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Original Article

Corrected FIM effectiveness as an index independent of FIM score on admission

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Abstract

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Objective: To correct Functional Independence Measure (FIM) effectiveness for low FIM scores to obtain an index independent of FIM score on admission.

Methods: A total of 1,101 stroke patients in Kaifukuki rehabilitation wards were studied. They were divided into 13 groups according to the motor FIM score on admission, in 6-point increments. The parameter "A" was derived so that motor FIM effectiveness, calculated as motor FIM gain/(A − motor FIM score on admission), was around 0.65.

Results: Motor FIM effectiveness was an index independent of motor FIM score on admission when A was 42, 64, 79, 83, 87, 89, or 91 points (when motor FIM on admission was 13−18 points, 19−24 points, 25−30 points, 31−36 points, 37−42 points, 43−48 points, or 49−90 points).

Conclusions: Corrected FIM effectiveness, which is independent of FIM on admission, may be useful for comparisons between hospitals admitting patients with varying degrees of severity.

Key words: FIM effectiveness, patient severity, FIM on admission, correction

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Introduction

The Functional Independence Measure (FIM) is a technique used for evaluating activities of daily living (ADL). The scale consists of 13 motor items (motor FIM) with a score range of 13−91 points, and 5 cognitive items (cognitive FIM) with a score range of 5−35 points. The result indicates to what extent an individual is capable of independent ADL. The mean gain in FIM (FIM score at discharge − FIM score on admission) is the greatest for patients with moderate assistance. On the other hand, patients with low FIM scores on admission exhibit little improvement, while those with high FIM scores on admission demonstrate a ceiling effect, and both groups display little gain in FIM.

One means of correcting for the ceiling effect is FIM effectiveness, calculated as (FIM at discharge − FIM on admission)/(A − FIM on admission) [1]. A is generally taken to be 126 points for overall FIM score, and 91 points for motor FIM. For a patient with FIM on admission of 81 points, for example, the maximum motor FIM gain is 10 points (91 − 81), and if the potential improvement in score is used as the denominator and actual improvement as the numerator, the resulting value between 0 and 1 indicates the actual rate of improvement out of the total potential improvement.

The fact that FIM gain is dependent on (affected by) FIM score on admission is a major impediment when comparing mean FIM gain between different hospitals and regions. If the distribution of patient severity (proportions of patients having various degrees of severity) differs between hospitals or regions, this would make it impossible to compare mean FIM gain.

The objective of this study was to elucidate whether or not FIM effectiveness is an index that is dependent on FIM score on admission, and if this is the case, to correct it to obtain an index that is independent of FIM score on admission.

Subjects and Methods

A retrospective epidemiological study was conducted. A total of 1,101 stroke patients who were admitted to Kaifukuki rehabilitation wards in K Hospital between April 1, 2008 and July 16, 2013, after undergoing treatment at an acute hospital, were enrolled. The following patients were excluded: those with subarachnoid hemorrhage, those admitted within 7 days or more than 60 days after onset, those who spent less than 14 days or over 180 days in hospital, those who died in hospital, and those with motor FIM score on admission of 91 points or with motor FIM gain of less than 0 point. All the required items were available from all subjects, with no missing data. Table 1 shows the basic attributes of the 1,101 subjects. Other than a shorter period between onset and admission, the subjects were very similar to those recorded in the national survey of Kaifukuki rehabilitation wards [2].

This study complied with the regulations of the Clinical Research Ethics Committee of the authors' hospital, and was performed with the permission of staff previously designated by the Clinical Research Ethics Committee. All personal information was converted to data, which was handled in such a way that individuals could not be identified.

Study 1: Motor FIM gain and motor FIM effectiveness

Motor FIM score on admission was divided into 13 groups in 6-point increments (13–18 points, 19–24 points, ... , 85–90 points) (Figure 1), and the mean motor FIM gain and mean motor FIM effectiveness were calculated for each group.

Study 2: Correction of motor FIM effectiveness

Motor FIM effectiveness was stable at around 0.65 for patients with motor FIM scores on admission of 49–90 points, but was dependent on motor FIM score on admission for patients with scores of 13–48 points. We therefore corrected the denominator for calculating motor FIM effectiveness to 91 points for patients with motor FIM scores on admission of 13–48 points, so that motor FIM effectiveness was around 0.65. In practical terms, when motor FIM scores on admission are 43–48 points, mean motor FIM gain is 28.23 points (X) and mean value for "91 – motor FIM on admission" is 45.44 points (Y), calculation of motor FIM effectiveness yields 0.623. In the case of X/(Y – 1), the result is 0.635; in the case of X/(Y – 2), the result is 0.650, and in the case of X/(Y – 3), the result is 0.665. In other words, reducing the denominator of the equation for calculating motor FIM effectiveness from 91 to 89 points would bring motor FIM effectiveness to around 0.65. For the 78 patients with motor FIM scores on admission of 43–48 points, the mean calculated motor FIM effectiveness [motor FIM gain/(89 – motor FIM on admission)] was 0.652. We also used the same method to calculate A for the groups with motor FIM scores on admission of 13–18 points, 19–24 points, 25–30 points, 31–36 points, and 37–42 points, so that the corrected motor FIM effectiveness, calculated as motor FIM gain/(A – motor FIM on admission) became around 0.65.

Table 1. Clinical characteristics of subjects in this study compared with national survey.

	This study	National survey [2]
Number of patients	1,101	14,011
Sex	Male 670, female 431	56.8% males, 43.2% females
Infarction, hemorrhage	Infarction 706, hemorrhage 395	—
Age	68.9±13.7	72.0
Duration of onset of stroke to admission	21.1±10.4	36.6
Length of hospital stay	81.4±39.9	89.4
Motor FIM score at admission	48.8±25.6	—
Cognitive FIM score at admission	22.8± 9.4	—
Total FIM score at admission	71.6±33.0	68.4
Motor FIM score at discharge	67.9±24.2	—
Cognitive FIM score at discharge	26.5± 8.4	—
Total FIM score at discharge	94.4±31.4	85.8
Motor FIM gain	19.1±15.26	—
Cognitive FIM gain	3.7± 4.5	—
Total FIM gain	22.8±17.9	17.4

FIM, Functional Independence Measure.
Data for this study are expressed as mean±standard deviation, or number of patients.

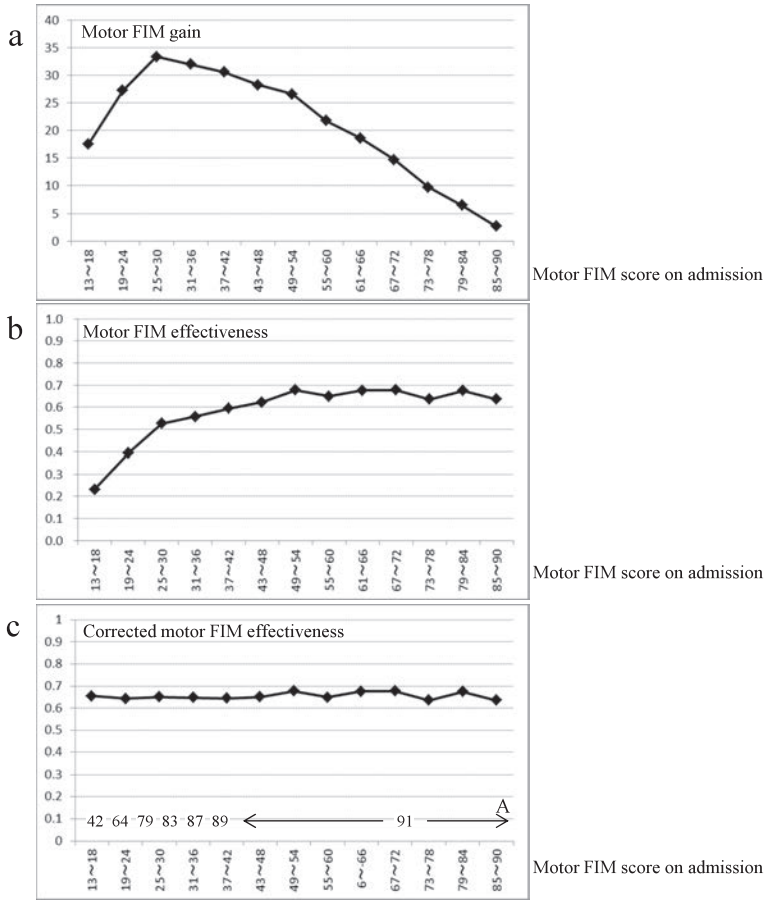

Figure 1. The association between motor FIM score on admission and motor FIM gain (A), motor FIM effectiveness (b), and corrected motor FIM effectiveness (c).
FIM, Functional Independence Measure. A is the parameter from the following equation: Motor FIM effectiveness = motor FIM gain / (A − motor FIM at admission).

Results

Figure 1a shows the association between motor FIM score on admission and motor FIM gain. Motor FIM gain was greatest for patients with motor FIM scores on admission of 25−30 points. These results show that motor FIM gain is an index that depends on motor FIM score on admission (Figure 1a).

Figure 1b shows the association between motor FIM score on admission and motor FIM effectiveness. Motor FIM effectiveness was stable at around 0.65 for patients with motor FIM scores on admission of 49−90 points, but was lower than 0.65 for those with scores of 13−48 points. These results show that motor FIM effectiveness is also an index that depends on motor FIM score on admission (Figure 1b).

For motor FIM scores on admission of 13−48 points, the values of A that yielded corrected motor FIM effectiveness [motor FIM gain/(A − motor FIM on admission)] at around 0.65 were 42, 64, 79, 83, 87, and 89 points for motor FIM scores on admission of 13−18 points, 19−24 points, 25−30 points, 31−36 points, 37−42 points, and 43−48 points, respectively (Table 2). Corrected motor FIM effectiveness ranged from 0.636 (when motor FIM scores on admission were 85−90 points) to 0.677 (when motor FIM scores on admission were 49−54 points), and was an index independent of motor FIM score on admission (Figure 1c). The mean corrected motor FIM effectiveness at K Hospital was 0.655 ± 0.402.

Discussion

We found similar associations of motor FIM score on admission with motor FIM gain (Figure 1a) and with motor FIM effectiveness (Figure 1b) as previously reported [3, 4].

In this study, we found that (1) FIM effectiveness is an index that depends on motor FIM score on admission for scores of 13−48 points, and (2) adjusting the value of A in the equation to calculate motor FIM effectiveness [motor FIM gain/(A − motor FIM on admission)] to 42, 64, 79, 83, 87, and 89 points (for

Table 2. Corrected motor FIM effectiveness.

Motor FIM score at admission	13~18	19~24	25~30	31~36	37~42	43~48
Number of patients	223	62	57	60	67	78
Motor FIM effectiveness	0.231	0.393	0.527	0.557	0.595	0.623
X: mean motor FIM gain	17.53	27.23	33.37	31.97	30.52	28.23
Y: mean (91−motor FIM at admission)	76.62	69.63	63.53	57.42	51.45	45.44
X/(Y−1) : A=90						0.635
X/(Y−2) : A=89						**0.650**
X/(Y−3) : A=88					0.630	0.665
X/(Y−4) : A=87					**0.643**	
X/(Y−5) : A=86				0.610	0.657	
X/(Y−6) : A=85				0.622		
X/(Y−7) : A=84				0.634		
X(Y−8) : A=83				**0.647**		
X/(Y−9) : A=82			0.612	0.660		
X(Y−10) : A=81			0.623			
X/(Y−11): A=80			0.635			
X/(Y−12): A=79			**0.648**			
X(Y−13) : A=78 ~			0.660			
X/(Y−27): A=64		**0.639**				
X(Y−28) : A=63 ~		0.654				
X/(Y−49): A=42	**0.635**					
X/(Y−50): A=41	0.658					
Corrected motor FIM effectiveness	**0.656**	**0.644**	**0.650**	**0.648**	**0.645**	**0.652**

FIM, Functional Independence Measure.
A is the parameter from the following equation: Motor FIM effectiveness = motor FIM gain /(A − motor FIM at admission).
In patients whose motor FIM scores at admission are 13−18 points, A is not 41 point but 42 point for the corrected motor FIM effectiveness to be near 0.65.
In patients whose motor FIM scores at admission are 19−24 points, A is not 63 point but 64 point for the corrected motor FIM effectiveness to be near 0.65.

motor FIM scores on admission of 13−18 points, 19−24 points, 25−30 points, 31−36 points, 37−42 points, and 43−48 points, respectively) yielded an index (corrected motor FIM effectiveness) that is independent of motor FIM score on admission.

FIM effectiveness is equivalent to rehabilitation effectiveness, Montebello Rehabilitation Factor Score, and relative functional gain [1]. This method was first proposed by Heinemann *et al.* [5]. FIM effectiveness is more frequently used than FIM gain, which is an index dependent on FIM score on admission, when investigating the effect of a particular factor on rehabilitation [1]. FIM effectiveness is an index that expresses the actual improvement as a proportion of potential improvement.

Motor FIM effectiveness was stable at around 0.65 for patients with motor FIM scores on admission of 49−90 points, but decreased to around 0.23 for those with low motor FIM scores on admission (13−18 points). Although patients whose motor FIM scores on admission are 13−18 points can theoretically attain an FIM gain of 73−78 points (91 points minus 13−18 points), in practice few patients achieve such improvement, which lowers the value of motor FIM effectiveness. Thus, motor FIM effectiveness is also an index that depends on motor FIM score on admission.

Outcome indices that are dependent on ADL on admission cannot be used to compare outcomes between hospitals or regions that have patients of varying degrees of severity. Even if the mean FIM score on admission for a particular hospital is known, FIM gain cannot be corrected in the absence of information on the proportions of patients with mild, moderate, and severe disability. Instead of FIM gain with the above-mentioned issues, other methods have been used in outcome studies, including (1) FIM effectiveness, (2) multiple regression analysis for severe patients (those with motor FIM scores on admission of 13−34 points) [3], (3) multiple regression

analysis with motor FIM score on admission restricted to narrow bands (eliminating differences between motor FIM score on admission within the same group) [4], (4) regarding the distribution of severity in all hospitals as a "standard severity distribution" and calculating adjusted motor FM gain based on the assumption that patients admitted to individual hospitals have the same distribution of severity as the standard severity distribution [4]. The above methods, with the addition of the corrected FIM effectiveness method used in the present study, are all useful in studying the outcomes of rehabilitation.

The present study had some limitations. First, we divided patients into 13 groups according to motor FIM score on admission in 6-point increments. It would have been more accurate to calculate A if FIM was divided into 1-point increments. In this case, however, a far greater number of subjects than those used in the present study would be required in order to obtain results without any variation. A study utilizing nationwide data is therefore desirable. Second, our study covered only patients in a single hospital. Third, it remains unclear whether or not this index is disease-dependent. Investigations of patients with conditions other than stroke (such as orthopedic disorders and disuse syndrome) are therefore required.

One topic for further study is inter-hospital comparisons of corrected FIM effectiveness. This study should start by investigating the values of A to obtain corrected FIM effectiveness based on national (or regional) data. Next, these values of A should be used to calculate corrected FIM effectiveness for all patients. It would then be possible to compare mean values between different hospitals (using the values of A derived from national data, rather than calculating them separately for each hospital). Corrected FIM effectiveness, which is an index of rehabilitation outcome independent of FIM score on admission, may provide a more accurate evaluation of the effect of various factors on rehabilitation outcomes than the conventionally used index of FIM effectiveness.

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