Validity of Total Score of Functional Independence Measure (FIM®) In Stroke Survivors

Mikhail Saltychev PhD, MD1, Janne Lähdesmäki PhD, MD2, Petteri Jokinen MD1, Katri Laimi PhD, MD1

Abstract

Objectives
To investigate the internal consistency and dimensionality of FIM®.

Methods
Register-based study of 493 stroke survivors who participated in the multidisciplinary in-patient rehabilitation. Cronbach’s alpha and exploratory factor analysis.

Results
The internal consistency demonstrated a very high Cronbach’s alpha of 0.97. The exploratory factor analysis resulted in a 2-factor structure. First 13 items of FIM® loaded especially on factor 1 and the rest 5 items on factor 2. The loadings of first 13 items on motor factor varied from 0.66 to 0.96. Respectively, the loading of the last five items on cognitive factor varied from 0.71 to 0.82.

Conclusions
Amongst stroke survivors, the FIM® total score may not reflect the real situation with patients’ disability level or need for assistance. Instead, when handled separately, motor and cognitive subscores seemed to be valid.

Keywords: FIM, independence; functioning; factor analysis; consistency; validity

INTRODUCTION

Since its development in 1987 (sponsored by the American Academy of Physical Medicine & Rehabilitation and the American Congress of Rehabilitation Medicine), the Functional Independence Measure (FIM®) has been the golden standard when evaluating a functioning level and a need for assistance amongst patients with different health disorders including stroke (1). FIM® has been used in all age groups and it has been translated into numerous languages (2-5). While often praised for its validity (6, 7), some uncertainties related to psychometric properties of FIM® have been proposed (8, 9). While some previous studies confirmed the unidimensional nature of FIM®, meaning that all FIM®-items describe the same concept “disability”, other studies have suggested that FIM® is multidimensional and that the total FIM® score may fail to reliably assess the need for assistance. In other words, FIM® may measure a need for assistance inflicted by two or even more detached concepts and, if so, counting a total score would be unjustified. Such concerns are important as the FIM® total score is routinely used in clinical practice by health care and rehabilitation professionals. Often the effectiveness and cost-efficiency of an intervention is judged by the difference between FIM® total score before and after the intervention (10, 11).

The objective of this study was to investigate the internal consistency and dimensionality of FIM® in stroke survivors.

METHODS

This was a retrospective register-based study of 493 stroke survivors who participated in the multidisciplinary in-patient rehabilitation program in a university hospital between October 2009 and May 2017. Patients with both ischemic and hemorrhagic stroke were included. The FIM® score of all consecutive patients was filled out by nurses certified to using FIM® except for ‘moving at stairs’, which was assessed by a trained physiotherapist.

The assessment was usually made within the first two days of rehabilitation. In case of a register-based study, no approval of an ethical committee was needed.

The FIM® has been broadly described in previous studies (12). Briefly, the FIM® consists of 18 items described in Table 1. Each item is valued on a Likert-like scale from one (‘extreme need for assistance’) to seven (‘completely independent’). Based on these individual items, three different scores are usually calculated and documented in patient’s records: a ‘motor’ score (the sum...
score of the first 13 items), a ‘cognitive’ score (the sum of the last five items), and a total score that is the sum of motor and cognitive scores. The maximum possible total score is 126 points.

**Statistical analysis**

The internal consistency of the FIM® was assessed with Cronbach’s alpha along with its 1-side 95% confidence limit (95% CI). Alpha ≥ 0.9 was considered excellent, ≥ 0.8 good, ≥ 0.7 acceptable, ≥ 0.6 questionable, ≥ 0.5 poor, and <0.5 was considered unacceptable. This study employed exploratory factor analysis to approximate the construct structure of FIM®. The goal was to determine if FIM® measures only one latent trait (e.g. disability or need for assistance) or if there are other possible significant latent variables affecting the results as well. The results were analyzed both numerically and graphically. Exploratory factor analysis (principal factors) was applied with a minimum eigenvalue for retention set at >1.0 (Kaiser’s rule). The results of factor analysis were rotated by an orthogonal Varimax rotation assuming there is no correlation between factors. Retained and excluded factors were also explored visually on a scree plot including a parallel analysis. The demographic characteristics were reported as percentages when appropriate, as means, ranges, and standard deviations (SDs) if distributed normally, and as medians, ranges, and interquartile ranges (IQRs) if distributed abnormally or in the case of ordinal variables. All the analyses were performed using Stata/IC Statistical Software: Release 14. College Station (StataCorp LP, TX, USA).

**RESULTS**

The median age of 493 stroke survivors participated in rehabilitation was 61 (IQR 52 to 69, range 16 to 87) years. Of them, 285 (58%) were men and 208 (42%) were women. The rehabilitation was started (median) 48 (IQR 26 to 85, range 0 to 1876) days after the stroke onset. The median duration of rehabilitation was 28.5 (IQR 18 to 43, range 1 to 135) days. Therapy and training were started at the day of admission. FIM® measurements were conducted within median of 2 days (IQR 2 to 3, range 0 to 30) after admission. FIM® scores were on average: total score 87.2 (SD 29.8), motor score 61.2 (SD 24.7), and cognitive score 26.0 (SD 7.8) points.

The internal consistency demonstrated a very high Cronbach’s alpha of 0.97 (95% CI 0.96). The exploratory factor analysis resulted in 2-factor structure (eigenvalues 11.6 and 2.0, respectively) that can be seen in Figure 1. After the orthogonal Varimax rotation, first 13 items of FIM® loaded especially on factor 1 and the rest 5 items on factor 2. For convenience, these factors were named ‘motor’ and ‘cognitive’ subsets of FIM®. The loadings of first 13 items on motor factor varied from 0.66 to 0.96. Respectively, the loading of the last five items on cognitive factor varied from 0.71 to 0.82. The chi-square test showed p-value <0.0001.

**DISCUSSION**

Based on the results of this retrospective register-based study amongst 493 stroke survivors who participated in the multidisciplinary in-patient rehabilitation, FIM® was not unidimensional. Instead, two factors (named here ‘motor’ and ‘cognitive’) were clearly present. The items loadings

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**Table 1. Exploratory factor analysis of FIM® with Varimix orthogonal rotation.**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Factor1</th>
<th>Factor2</th>
<th>Uniqueness</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Eating</td>
<td>0.66</td>
<td>0.35</td>
<td>0.44</td>
</tr>
<tr>
<td>B. Grooming</td>
<td>0.77</td>
<td>0.46</td>
<td>0.20</td>
</tr>
<tr>
<td>C. Bathing</td>
<td>0.87</td>
<td>0.30</td>
<td>0.15</td>
</tr>
<tr>
<td>D. Dressing - Upper Body</td>
<td>0.90</td>
<td>0.26</td>
<td>0.13</td>
</tr>
<tr>
<td>E. Dressing - Lower Body</td>
<td>0.94</td>
<td>0.20</td>
<td>0.08</td>
</tr>
<tr>
<td>F. Toileting</td>
<td>0.91</td>
<td>0.26</td>
<td>0.10</td>
</tr>
<tr>
<td>G. Bladder Management</td>
<td>0.77</td>
<td>0.34</td>
<td>0.29</td>
</tr>
<tr>
<td>H. Bowel Management</td>
<td>0.66</td>
<td>0.34</td>
<td>0.45</td>
</tr>
<tr>
<td>I. Bed, Chair, Wheelchair</td>
<td>0.96</td>
<td>0.16</td>
<td>0.05</td>
</tr>
<tr>
<td>J. Toilet</td>
<td>0.96</td>
<td>0.18</td>
<td>0.05</td>
</tr>
<tr>
<td>K. Tub, Shower</td>
<td>0.94</td>
<td>0.20</td>
<td>0.07</td>
</tr>
<tr>
<td>L. Walk/Wheelchair</td>
<td>0.76</td>
<td>0.24</td>
<td>0.36</td>
</tr>
<tr>
<td>M. Stairs</td>
<td>0.78</td>
<td>0.14</td>
<td>0.36</td>
</tr>
<tr>
<td>N. Comprehension</td>
<td>0.21</td>
<td>0.82</td>
<td>0.28</td>
</tr>
<tr>
<td>O. Expression</td>
<td>0.11</td>
<td>0.76</td>
<td>0.42</td>
</tr>
<tr>
<td>P. Social Interaction</td>
<td>0.24</td>
<td>0.71</td>
<td>0.44</td>
</tr>
<tr>
<td>Q. Problem Solving</td>
<td>0.46</td>
<td>0.76</td>
<td>0.22</td>
</tr>
<tr>
<td>R. Memory</td>
<td>0.32</td>
<td>0.77</td>
<td>0.31</td>
</tr>
</tbody>
</table>

Figure 1. Screeplot of exploratory factor analysis of FIM® along with a parallel analysis.
on these two factors were corresponding with the official motor and cognitive FIM® subsets. The study sample might not represent the general population of stroke survivors. Our target population was consisted of those stroke patients, who were admitted to a university hospital clinic on average within two months after stroke, assuming that substantial rehabilitation goals could be achieved during a relatively short intervention. Obviously, our sample lacked patients with mild symptoms with no need for intensive in-patient rehabilitation. Patients with severe stroke and little potential for rehabilitation were not represented as well. In addition, the median age of patients was 61 years, which is probably less than in stroke patients who attend primary health care services. The nurses who performed FIM® assessments were rigorously trained and experienced in using FIM®. A less precise assessment especially in outpatient settings may affect the results. On the other hand, the study sample was big enough to achieve statistically significant results. The sample consisted of consecutive patients whose health status was documented comprehensively and precisely. Previous research reported consistently that FIM® is not a unidimensional but rather a two-dimensional (‘cognitive’ and ‘motor’ factors) scale. Some reports even found up to five factors within the FIM® (13). Differences in study settings, patients’ age group, diversities in FIM® language versions, or other reasons may partly explain these variations. The results of the present study were in line with other reports, which suggested that FIM® is multidimensional and its total score should be used either with caution or even not used at all (9, 14).

While FIM® would not be perfect for assessing the total score of “disability”, as suggested in our study population, using motor and cognitive sub-scores of FIM® seems to be reasonable in stroke rehabilitants. When the total score of FIM® is assessed, the internal consistency of FIM® demonstrated a very high estimate of 0.96. In fact, it could be considered too high indicating a potential test redundancy (15). A further confirming evaluation on reduced number of FIM® items may reveal how many items are actually needed to achieve the same or approximately the same result of FIM® evaluation. Further investigation may also be directed to testing the results of this study in different settings, e.g. amongst stroke survivors in primary care or those left outside a highly specialized rehabilitation intervention.

CONCLUSIONS

Amongst stroke survivors, the FIM® was found to be multidimensional. Its’ total score may not reflect the real situation with patients’ disability level or need for assistance. Instead, when handled separately, motor and cognitive sub-scores seemed to be valid.

REFERENCES