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ORIGINAL ARTICLE

Reliability and validity of the Spanish adaptation of the Functional Independence Measure + Functional Assessment Measure

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ABSTRACT

BACKGROUND: The Functional Independence Measure + Functional Assessment Measure (FIM+FAM) Scale is one of the most widely used instruments to measure functional independence post-stroke, and features many cultural adaptations to various languages.
AIM: The aim of this study was to determine the psychometric properties of a Spanish cross-cultural adaptation of the FIM+FAM for use in the stroke population.
DESIGN: Observational study.
SETTING: Outpatient long-term service of a neurorehabilitation unit.
POPULATION: One hundred and twenty-two individuals with stroke.
METHODS: The functional independence of the participants was assessed with the adapted version of the FIM+FAM. Additionally, the functional, motor and cognitive condition of the participants was assessed with a battery of standardized clinical instruments. Finally, a group of 31 participants out of the total were evaluated a second time with the FIM+FAM by a different evaluator than the one who performed the first evaluation. Internal consistency, inter-rater reliability and convergent validity with other clinical instruments of the adapted version of the FIM+FAM were determined.
RESULTS: The internal consistency of the adapted version of the FIM+FAM was excellent, as evidenced by Cronbach's α values that exceeded 0.973. The inter-rater reliability was likewise excellent, with correlations above 0.990 in all domains and subscales. Additionally, the convergent validity of the scale adaptation with clinical instruments was variable, with values ranging from 0.264 to 0.983, but consistent with the construct assessed in the different instruments examined.
CONCLUSIONS: The internal consistency, inter-rater reliability and convergent validity of the Spanish-adapted version of the FIM+FAM Scale showed excellent reliability and validity of the adaptation, which supports its use to assess functional independence after stroke.
CLINICAL REHABILITATION IMPACT: Availability of a valid adaptation for the evaluation of functional independence after stroke in Spanish population.

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KEY WORDS: Disability evaluation; Stroke; Reproducibility of results.

Stroke is one of the most common causes of disability,[1] as it can negatively affect motor, cognitive and social skills, limiting independence in activities of daily living.[2] As an example, recently published data from the 2020 survey on disability, personal autonomy and dependency situations show that a total of 361,500 people in Spain have

some type of disability caused by stroke.[3] Various instruments, such as the Barthel Index or the Functional Independence Measure (FIM) assess independence through performance in several activities of daily living. Specifically, the Barthel Index was originally developed by Mahoney and Barthel in 1965[4] and later modified by Collin, Wade, Davies and Horne[5] to assess motor independence and ambulation. Years later, the FIM was developed by a task force supported by the American Academy of Physical Medicine and Rehabilitation and the American Congress of Rehabilitation Medicine to address the lack of standardized measures of disability, the limited sensitivity of the Barthel Index, and to provide a tool based on the International Classification of Impairment, Disabilities and Handicaps that could be used in the medical system of the USA.[6] Currently, the FIM is one of the most widely used measures of disability not only in the United States, where accredited medical centers in various health commissions are required to use this tool[7], but in the rest of the world.

The FIM is composed of 18 items, 13 of them to assess the performance in motor activities, including self-care, sphincter control, transfers and locomotion, and the remaining 5 items to assess cognitive skills. The items are assessed on a scale of 1 to 7, where 1 represents total need for assistance and 7 represents total independence. The FIM can be administered individually or in conjunction with the Functional Assessment Measure (FAM), an add-on to this scale originally developed by a group at Santa Clara Valley Medical Center (San Jose, CA, USA) led by Karyl Hall in the late 1980s[8] to address areas of rehabilitation underrepresented on the FIM, especially communication, psychosocial adjustment, and cognition. This add-on consists of 12 new items that complement the assessed areas of the FIM or add new ones, resulting in an instrument known as FIM+FAM, which consists of 30 items covering self-care, sphincter control, movement, communication, cognitive status and psychosocial status, the latter two domains being considered together or separately. In 1997, a group of 28 centers in the United Kingdom led by Lynne Turner-Stokes adapted the FIM+FAM, correcting FAM items that were confusing and subjective for users in this country[9] and improving the reliability of the measure with respect to its original version.[10] The FIM+FAM has continued to be revised and evolved with the inclusion, since version 2.2, of 6 additional items that constitute the Extended Activities of Daily Living domain.[11] The UK FIM+FAM is now the leading measure of specialist rehabilitation services in the UK and its results are included in the national clinical database UK Rehabilitation Outcomes Collaborative.[12]

Despite the widespread use of the FIM and the FIM+FAM, both of which have versions translated into different languages,[13-16] the reliability and validity of the cultural adaptations are largely unknown, including the Spanish version. Consequently, the aim of this study was to determine the internal consistency, inter-rater reliability and convergent validity of a Spanish adaptation of the FIM+FAM.

Materials and methods

Participants

A sample of adults with a diagnosis of ischemic or hemorrhagic stroke confirmed by computed tomography or magnetic resonance imaging was recruited from the Institute of Neurological Rehabilitation (IRENEA) (Valencia, Spain). All participants were included in a neurorehabilitation program customized to their particular needs.

A minimum sample size of 111 participants was calculated to ensure a power of 0.95, assuming a mean effect size of 0.3 and a probability of error of 0.05, for the convergent validity analysis. An additional group of 11 participants were considered for a possible 10% loss of data.

The study was approved by the Ethics Committee of the Universitat Politècnica de València (P0925052022). All eligible candidates who agreed to participate in the study provided written informed consent prior to participation.

Instrumentation

The methodology proposed by Beaton *et al.*[17] was followed to translate the English version of the FIM+FAM into Spanish. Two bilingual translators, experts in Spanish and English, translated the FIM+FAM from English into Spanish separately. Both versions were contrasted by an investigator, resulting in a first version of the adaptation to Spanish. This version was translated back into English by two experts in this language, and the study investigators, together with the translators, contrasted both versions and verified that there was no disparity between them. The Spanish adaptation of the scale was administered by three investigators to an initial sample of 30 patients to test the feasibility of the translation. The score sheet resulting from the Spanish adaptation of the FIM+FAM is provided as Supplementary Digital Material 1 (Supplementary Text File 1).

Procedure

The level of functional independence of all participants was assessed with the adapted version of the FIM+FAM. In addition, the level of disability of the participants were

assessed with the Barthel Index, the Disability Rating Scale,[18] the modified Rankin Scale,[19] the Glasgow Outcome Scale Extended[20] and the National Institutes of Health Stroke Scale.[21] The mobility and ambulation of the participants was assessed with the Clinical Outcome Variables Scale.[22] Finally, the communication skills and global cognitive condition were assessed with the Mississippi Aphasia Screening Test[23] and the Mini-Mental State Examination.[24] All assessments were carried out within the same week by four occupational therapists, two physical therapists, two neuropsychologists and a speech therapist with more than five years of experience in neurorehabilitation, according to the nature of the skill examined.

A group of 31 subjects (25% of the total) was randomly selected from the sample of participants, and were assessed a second time with the FIM+FAM by an experimenter different from the first assessment, to determine inter-rater reliability. Participants received the same instructions for all assessments. The administration of both assessments with the FIM+FAM was performed on the same day, with a minimum break of one hour, allowing participants to rest between assessments.

Statistical analysis

The normality of the data distribution was analyzed with the Shapiro-Wilk Test. Homoscedasticity was analyzed with the Levene Test. Scores on all scales and clinical tests showed a non-normal distribution. Data analysis was performed as described in similar studies.[25-27]

First, the internal consistency of the adapted version of the FIM+FAM was investigated with Cronbach's alpha,[28] which represents the average of the correlations between the items constituting the instrument. Alpha values greater than 0.80 were considered representative of good internal consistency,[29] which would support that the construct measured by the instrument (functional independence) is present in each item of the instrument.

Second, inter-rater reliability was examined using the intraclass correlation coefficient (ICC) of the two-way random effects model, with a single measure (2.1). Correlations greater than 0.8 were considered very strong. Values ranging between 0.6 and 0.8 and between 0.4 and 0.6 were considered indicators of strong and moderate correlations, respectively. Values ranging between 0.2 and 0.4 and below 0.2 were considered indicators of weak and very weak correlations, respectively.[30]

Finally, the convergent validity of the adapted version of the FIM+FAM with the different clinical instruments was determined by Spearman correlation analysis.

The maximum type I error was set at 5% for all analyses. Statistical data analysis was performed with SPSS v22 (Inc., Chicago, IL, USA).

Results

Participants

A total of 122 participants, 39 women (32%) and 83 men (68%), with a mean age of 63.7±14.3 years, were included in the study from May 2022 to November 2022. Participants presented both ischemic (N.=77, 63.1%) and hemorrhagic etiology (N.=45, 36.9%), and a median time since injury of 126.7±174.4 days.

Participants showed a median total FIM+FAM Score of 110 [76-160], with motor and cognitive subscale scores of 55 [29-92] and 55 [40-71], respectively. The total median score on the Extended Activities of Daily Living subscale of the participants was 6 [6-11] Figure 1 shows the median score of the participants on each of the FIM+FAM items.

Additionally, with respect to the level of disability, participants obtained median scores of 42 [12-87.25] on the Barthel Index, 7 [6-12] on the Disability Rating Scale, 4 [4-5] on the modified Rankin Scale, 3 [3-3] on the Glasgow Outcome Scale Extended, and 7 [3-13] on the National Institutes of Health Stroke Scale. With respect to mobility and ambulation, the median score on the Clinical Outcome Variables Scale was 49 [26-75.75]. Finally, with respect to communication and cognitive skills, participants had a median score of 96 [72-100] on the Mississippi Aphasia Screening Test and 26 [21.75-29] on the Mini-Mental State Examination.

The subset of 31 participants randomly selected for the inter-rater reliability study included 8 women (25.8%) and 23 men (74.2%), who had a mean age of 60.4±15.3 years and ischemic (N.=24) and hemorrhagic (N.=7) etiology, with a mean time since injury of 129.3±188.6 days.

Internal consistency

The internal consistency of the translated version of the FIM+FAM, either considering exclusively the 30 original items of the scale or including the 6 additional items of the Extended Activities of Daily Living, was high, in accordance with the obtained Cronbach's α values of .973 and .974, respectively. Correlations of variable strength were found among the scale items, ranging from r=0.163, obtained for the 'Locomotion: Stairs' *(Subir/bajar escaleras)* and 'Comprehension' (*Comprensión*) items, to r=0 .966,

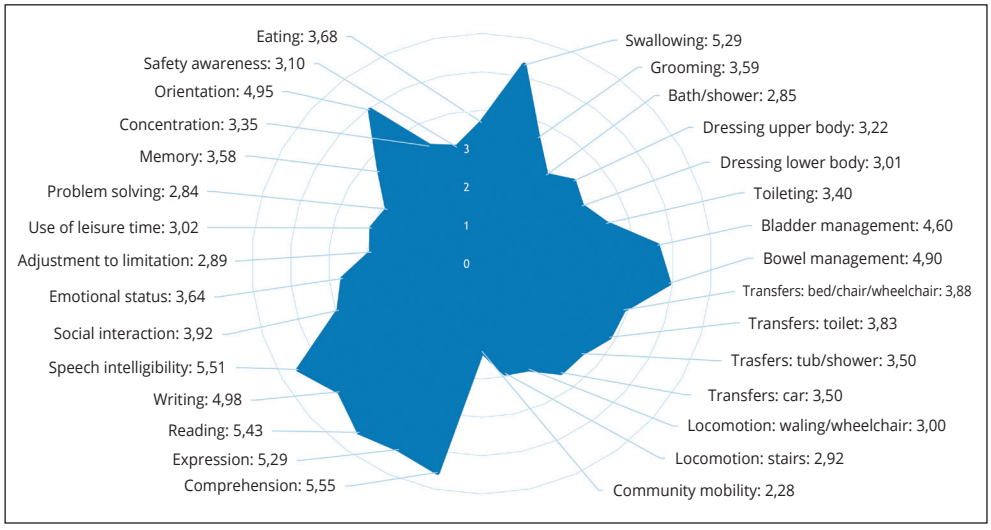

Figure 1.—Average score of the participants in each of the items of the FIM+FAM Scale.

obtained for the 'Transfers: Toilet' (*Transferencia: retrete*) and 'Transfers: Tub/Shower' (*Transferencias: bañera-ducha*) items.

Inter-rater reliability

Inter-rater reliability was excellent, with very strong correlations in all domains and subscales (Table I). Even the cognitive domains, which showed the lowest correlations, presented values above 0.990.

TABLE I.—*Inter-rater reliability of the Spanish version of the FIM+FAM Scale.*

	Rater 1	Rater 2	ICC
Total	106 [66-179]	113 [70-178]	0.998*
Motor subscale	56 [29-98]	55 [33-98]	0.997*
Self-care	22 [12-41]	22 [16-39]	0.993*
Bladder/bowels	12 [2-14]	12 [2-14]	0.999*
Locomotion	18 [7-42]	20 [9-42]	0.998*
Cognitive subscale	51 [38-74]	51 [37-77]	0.994*
Communication	31 [17-35]	31 [17-35]	0.992*
Cognitive/psychosocial	28 [22-46]	29 [23-46]	0.991*
Extended activities of daily living	6 [6-8]	6 [6-8]	1.000*

*P<0.001.

Convergent validity

All subscales and modules of the FIM+FAM showed significant correlations of variable strength with all clinical scales and tests (Table II). Among these, the strongest correlations were found between the motor modules and subscales and the Barthel Index, the Disability Rating Scale and the Clinical Outcome Variables Scale. Likewise, the weakest correlations were found between these modules and the instruments that assessed cognitive abilities, *i.e.*, the Mississippi Aphasia Screening Test and the Mini-Mental State Examination. At a particular level, each module and subscale showed stronger correlations with those in-

TABLE II.—*Convergent validity of the Spanish version of the FIM+FAM Scale with other clinical instruments.*

	Barthel Index	Disability Rating Scale	Modified Rankin Scale	Glasgow Outcome Scale Extended	National Institutes of Health Stroke Scale	Clinical Outcome Variables Scale	Mississippi Aphasia Screening Test	Mini-Mental State Examination
Total	0.937*	-0.905*	-0.728*	0.540*	-0.757*	0.861*	0.541*	0.542*
Motor subscale	0.983*	-0.844*	-0.704*	0.530*	-0.768*	0.920*	0.359*	0.387*
Self-care	0.962*	-0.807*	-0.712*	0.525*	-0.746*	0.892*	0.360*	0.366*
Bladder/bowels	0.796*	-0.806*	-0.524*	0.343*	-0.596*	0.725*	0.274*	0.370*
Locomotion	0.952*	-0.837*	-0.726*	0.500*	-0.771*	0.921*	0.264*	0.424*
Cognitive subscale	0.655*	-0.795*	-0.645*	0.473*	-0.579*	0.565*	0.729*	0.668*
Communication	0.451*	-0.558*	-0.424*	0.287*	-0.461*	0.366*	0.790*	0.415*
Cognitive/psychosocial	0.646*	-0.785*	-0.645*	0.448*	-0.514*	0.549*	0.565*	0.641*
Extended activities of daily living	0.726*	-0.685*	-0.561*	0.526*	-0.585*	0.653*	0.435*	0.441*

*P<0.001.

struments that best represented the skills assessed by them, and vice versa. As an example, the Communication module of the FIM+FAM showed the strongest correlations with the Mississippi Aphasia Screening Test and the weakest correlations with the Clinical Outcome Variables Scale.

Regardless of the strength, the sign of the correlations was consistent with the fact that a better functional level assessed with the FIM+FAM was associated with a better functional level and less disability, better mobility and ambulation, and better communication and cognitive skills, as assessed with the other scales and clinical tests.

Discussion

This study investigates the internal consistency, inter-rater reliability and convergent validity of a Spanish adaptation of the FIM+FAM Scale, one of the most widespread measures of functional independence, in a representative sample of individuals with stroke. The results show that the adaptation of the scale had high internal consistency and inter-rater reliability, and convergent validity with other clinical instruments consistent with the construct assessed. The findings on reliability and validity of the scale support its use for the assessment of functional independence after stroke.

The level of independence of the participants was representative of the most prevalent sequelae in the subacute and chronic phases after stroke. Thus, participants showed deficits that especially affected mobility and locomotion and toilet use in the motor domain and problem solving and adjustment to limitations in the cognitive domain, which evidences the heterogeneity of deficits after stroke.

The high internal consistency of the translated version of the FIM+FAM was consistent with the values reported for both the original version of the scale[31] and the FIM Scale administered alone.[31, 32] Interestingly, existing studies of the psychometric properties of various cultural adaptations of both the FIM[13, 14] and the FIM+FAM[16] in the stroke population have shown internal consistency values very similar to those found in this study. However, although it is desirable for clinical instruments to have high consistency, as this ensures that their items assess the same construct, it should be noted that a high internal consistency value may also suggest that some items may be redundant.[33]

The inter-rater reliability of the adapted version of the FIM+FAM demonstrates the excellent consistency or reproducibility of the adaptation of the instrument. The high degree of interobserver agreement evidences the ability of the instrument to provide consistent measures of functional independence without being significantly affected by the biases of different raters, which enables its use in the clinical setting. Analogous to the results on internal consistency, the findings on inter-rater reliability are consistent with those reported in previous studies that investigated the original version of the FIM,[34] and also adapted versions of the instrument.[14]

The convergent validity of the adapted version of the FIM+FAM reveals a variable but consistent relationship with other clinical instruments widely used in neurorehabilitation, showing a stronger association with measures of motor functioning. The overrepresentation of motor skills in the FIM Scale has been evidenced in previous investigations of the convergent validity of the scale.[31] Not surprisingly, as previously mentioned, the design of the FAM was motivated by this limitation.[8] Our results show that, despite the addition of this supplement, the relationship of the FIM+FAM with instruments that essentially assess cognitive constructs remains limited, and should be taken into consideration when interpreting the level of functional independence from the overall score on the FIM+FAM Scale. The convergent validity of the adapted version of the FIM+FAM is equally comparable to that demonstrated by the original FIM Scale with various measures,[31, 35, 36] as well as to that demonstrated by cultural adaptations of the scale,[14] which supports the results obtained in this study.

Limitations of the study

Although the particular characteristics of the participants examined may limit the extrapolation of the findings to other populations, the results of the present study indicate that the adapted version of the FIM+FAM is an instrument with excellent reliability and validity for assessing functional independence in individuals who have suffered a stroke, which supports the use of this tool in the clinical setting.

Conclusions

The internal consistency, inter-rater reliability and convergent validity of the Spanish version of the FIM+FAM Scale demonstrate the excellent reliability and validity of the adaptation and support its use to assess the functional independence of individuals with stroke.

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Conflicts of interest
The authors certify that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript.

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Authors' contributions
All authors read and approved the final version of the manuscript.

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