient performs the activity without assistance, but requires guidance or verbal encouragement to return to bed on the left side.	The patient performs the activity but uses the bed rail or an external object to return to the bed on the left side.	The patient performs the activity independently, without the need to use the bed rail or other external object or verbal reinforcement.
BLOCK 2 - BEDSIDE MOBILITY							
Task description	**0**	**1**	**2**	**3**	**4**	**5**	**6**
Transfer from sitting to standing - *Does the patient need assistance to stand up from a sitting position?*	The patient does not perform any stage of the activity, regardless of whether the reason that makes it difficult is muscle weakness, sensory alteration, pain. or alteration of cardiorespiratory functions. If clinical restriction. do not score (write CR).	The patient requires great help from the evaluator to perform the activity. About 25 % of the movement is performed by the patient. Bilateral manual assistance may be required.	The patient requires moderate help from the evaluator to perform the activity. About 50 % of the movement is performed by the patient. Bilateral manual assistance may be required.	The patient requires little help from the evaluator to perform the activity. About 75 % of the movement is performed by the patient. Bilateral manual assistance may be required.	The patient performs the activity without assistance, but requires guidance or verbal encouragement.	The patient performs the activity, but needs support from the upper limbs with an auxiliary device to get up.	The patient performs the activity independently, without the need for support with the upper limbs or verbal reinforcement.

Table 1 (*Continued*)

BLOCK 1 - MOBILITY IN THE BED							
Stay in a standing position - *Does the patient need assistance to stand?*	The patient does not perform any stage of the activity, regardless of whether the reason that makes it difficult is muscle weakness, sensory alteration, pain, or alteration of cardiorespiratory functions. If clinical restriction. do not score (write CR).	The patient requires great help from the evaluator to maintain the posture. About 25 % of posture maintenance is performed by the patient. Bilateral manual assistance may be required.	The patient requires moderate help from the evaluator to maintain the posture. About 50 % of posture maintenance is performed by the patient. Bilateral manual assistance may be required.	The patient requires little help from the evaluator to maintain posture. About 75 % of posture maintenance is performed by the patient.	The patient maintains the posture without assistance for at least 10 s, but requires verbal guidance or encouragement to remain upright.	The patient maintains the posture for at least 10 s without assistance from the evaluator, but uses the support of the upper limbs through an auxiliary device to remain standing.	The patient maintains the posture independently for at least 10 s without the need for external assistance (gait device or evaluator) or verbal reinforcement.
Return from standing position to sitting - *Does the patient need assistance to sit down after standing?*	The patient does not perform any stage of the activity, regardless of whether the reason that makes it difficult is muscle weakness, sensory alteration, pain. or alteration of cardiorespiratory functions. If clinical restriction. do not score (write CR).	The patient requires great help from the evaluator to perform the activity. About 25 % of the movement is performed by the patient. Bilateral manual assistance may be required.	The patient requires moderate help from the evaluator to perform the activity. About 50 % of the movement is performed by the patient. Bilateral manual assistance may be required.	The patient requires little help from the evaluator to perform the activity. About 75 % of the movement is performed by the patient. Bilateral manual assistance may be required.	The patient performs the activity without assistance, but requires guidance or verbal encouragement.	The patient performs the activity, but needs support from the upper limbs with an auxiliary device to sit down.	The patient performs the activity independently, without the need for support with the upper limbs or verbal reinforcement.
Self-transfer to out-of-bed sitting - *Does the patient need assistance transferring to out-of-bed sitting?*	The patient does not perform any stage of the activity, regardless of whether the reason that makes it difficult is muscle weakness, sensory alteration, pain. or alteration of cardiorespiratory functions. If clinical restriction. do not score (write CR).	The patient requires great help from the evaluator to perform the activity. About 25 % of the movement is performed by the patient. Bilateral manual assistance may be required.	The patient requires moderate help from the evaluator to perform the activity. About 50 % of the movement is performed by the patient. Bilateral manual assistance may be required.	The patient requires little help from the evaluator to perform the activity. About 75 % of the movement is performed by the patient. Bilateral manual assistance may be required.	Patient transfers without assistance but requires verbal guidance or encouragement.	The patient performs the activity, but needs support from the upper limbs through an auxiliary device to transfer.	The patient transfers independently, without the need for support with the upper limbs with an auxiliary device or verbal reinforcement.
BLOCK 3 - MOBILITY IN SPACE							
Task description	**0**	**1**	**2**	**3**	**4**	**5**	**6**
Ambulation - *The patient needs assistance to walk?*	The patient does not perform any stage of the activity, regardless of whether the reason that makes it difficult is muscle weakness, sensory alteration, pain, or alteration of cardiorespiratory functions. If clinical restriction, do not score (write CR).	The patient needs a lot of help to walk a distance of less than 5 m. About 25 % of the movement is performed by the patient. Bilateral manual assistance may be required.	The patient requires moderate assistance to walk a distance of at least 5 m. About 50 % of the movement is performed by the patient. Bilateral manual assistance may be required..	The patient requires light assistance from one person to walk a distance of at least 5 m. About 75 % of the movement is performed by the patient.	Patient requires continuous supervision to walk a distance of at least 5 m.	Patient walks without assessor assistance a distance of at least 5 m, but requires a gait device.	The patient walks independently, a distance of at least 5 m, without the need for external assistance (gait device or evaluator) or verbal reinforcement.

Table 1 (*Continued*)

BLOCK 1 - MOBILITY IN THE BED							
Crouch to pick up a pen on the floor - *Does the patient need assistance picking up a pen off the floor?*	The patient does not perform any stage of the activity, regardless of whether the reason that makes it difficult is muscle weakness, sensory alteration, pain, or alteration of cardiorespiratory functions. If clinical restriction, do not score (write CR).	The patient requires great help from the evaluator to perform the activity. About 25 % of the movement is performed by the patient. Bilateral support Bilateral manual assistance may be required.	The patient requires moderate help from the evaluator to perform the activity. About 50 % of the movement is performed by the patient. Bilateral manual assistance may be required..	The patient requires little help from the evaluator to perform the activity. About 75 % of the movement is performed by the patient. Bilateral manual assistance may be required.	The patient performs the activity without assistance, but requires verbal guidance or encouragement.	The patient performs the activity, but needs to lean on some device or surface.	The patient performs the activity independently, without the need for support with the upper limbs or verbal reinforcement.
Return to position standing after squatting to pick up a pen from the floor - *Does the patient need assistance to return to position standing after picking up the object from the floor?*	The patient does not perform any stage of the activity, regardless of whether the reason that makes it difficult is muscle weakness, sensory alteration, pain, or alteration of cardiorespiratory functions. If clinical restriction, do not score (write CR).	The patient requires great help from the evaluator to perform the activity. About 25 % of the movement is performed by the patient. Bilateral manual assistance may be required.	The patient requires moderate help from the evaluator to perform the activity. About 50 % of the movement is performed by the patient. Bilateral manual assistance may be required.	The patient requires little help from the evaluator to perform the activity. About 75 % of the movement is performed by the patient. Bilateral support Bilateral manual assistance may be required.	The patient performs the activity without assistance, but requires verbal guidance or encouragement.	The patient performs the activity, but needs to lean on some device or surface.	The patient performs the activity independently, without the need for support with the upper limbs or verbal reinforcement.
Climb five steps - Does the patient need assistance to climb five steps?	The patient does not perform any stage of the activity, regardless of whether the reason that makes it difficult is muscle weakness, sensory alteration, pain or alteration of cardiorespiratory functions. If clinical restriction do not score (write CR).	The patient needs great assistance to climb less than 5 times the step. About 25 % of the movement is performed by the patient. Bilateral manual assistance may be required.	The patient requires moderate assistance to climb the step 5 times. About 50 % of the movement is performed patient. Bilateral manual assistance may be required.	The patient requires light assistance to climb the step 5 times. About 75 % of the movement is performed by the patient. Bilateral manual assistance may be required.	Patient requires continuous supervision to step 5 times up the step.	The patient climbs 5 times without assistance from the evaluator using a walking aid or surface support.	The patient climbs the step 5 times independently, without the need for external help (gait device or evaluator) or verbal reinforcement.

Table 2 Sociodemographic and clinical characteristics of patients (n = 110).

	N (%)		
Age		53.3 (14.6)	
Hospital admission day (Days)			6 (3−13)
Glasgow coma scale (GCS)		15.0 (0.4)	
Place of hospital admission			
Liver ward	30 (28.0)		
Cardiovascular ward	30 (28.0)		
Neurological ward	33 (30.8)		
Intensive care unit	14 (13.1)		
Sex			
Female	50 (46.7)		
Male	57 (53.3)		
Admission profile			
Clinical	83 (77.6)		
Surgical	24 (22.4)		
Comorbidities			
SAH	53 (49.5)		
DM	34 (31.8)		
Dyslipidemia	7 (6.5)		
Cardiac	45 (42.1)		
Pulmonary	9 (8.4)		
Neurological	40 (37.4)		
Vascular	16 (15.0)		
Neoplasms	5 (4.7)		
Arthropathies	3 (2.8)		
Gastrohepatic	36 (33.6)		
Mechanical ventilation(yes)	2 (1.9)		
Adverse events - A1	8 (7.5)		
Adverse events - B	7 (6.5)		
Adverse events − A2	6 (5.6)		

A1, evaluator A first test; A2, evaluator A retest; B, evaluator B; DM, diabetes mellitus; SAH, systemic arterial hypertension.
All data are N(%) except for hospital admission day [median (interquartile range 25 %−75 %)] and age and Glasgow Coma Scale [mean (standard deviation)].

Table 3 Values of the measurements of the muscle strength and mobility assessment scales in the study sample (n: 110).

	Mean (SD)	Median (IQR 25−75%)
HMob(Block 1 A1)	38.1 (7.5)	40 (38−42)
HMob(Block 2 A1)	20.6 (6.5)	24 (21−24)
HMob(Block 3 A1)	16.8 (9.1)	23 (10−24)
HMob(Total A1)	75.1 (20.0)	85 (68−89)
FSS(A1)	30.9 (6.7)	34 (30−35)
FIM(A1)	11.3 (4.5)	14 (10−14)
HMob(Block 1 B)	38.1 (6.6)	41 (38−42)
HMob(Block 2 B)	20.6 (6.5)	24 (21−24)
HMob(Block 3 B)	16.8 (9.1)	23 (10−24)
HMob(Total B)	75.3 (20.0)	86 (66−89)
HMob(Block 1 A2)	38.1 (6.8)	41 (38−42)
HMob(Block 2 A2)	20.6 (6.5)	24 (20−24)
HMob(Block 3 A2)	17.1 (8.9)	23 (11−24)
HMob(Total A2)	75.6 (20.1)	86 (68−89)
Prior Barthel Index	92.6 (17.4)	
Muscle strength (MRC)	51.7 (11.0)	

A1, evaluator A first test; A2, evaluator A retest; B, evaluator B; FIM: functional independence measure, FSS, Functional Status Scale measure; MRC: medical research council.

95% CI = 0.973, 0.988, p-value , 0.0001; A1-B: ICC = 0.993, 95 % CI = 0.990, 0.995, p-value $<$ 0.0001; A2-B: ICC = 0.986, 95%CI = 0.979, 0.990, p-value $<$ 0.0001). For analysis of absolute reliability using the Bland-Altmann method, the following mean biases and limits of agreement between raters were observed (A1- A2: −0.29, upper limit: 6.5, lower limit: - 7.1, p-value: 0.703; A1-B: −0.123, upper limit: 6.38, lower limit: −6.63, p-value: 0.394; A2-B: −0.137, upper limit: 4.7, lower limit: −4.95, p-value: 0.575), which are described in Fig. 2. The criterion validity of HMob through Pearson's correlation analysis was 0.967 (p-value $<$ 0.0001) when compared to the FSS and 0.926 (p-value $<$ 0.0001) for the MIF. The ceiling effect was 20.9 % while the floor effect was 0 %.

Discussion

In this study, a new scale was developed to assess mobility in hospitalized patients, to address relevant aspects of this important variable that must be measured during hospitalization. We identified high internal consistency, intra- and inter-rater reliability, and validity in relation to the FSS and MIF scales. The final version of the HMob consisted of 15 mobility-related tasks, which were divided into three blocks

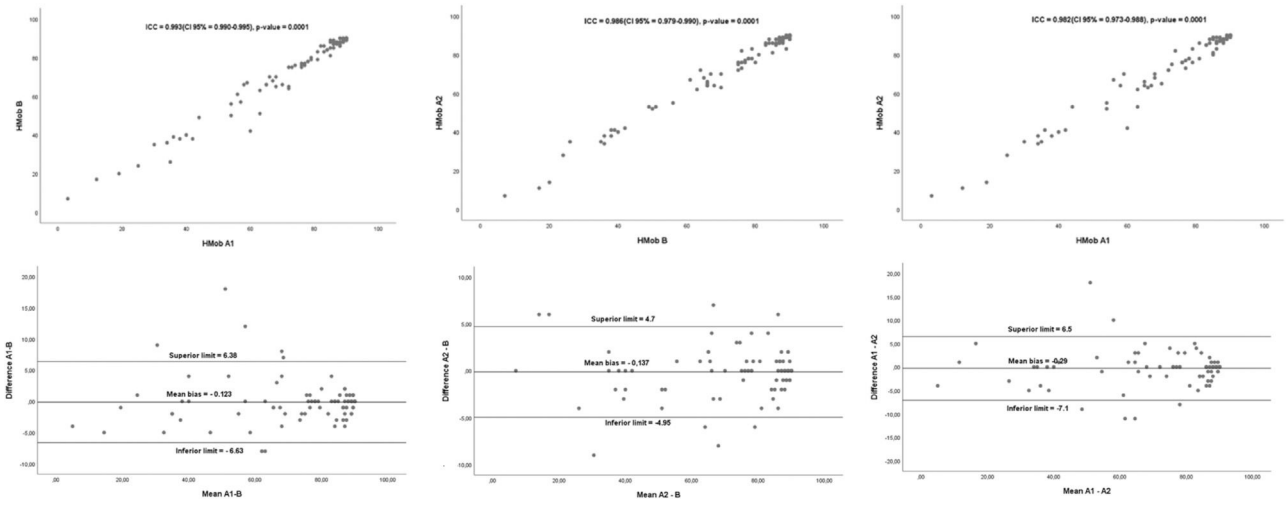

Fig. 2 Bland-Altmann graphs and ICC analysis of measurements performed with the Hmob scale.

(mobility in bed, bedside, and space), with a score from 0 to 6 for each task.

The main advantages of HMob compared to other instruments were the assessment of laterality in the execution of tasks, in addition to including the main tasks related to basic mobility, from those in bed to those involving displacement in space. It is essential to monitor patients with laterality changes, such as patients with stroke, which was the most frequent population in the neurological ward. Based on this information, we can suggest placing the patient in a bed which makes their movement easier and safer. Another positive aspect of this study was having applied this scale in different clinical settings in the hospital environment, including patients with cardiovascular, neurological, clinical and critical problems, both in inpatient units and in adult intensive care units. Unlike the FSS scale, for example, its use is not restricted only in situations where the cause of the change in mobility was muscle weakness, but also in situations where the cause encompassed other problems such as sensorineural changes, motor control, and cardiorespiratory changes, for examples.[11]

With this new scale, the score for each task was also simplified in relation to other instruments such as the FSS, which has 8 scoring levels, whereas the HMob has 7 scoring levels. Although there are good levels of reliability for FSS and FIM21, there is some difficulty in levels 0, 1, and 2, which can be minimized by reducing it to 2 levels (0 and 1), still including the qualification of clinical restriction (CR) for situations where the evaluation was not possible due to this reason.[11]

From the point of view of its applicability, there was a 6.36% occurrence of adverse events during the evaluation, all resolving after interruption of the evaluation, without serious complications. Although the use of the scale is safe, caution must be taken when applying it because it involves basic activities performed with a greater intensity in relation to day-to-day activities such as climbing stairs and squatting. The low floor effect found in this study suggests good use of the instrument in most patients. The ceiling effect of approximately 20.9% was equivalent to other studies and can be explained by the fact that most of the evaluated patients were in the inpatient units and had a better level of mobility.[22,23]

One of the limitations of the study was the percentage of ceiling effect, which may suggest a low ability to identify improvements, but it has a low impact because the purpose of the instrument is to be used in the assessment of basic mobility. Another limitation was the adverse events found, but these resolved quickly after rest.

Conclusion

The HMob scale showed excellent internal consistency, intra- and inter-rater reliability, and convergent validity with the FSS scales and the FIM (motor domain), which suggests that it can be used in daily practice to measure mobility in hospitalized patients. New studies are needed to assess HMob responsiveness and prognostic ability with post-discharge outcomes.

Conflicts of interest

The authors declare that they have no conflicts of interest.

Acknowledgements

The study received support from the Conselho Nacional de Desenvolvimento Científico e Tecnológico — Brasil(CNPq) and from the Fundo de Amparo à Pesquisa do Estado da Bahia(FAPESB). “Bolsista do CNPq — Brasil” and “Bolsista da FAPESB”

Supplementary materials

Supplementary material associated with this article can be found in the online version at doi:10.1016/j.bjpt.2024.101047.

References

1. Bouça-Marchado R, Maetzler W, Ferreira J. What is functional mobility applied to Parkinson's disease? *J Parkinsons Dis*. 2018;8 (1):128–130. https://doi.org/10.3233/JPD-171233.
2. Rydingsward JE, Horkan CM, Mogensen KM, Quraishi SA, Amrein K, Christopher KB. Functional status in ICU survivors and out of hospital outcomes: a cohort study. *Crit Care Med*. 2016;44 (5):869–879. https://doi.org/10.1097/CCM.0000000000001627.
3. Silva VZ, Araujo Neto JA, Cipriano Jr G, Pinedo M, Needham DM, Zanni JM, et al. Versão brasileira da escala de Estado Funcional em UTI: tradução e adaptação transcultural. *Rev Bras Ter Intensiva*. 2017;19(1):34–38. https://doi.org/10.5935/0103-507X.20170006.
4. Parry SM, Granger CL, Berney S, Jones J, Beach L, El-Ansary D, et al. Assessment of impairment and activity limitations in the critical ill: a systematic review of measurement instruments and their clinimetric properties. *Intensive Care Med*. 2015;41 (5):744–762. https://doi.org/10.1007/s00134-015-3672-x.
5. Parry SM, Denehy L, Beach L, Berney S, Williamson H, Granger C. Functional outcomes in ICU – what should we be using? – an observational study. *Crit Care*. 2015;19:127. https://doi.org/10.1186/s13054-015-0829-5.
6. Jesus F, Paim D, Brito J, Barros I, Nogueira T, Martinez B, et al. Declínio da mobilidade dos pacientes internados em unidade de terapia intensiva. *Rev Bras Ter Intensiva*. 2016;28(2):114–119. https://doi.org/10.5935/0103-507X.20160025.
7. Chase JA, Lozano A, Hanlon A, Bowles K. Identifying factors associated with mobility decline among hospitalized older adults. *Clin Nurs Res*. 2018;27(1):81–104. https://doi.org/10.1177/1054773816677063.
8. Tipping C, Bailey M, Bellomo R, Berney S, Buhr H, Denehy L, et al. the ICU Mobility Scale has construct and predictive validity and is responsive. *Ann Am Thorac Soc*. 2016;13(6):887–893. https://doi.org/10.1513/AnnalsATS.201510-717OC.
9. Parry S, Huang M, Needham D. Evaluating physical functioning in critical care: considerations for clinical practice and research. *Crit Care*. 2017:21–249. https://doi.org/10.1186/s13054-017-1827-6.
10. Kawaguchi YM, Nawa R, Figueiredo T, Martins L, Pires-Neto R. Perme Intensive Care Unit Mobility Score e ICU Mobility Score: tradução e adaptação cultural para a língua portuguesa falada no Brasil. *J Bras Pneumol*. 2016;42(6):429–434. https://doi.org/10.1590/S1806-37562015000000301.
11. Thrush A, Rosek M, Dekerlegand JL. The clinical utility of the functional status score for the intensive care unit at a long-term acute care hospital: a prospective cohort study. *J Am Phys Ther Assoc*. 2012;92(6):1536–1545. https://doi.org/10.2522/ptj.20110412.
12. Mokkink LB, Terwee CB, Patrick DL, Alonso J, Stratford PW, Knol DL, et al. The COSMIN checklist for assessing the methodological quality of studies on measurement properties of health status measurement instruments: an international Delphi study. *Qual Life Res*. 2010;19(4):539–549. https://doi.org/10.1007/s11136-010-9606-8.
13. Mokkink LB, Prinsen CA, Bouter LM, de Vet HC, Terwee CB. The COnsensus-based Standards for the selection of health Measurement INstruments (COSMIN). *Braz J Phys Ther*. 2016;20 (2):105–113. https://doi.org/10.1590/bjpt-rbf.2014.0143.
14. Organização Mundial da Saúde. *Classificação Internacional de Funcionalidade, Incapacidade e Saúde (CIF)*. 2004. Lisboa.
15. Latronico N, Gosselink R. Abordagem dirigida para o diagnóstico de fraqueza muscular grave na unidade de terapia intensiva. *Rev Bras Ter Intensiva*. 2015;27(3):199–201. https://doi.org/10.5935/0103-507X.20150036.
16. Keith RA, Granger CV, Hamilton BB, Sherwin FS. The functional independence measure: a new tool for rehabilitation. *Adv Clin Rehabil*. 1987;1:6–18.
17. Conceição T, Gonzáles AI, Figueiredo F, Vieira D, Bundchen DC. Critérios de segurança para iniciar mobilização precoce em unidade de terapia intensiva. Revisão sistemática. *Ver Bras Ter Intensiva*. 2017;29(4):509–519. https://doi.org/10.5935/0103-507X.20170076.
18. Landis JR, Koch CG. The measurement of observer agreement for categorical data. *Biometrics*. 1977;33(1):159–174.
19. Souza AC, Alexandre NM, Guirardello E. Propriedades psicométricas na avaliação de instrumentos: avaliação da confiabilidade e da validade. *Epidemiol Serv Saúde*. 2017;26 (3):649–659. https://doi.org/10.5123/s1679-49742017000300022.
20. Kottner J, Audige L, Brorson S, Donner A, Gajewski BJ, Hróbjartsson A, et al. Guidelines for reporting reliability and agreement studies (GRRAS) were proposed. *Int J Nurs Stud*. 2011;48(6):661–671. https://doi.org/10.1016/j.ijnurstu.2011.01.016.
21. Alves GAA, Martinez BP, Lunardi AC. Assessment of the measurement properties of the Brazilian versions of the Functional Status Score for the ICU and the Functional Independence Measure in critically ill patients in the intensive care unit. *Rev Bras Ter Intens*. 2019;31(4):521–528. https://doi.org/10.5935/0103-507X.20190065.
22. Huang M, Chan KS, Zanni JM, Parry SM, Neto SGB, Neto JAA, et al. Functional Status Score for the Intensive Care Unit (FSS-ICU): an international clinimetric analysis of validity, responsiveness, and minimal important difference. *Crit Care Med*. 2016;44(12):e1155–e1164. https://doi.org/10.1097/CCM.0000000000001949.
23. Denehy L, Morton NA, Skinner EH, Edbrooke L, Haines K, Warrillow S, et al. A physical function test for use in the intensive care unit: validity, responsiveness, and predictive utility of the physical function ICU test (scored). *Phys Ther*. 2013; 9312:1638–1645. https://doi.org/10.2522/ptj.20120310.