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Original Article

A comparison of the corrected Functional Independence Measure (FIM) effectiveness at Kaifukuki rehabilitation hospitals participating in the Kumamoto Stroke Liaison Critical Pathway

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ABSTRACT
Sannomiya K, Tokunaga M, Nakanishi R, Watanabe S, Terasaki T, Kawano S, Yamakuma K, Kanazawa C, Hirata Y, Yamaga M, Hashimoto Y. A comparison of the corrected Functional Independence Measure (FIM) effectiveness at Kaifukuki rehabilitation hospitals participating in the Kumamoto Stroke Liaison Critical Pathway. Jpn J Compr Rehabil Sci 2014; 5: 66−71.
Objective: To compare the mean corrected FIM effectiveness (which is insusceptible to FIM score on admission) at six Kaifukuki rehabilitation hospitals.
Methods: A total of 2,192 stroke patients were studied. Using data from all the Kaifukuki rehabilitation hospitals, the value of “A” was found where the corrected FIM effectiveness [FIM gain/(A − FIM score on admission)] is approximately 0.63. Then a Kruskal-Wallis test was conducted to determine whether there was a significant difference between the mean corrected FIM effectiveness of the six hospitals.
Results: The mean corrected FIM effectiveness ranged from 0.567 (Hospital D) to 0.841 (Hospital C) showing a significant difference between the six hospitals (p<0.001).
Conclusion: Using the corrected FIM effectiveness enabled a comparison of FIM improvement at the six Kaifukuki rehabilitation hospitals which had differing levels of severity distribution.
Key words: liaison critical pathway, corrected total FIM effectiveness, severity distribution, inter-hospital comparison

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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 [1]. The result indicates to what extent an individual is capable of independent ADL. The FIM gain (FIM score at discharge − FIM score on admission) is the greatest for patients with moderate assistance [2]. 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 FIM gain [2]. 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 patients' 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 corrected motor FIM effectiveness reported by Tokunaga et al. [3] is an FIM improvement index which is insusceptible to motor FIM on admission. The corrected motor FIM effectiveness = motor FIM gain/(A − motor FIM on admission), and the value of "A" is a figure that differs according to motor FIM on admission [3]. However, we were unable to find reports that compared corrected motor FIM effectiveness between hospitals. Likewise, the Kumamoto Stroke Liaison Critical Pathway records total FIM score and not motor FIM score, so it was necessary to clarify the value of A of the corrected total FIM effectiveness.

The aims of this study were: (1) to use data from all the Kaifukuki rehabilitation hospitals in Kumamoto to demonstrate the value of A of the corrected total FIM effectiveness, and (2) to compare the mean corrected total FIM effectiveness at the six Kaifukuki rehabilitation hospitals.

Subjects and Methods

Participating in the liaison critical pathway managed by the Kumamoto Seamless Stroke Referral Associates for CVD Amelioration (K-STREAM) are nine acute phase hospitals, 39 Kaifukuki rehabilitation hospitals, 20 long-term healthcare facilities (*roken*), 39 convalescent hospitals, and 42 clinics. Of the stroke patients admitted to acute phase hospitals between November 25, 2007 and June 2, 2013 and registered on the electronic version of the liaison critical pathway [4], the following patients were excluded: Patients for whom FIM score was not recorded on admission/discharge to/from the Kaifukuki rehabilitation hospitals, patients aged 95 or older, patients for whom the number of days between onset and admission was other than 7 to 60 days, patients whose length of stay in hospital was other than 15 to 180 days, patients whose FIM score on admission was 126 points, and patients whose FIM gain was less than 0 point. As a result, 2,192 patients were included in the present study.

Other than 9 patients whose age was unknown, all the data required for this study were recorded. Table 1 shows the basic attributes of the 2,192 patients in this study. Except for the relatively short stay in acute phase hospitals, the patient attributes were similar to those found in the national survey of patients in Kaifukuki rehabilitation wards [5].

This epidemiological research had a retrospective design. In November 20, 2013, permission to conduct the study was obtained from K-STREAM representatives. Anonymous data from all patients in the Kumamoto Stroke Liaison Critical Pathway was subsequently saved in an Excel format. In accordance with the provisions of the clinical research review board of Kumamoto Kinoh Hospital, permission was obtained from the official who had been nominated in advance by the review board. The study was subsequently conducted. All personal information was converted into data and treated in a way that prevented the identification of individuals.

Study 1: Comparison between six hospitals

In order of the number of patients, the six Kaifukuki rehabilitation hospitals were Hospital A (524 patients), Hospital B (275 patients), Hospital C (265 patients), Hospital D (187 patients), Hospital E (167 patients), and Hospital F (139 patients), and the 29 hospitals (635 patients) with 90 patients or less were determined to be other hospitals. The 6 hospitals A-F were compared in terms of the patients' ages, number of days from onset to admission, length of stay in hospital, FIM score on admission, FIM score at discharge, and FIM gain. The comparison of the 6 hospitals used the Kruskal-Wallis test (significance level of less than 5%).

Study 2: The corrected FIM effectiveness of all the hospitals

FIM scores on admission at each hospital were divided into 12 groups in nine-point increments (18−26 points, 27−35 points, . . ., 118−125 points) (Fig. 1). In the range of 72−125 FIM score on admission, the average FIM effectiveness [6] was uniform at around 0.63. More specifically, this ranged from an average of 0.598 (117−125 FIM score on admission) to an average

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

	This study	National survey [5]
Number of patients	2,192	14,011
Sex	Male 1,134, female 1,049, unknown 9	56.8% males, 43.2% females
Infarction, hemorrhage	Infarction 1,444, hemorrhage 610, SAH 138	−
Age	72.6±12.8	72.0
Number of days from onset of stroke to admission	17.7± 8.6	36.6
Length of hospital stay	93.0±45.7	89.4
Total FIM score on admission	66.4±35.1	68.4
Total FIM score at discharge	88.7±36.0	85.8
Total FIM gain	22.3±19.7	17.4

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

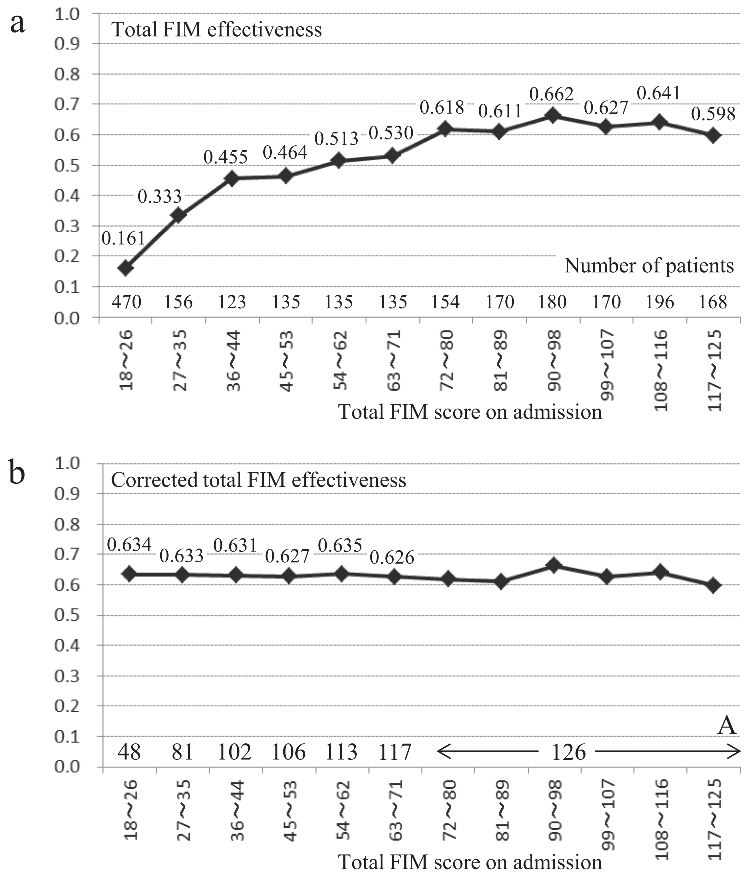

Figure 1. The association between total FIM score on admission and total FIM effectiveness (a), and corrected total FIM effectiveness (b). “A” is the parameter from the following equation: corrected total FIM effectiveness = total FIM gain/(A − total FIM on admission). Figures on a polygonal line, average value.

of 0.662 (90−98 FIM score on admission), and the average FIM effectiveness for 1,038 patients with an FIM score of 72−125 on admission was 0.627 (Fig. 1a). On the other hand, for an FIM score range of 18−71 points, the lower the FIM score on admission, the lower the average FIM effectiveness.

Next, to make the average of FIM effectiveness also around 0.63 for FIM score on admission ranging from 18−71 points, the denominator of 126 points of the FIM effectiveness [FIM gain/(126 points − FIM score on admission)] was corrected based on the report of Tokunaga et al. [3]. More specifically, FIM gain (X) of patients with an FIM score of 63−71 on admission averaged 31.21 points, “126 points − FIM score on admission (Y)” averaged 58.88 points, and FIM effectiveness (X/Y) was 0.530 (Table 3). The X/(Y − 8) was 0.613, the X/(Y − 9) was 0.626, the X/(Y − 10) was 0.639, and it was predicted that if the denominator of FIM effectiveness decreased from 126 points to 117 points (126 points − 9 points), then the corrected FIM effectiveness would be approximately 0.63 (Table 3). Next, with regard to the 135 patients whose FIM score on admission was 63−71 points, corrected FIM effectiveness [FIM gain/(117 points − FIM score on admission)] was calculated, and the average of 0.626 for the 135 patients was found (Table 3). Using the same method, for groups with FIM score on admission of 18−26, 27−35, 36−44, 45−53 and 54−62 points, the value of A was found so that the corrected FIM effectiveness [FIM gain/(A − FIM score on admission)] would be approximately 0.63.

Study 3: Comparison of each hospital’s mean corrected FIM effectiveness

To find the mean corrected FIM effectiveness of the 6 hospitals A−F and ascertain whether there was a significant difference between the 6 hospitals, a Kruskal-Wallis test was conducted. If there was a significant difference, a pair comparison was conducted using Scheffé’s method. The level of significance in both cases was less than 5%.

Results

The 6 hospitals displayed a significant difference in age, number of days from onset to admission, length of stay in hospital, FIM score on admission, and FIM gain. FIM score at discharge showed no significant difference (Table 2).

A correlation between FIM score on admission and FIM effectiveness was indicated (Fig. 1a), as was a correlation between FIM score on admission and corrected FIM effectiveness (Fig. 1b). The value of A that yielded corrected FIM effectiveness [FIM gain/(A − FIM score on admission)] at around 0.63 were 48, 81, 102, 106, 113, and 117 points for FIM score on admission of 18−26 points, 27−35 points, 36−44 points, 45−53 points, 54−62 points, and 63−71 points, respectively (Table 3).

As for the mean corrected FIM effectiveness, in the range of 0.567 (Hospital D) to 0.841 (Hospital C), a significant difference was found between the 6

Table 2. Comparison between 6 hospitals.

	Hospital A	Hospital B	Hospital C	Hospital D	Hospital E	Hospital F	Significance
Number of patients	524	275	265	187	167	139	−
Age	68.8	73.1	70.9	71.8	75.2	74.0	p<0.001
Number of days from onset of stroke to admission	18.4	15.7	18.9	20.3	14.4	17.9	p<0.001
Length of hospital stay	85.3	93.8	108.3	78.3	106.0	97.5	p<0.001
Total FIM score on admission	70.7	66.8	65.3	75.3	64.2	66.2	p<0.01
Total FIM score at discharge	94.4	87.6	95.4	92.0	86.2	89.9	n.s.
Total FIM gain	23.7	20.8	30.1	16.7	22.0	23.8	p<0.001
Total FIM effectiveness	0.495	0.472	0.593	0.473	0.511	0.466	p<0.001
Corrected total FIM effectiveness	0.645	0.594	0.841	0.567	0.647	0.649	p<0.001

Numbers, average; Significance, significance between the 6 hospitals (Kruskal-Wallis test); n.s., not significant.

Table 3. Corrected total FIM effectiveness.

Total FIM score at admission	18−26	27−35	36−44	45−53	54−62	63−71
Number of patients	470	156	123	135	135	135
X: average of total FIM gain	16.89	31.72	39.07	35.55	34.96	31.21
Y: average of "126 − total FIM at admission"	106.01	95.39	85.94	76.78	68.14	58.88
X/Y: total FIM effectiveness	**0.161**	**0.333**	**0.455**	**0.464**	**0.513**	**0.530**
X/(Y − 8): A=118						0.613
X/(Y − 9): A=117						**0.626**
X/(Y − 10): A=116						0.639
X/(Y − 12): A=114					0.623	
X/(Y − 13): A=113					**0.634**	
X/(Y − 14): A=112					0.646	
X/(Y − 19): A=107				0.615		
X/(Y − 20): A=106				**0.626**		
X/(Y − 21): A=105				0.637		
X/(Y − 23): A=103			0.621			
X/(Y − 24): A=102			**0.631**			
X/(Y − 25): A=101			0.641			
X/(Y − 44): A=82		0.617				
X/(Y − 45): A=81		**0.629**				
X/(Y − 46): A=80		0.642				
X/(Y − 78): A=48	0.603					
X/(Y − 79): A=47	**0.625**					
X/(Y − 80): A=46	0.649					
Corrected total FIM effectiveness	**0.634**	**0.633**	**0.631**	**0.627**	**0.635**	**0.626**

FIM, Functional Independence Measure.
"A" is the parameter from the following equation: Total FIM effectiveness = total FIM gain/(A − total FIM on admission).
In patients whose total FIM scores at admission are 18−26 points, "A" is not 47 points but 48 points for the corrected total FIM effectiveness to be near 0.63.

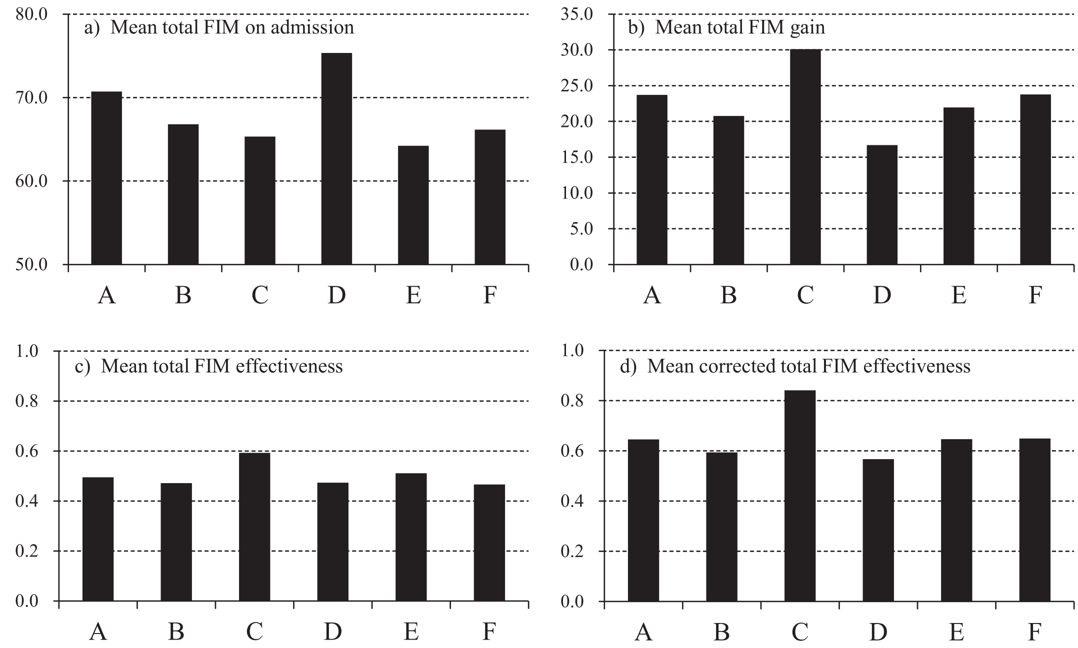

Figure 2. Comparison between 6 hospitals.
A−H, Hospital A−H.

hospitals (Kruskal-Wallis test) (Table 2). Hospital C had a significantly higher mean corrected FIM effectiveness than the other 5 hospitals (Scheffé's method, $p<0.01$ for hospitals A, B, D, and E, and $p<0.05$ for Hospital F). Figure 2 shows the mean FIM gain, mean FIM effectiveness, and mean corrected FIM effectiveness for the 6 hospitals. The order of the hospitals was similar for mean FIM gain (Fig. 2b) and mean corrected FIM effectiveness (Fig. 2d).

Discussion

This study used (1) data from the Kumamoto Stroke Liaison Critical Pathway to demonstrate the value of A of the corrected total FIM effectiveness [total FIM gain/(A − total FIM score on admission)], and demonstrated (2) that Hospital C had a significantly higher mean corrected FIM effectiveness than the other 5 hospitals.

There are few reports comparing Kaifukuki rehabilitation hospitals in terms of ADL gain, length of stay in hospital, and ADL efficiency (ADL gain/length of stay in hospital) [7−13]. These are divided into reports that (1) simply compared the hospitals without correcting the patients' severity [7, 8], (2) a report that selected the patients by their ADL on admission [9], and (3) reports that corrected the ADL gain according to the "standard severity distribution" [10−13].

Within this study, Hospital C had the highest mean corrected FIM effectiveness, and in a report which corrected ADL gain according to the standard severity distribution [13], Hospital C was also the hospital with the highest adjusted ADL gain. Although it is not possible to test for a significant difference among the figures obtained by correcting the standard severity distribution [10−13], the advantage with the corrected motor FIM effectiveness [3] and corrected total FIM effectiveness is that a significant difference can be statistically tested.

The order of the hospitals was similar for mean FIM gain and mean corrected FIM effectiveness. This can be explained by the fact that the average FIM gain is high for patients requiring moderate assistance, and is low for patients with either low FIM score on admission or high FIM score on admission [2], and that although the ratio of patients with high and low FIM score on admission differ greatly between hospitals, there is only a slight difference between the hospitals in terms of the ratio of patients requiring moderate assistance [9]. Tokunaga et al. [9] examined the Barthel Index (BI) on admission at 4 hospitals in Kumamoto and reported that although there were major differences for the ratio of patients scoring 0−10 points at the 4 hospitals at 9% to 41%, and for patients scoring 90 to 100 points at 2% to 22%, there was only a slight difference for the ratio of patients scoring 15−85 points at 57% to 69%. Since FIM gains were low for the patients with both high FIM on admission and low FIM on admission, which differed greatly in patient ratio between hospitals, as a consequence FIM gain may be insusceptible to FIM differences on admission. However, this result from Kumamoto needs further examination to ascertain whether the same result is also found nationally. Similarly, it should be clarified whether or not "FIM gain" is sufficient, rather than an accurate but cumbersome "corrected FIM effectiveness", when comparing FIM improvement between hospitals.

At hospitals with many severe patients who have low FIM score on admission (18−71 points), it is predicted that the mean "corrected FIM effectiveness" will be higher than the mean "FIM effectiveness". In fact, at Hospitals E, C, and F which had low mean FIM score on admission (many severe patients), the mean corrected FIM effectiveness increased.

The present study had some limitations. Firstly, the reliability of FIM score at each hospital is unclear. Attempts to evaluate the reliability of "Nichijo-seikatsu-kino-hyokahyo" score at each Kaifukuki rehabilitation hospital participating in the liaison critical pathway have only recently got underway [14, 15].

Secondly, while the corrected FIM effectiveness is a FIM improvement index that is insusceptible to FIM score on admission, this cannot correct the effect of other factors, such as the length of stay in hospital and age. To solve the problem that "the length of stay in hospital differs between hospitals", the corrected FIM effectiveness in the fixed period (e.g. 2 months) can be used. At Hospital E, which had the highest mean age, if the mean corrected FIM effectiveness (0.647) could be corrected by age, it would be a much higher figure. Tokunaga et al. [16] reported that FIM improvement decreases in a linear fashion for age 70 and older. If "excluding patients aged 70 and older" when comparing the hospitals' mean corrected FIM effectiveness, the effect of the "differences in age between the hospitals" may be reduced.

Future research issues include the following: (1) analyzing data from nationwide Kaifukuki rehabilitation hospitals, (2) comparing 3 methods that correct the difference in patients' severity (limiting the patients, using the standard severity distribution, or corrected FIM effectiveness), (3) establishing a way to correct the "hospital's mean corrected FIM effectiveness" by age, and (4) clarifying whether or not FIM gain is valid even when comparing FIM improvement between hospitals with different levels of patients' severity.

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