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Original Article

The influence of stroke type, gender, and age on FIM improvement

Makoto Tokunaga, MD, PhD,[1,2] Susumu Watanabe, MD, PhD,[1,2] Ryoji Nakanishi, MD, PhD,[1,2] Hiroaki Yamanaga, MD, PhD,[1,2] Hiroyuki Yonemitsu, MD, PhD,[1,2] Shuji Mita, MD, PhD,[2] Tadashi Terasaki, MD,[2] Yoshifumi Hirata, MD, PhD,[2] Makio Yamaga, MD, PhD,[2] Yoichiro Hashimoto, MD[2]

[1]Kumamoto Kinoh Hospital, Kumamoto, Japan
[2]Kumamoto Seamless Stroke Referral Associates for CVD Amelioration, Kumamoto (K-STREAM), Japan

ABSTRACT
Tokunaga M, Watanabe S, Nakanishi R, Yamanaga H, Yonemitsu H, Mita S, Terasaki T, Hirata Y, Yamaga M, Hashimoto Y. The influence of stroke type, gender, and age on FIM improvement. Jpn J Compr Rehabil Sci 2014; 5: 136−140.
Objective: The aim of this study was to elucidate the influence of stroke type, gender, and age on a corrected Functional Independence Measure (FIM) effectiveness score, an FIM improvement indicator corrected for FIM at the time of admission.
Methods: The subjects comprised 3,034 stroke patients enrolled in a stroke liaison clinical pathway. The subjects were divided into four groups based on stroke type (infarction or hemorrhage) and sex (male or female), and were stratified into nine different five-year age groups. We then investigated the mean corrected FIM effectiveness score.
Results: Mean corrected FIM effectiveness decreased in all four groups among subjects aged 70 years or older. Among subjects aged 69 or younger, cerebral hemorrhage was significantly greater than cerebral infarction, but no clear statistical difference was seen for gender.
Conclusion: During an investigation of FIM improvement in stroke patients, there is no great need to divide subjects by gender, but the patients should be stratified by stroke type and age.
Key words: corrected total FIM effectiveness, FIM improvement, type of stroke, sex, age

Correspondence: Makoto Tokunaga, MD, PhD
Department of Rehabilitation, Kumamoto Kinoh Hospital, 6−8−1 Yamamuro, Kita-ku, Kumamoto 860−8518, Japan.
E-mail: tokunaga@juryo.or.jp
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Introduction

The Functional Independence Measure (FIM) [1] is a technique used for evaluating activities of daily living (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 affected by FIM at the time of admission is a serious impediment to the investigation of factors that influence FIM improvement. This is because when FIM at the time of admission differs in groups with and without these factors, FIM gain cannot be easily compared.

Corrected motor FIM effectiveness [3] is a corrected improvement indicator of motor FIM effectiveness [4] that is not greatly affected by motor FIM at the time of admission. Corrected motor FIM effectiveness was calculated as follows: motor FIM gain/(A−motor FIM at time of admission); the variable A differs based on motor FIM at time of admission [3]. Using this type of corrected motor FIM effectiveness, Tokunaga et al. [5] investigated the effects of age on FIM improvement, and found that mean FIM improvement (corrected motor FIM effectiveness) was approximately constant for subjects under the age of 69, but decreased nearly linearly as age increased in subjects aged 70 or over.

However, it is possible that FIM improvement

differs based on stroke type and gender. Furthermore, it was desirable to verify if the relationship shown between age and FIM improvement in one hospital was universal or not by using multicenter data. Because Kumamoto Stroke Liaison Critical Pathway included total FIM effectiveness rather than motor FIM, Sannomiya et al. [6] used all *Kaifukuki* rehabilitation hospital data, and evaluated the variable A for the formula of corrected FIM effectiveness=total FIM gain/(A−FIM at time of admission).

The aim of the present study is to elucidate the influence of stroke type, sex, and age on corrected FIM effectiveness using the Kumamoto Stroke Liaison Critical Pathway data.

Subject and Methods

As of February 2014, participating in the liaison critical pathway managed by the Kumamoto Seamless Stroke Referral Associates for CVD Amelioration (K-STREAM) [7] are nine acute phase hospitals, 39 *Kaifukuki* rehabilitation hospitals, 20 long-term care health facilities (*roken*), 39 convalescent hospitals, and 42 clinics. The pathway contains 10,682 patients' data.

This epidemiological research had a retrospective design. In May 5, 2014, 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. The following patients were excluded: patients aged less than 10 and 100 or older, patients with subarachnoid hemorrhage, for whom the total FIM score was not recorded on admission/discharge to/from the Kaifukuki rehabilitation hospitals, patients whose total FIM score on admission was 126 points, and patients who died in the hospital or were transferred to acute phase hospitals. As a result, 3,034 patients were included in the present study. All the data required for this study was recorded.

Except for the relatively short stay in acute phase hospitals, the patient attributes (Table 1) were similar to those found in the national survey of patients in *Kaifukuki* rehabilitation wards [8].

Study 1: A comparison of the four groups divided by stroke type and gender

The subjects were classified by patient characteristics and divided into two groups by stroke type (cerebral infarction or cerebral hemorrhage) and two groups by gender (male or female) to create a total of four different groups. A Kruskal-Wallis test (significance level below 5%) was performed on these four groups to determine if a statistical difference was seen in age, FIM at time of admission, FIM at time of discharge, FIM gain, or corrected total FIM effectiveness score (hereinafter referred to as corrected FIM effectiveness).

Corrected FIM effectiveness was defined as: FIM gain/(A−FIM at time of admission). The A in the denominator was 48, 81, 102, 106, 113, 117, and 126 points for the following scores for FIM at the time of admission: 18−26, 27−35, 36−44, 45−53, 54−62, 63−71, and 72−125 points, respectively [6].

Study 2: The number of subjects in each age group

The subjects were divided into nine age groups: patients 49 years or less, 50−54 years, 55−59 years, 60−64 years, 65−69 years, 70−74 years, 75−79 years, 80−84 years, 85−89 years, 90−94 years, and 95−99 years. We examined the number of male patients with cerebral infarction in each of the nine age groups. Similarly, we examined the number of female patients with cerebral infarction, male patients with cerebral hemorrhage, and female patients with cerebral hemorrhage in each age group. We also determined the percentage of patients with cerebral infarction and the percentage of males in each age group.

Study 3: Mean corrected FIM effectiveness by age group

We divided male patients with cerebral infarction into nine groups by age, and calculated the mean score of corrected FIM effectiveness for each group. We similarly performed an examination for females with cerebral infarction, males with cerebral hemorrhage, and females with cerebral hemorrhage.

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

	This study	National survey [8]
Number of patients	3,034	14,011
Age	73.3±12.7	72.0
Sex	Male 1,631, female 1,403	56.8% males, 43.2% females
Infarction, hemorrhage	Infarction 2,050, hemorrhage 984	–
Length of stay in acute phase hospitals	16.0±21.8	36.6
Length of stay in Kaifukuki rehabilitation hospitals	99.7±53.8	89.4
Total FIM score at admission	65.9±34.9	68.4
Total FIM score at discharge	87.9±35.7	85.8
Total FIM gain	22.0±19.9	17.4

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

Study 4: An investigation of 1,057 patients aged 69 years or younger

We investigated if mean corrected FIM effectiveness differed for stroke type and gender in 1,057 patients aged 69 or younger. The two groups were compared using a Mann-Whitney *U* test (significance level below 5%). We also investigated if either age or corrected FIM effectiveness was correlated with cerebral infarction or cerebral hemorrhage using Spearman's rank correlation coefficient (significance level below 5%).

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.

Results

Statistical differences for age, FIM at the time of admission, FIM at the time of discharge, FIM gain, and corrected FIM effectiveness were seen in the four groups divided by stroke type and gender (Table 2).

The subjects included many males aged 60−89 with cerebral infarction, and many females aged 70−94 with cerebral infarction (Figure 1a). Compared with cerebral infarction, the difference in the number of patients by age was smaller for cerebral hemorrhage. The percentage of patients with cerebral infarction was 67.6% (2,050/3,034 patients), but a higher ratio was seen for elderly patients. The percentage of males was 53.8% (1,631/3,034 patients), but was lower for elderly patients (Figure 1b).

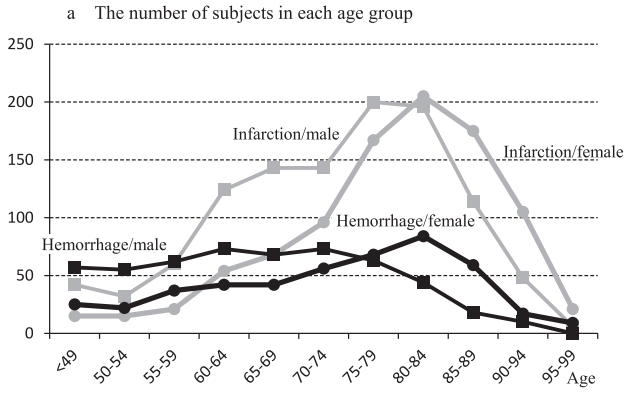
In the four groups divided by stroke type and age, the mean corrected FIM effectiveness in patients aged 70 years or older showed a nearly linear decrease (Figure 2).

Corrected FIM effectiveness for subjects aged 69 or younger was 0.93±0.67 for patients with cerebral hemorrhage (483 patients), and 0.70±0.39 for patients with cerebral infarction (574 patients). Cerebral hemorrhage showed a significantly higher trend (Figure 2). No statistical significance was seen in gender based on the corrected FIM effectiveness scores for patients aged 69 or younger (males, 0.80±0.54 [716 patients]; females, 0.82±0.58 [341 patients]). The correlation coefficient for corrected FIM effectiveness for patients aged 69 or younger was both small for patients with cerebral infarction (correlation coefficient−0.11, $p<0.01$) and for patients

Table 2. A comparison of the four groups divided by stroke type and gender.

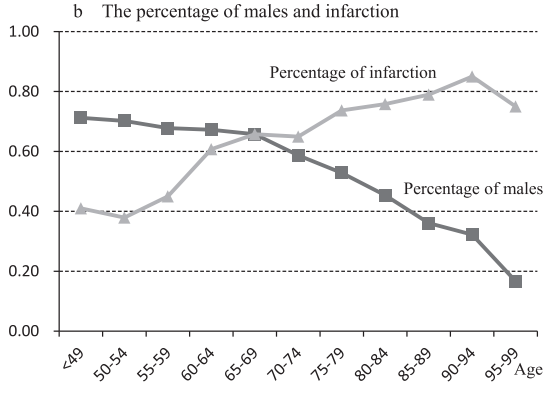
	Infarction/male	Infarction/female	Hemorrhage/male	Hemorrhage/female	Significance
Number of patients	1,108	942	523	461	−
Age	72.9±11.9	78.5±10.9	65.2±12.9	72.7±13.0	$p<0.001$
FIM at admission	74.8±33.6	63.6±34.8	61.7±34.7	54.0±33.6	$p<0.001$
FIM at discharge	94.3±32.5	82.1±37.4	91.5±34.2	80.7±38.1	$p<0.001$
FIM gain	19.4±17.5	18.5±17.0	29.8±23.6	26.6±22.9	$p<0.001$
Corrected FIM effectiveness	0.57±0.42	0.53±0.42	0.81±0.66	0.68±0.58	$p<0.001$

Significance, a Kruskal-Wallis test performed on four groups.



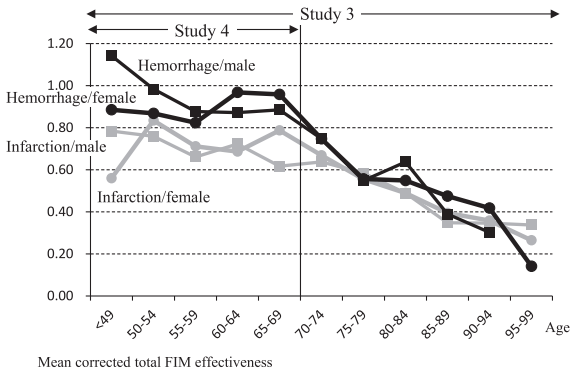
Number of patients

	<49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85-89	90-94	95-99	Total
Infarction/male	42	32	60	124	143	143	200	196	114	48	6	1108
Infarction/female	15	15	21	54	68	96	167	205	175	105	21	942
Hemorrhage/male	57	55	62	73	68	73	63	44	18	10	0	523
Hemorhage/female	25	22	37	42	42	56	68	84	59	17	9	461
Total	139	124	180	293	321	368	498	529	366	180	36	3034



	<49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85-89	90-94	95-99	average
Percentage of infarction	0.41	0.38	0.45	0.61	0.66	0.65	0.74	0.76	0.79	0.85	0.75	0.54
Percentage of males	0.71	0.70	0.68	0.67	0.66	0.59	0.53	0.45	0.36	0.32	0.17	0.68

Figure 1. The number of subjects in each age group (a), the percentage of males and infarction (b).
■ male; ● female; Gray, infarction; Black, hemorrhage.



Mean corrected total FIM effectiveness

	<49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85-89	90-94	95-99
Infarction/male	0.78	0.76	0.66	0.72	0.62	0.64	0.58	0.49	0.35	0.35	0.34
Infarction/female	0.56	0.83	0.71	0.69	0.79	0.67	0.55	0.49	0.39	0.36	0.26
Hemorrhage/male	1.14	0.98	0.88	0.87	0.88	0.75	0.55	0.64	0.39	0.30	–
Hemorrhage/female	0.89	0.87	0.82	0.97	0.96	0.75	0.56	0.55	0.47	0.42	0.14

Figure 2. Mean corrected FIM effectiveness by age group.
■ male; ● female; Gray, infarction; Black, hemorrhage.

with cerebral hemorrhage (correlation coefficient−0.11, $p<0.05$).

Discussion

The present study confirmed that the relationship shown between age and FIM improvement (FIM improvement was approximately constant in patients aged 69 years or younger and showed a nearly linear decrease as age increased in patients aged 70 years or older) in one hospital [5] is universal. We also investigated the relationships between stroke type and gender with FIM improvement. The results revealed a significant difference between the four groups divided by type of stroke and gender for age and FIM at time of admission. Age stratification and use of the FIM improvement indicator that was corrected for FIM at time of admission allowed elucidation of the influence of stroke type, gender, and age on FIM improvement. Specifically, (1) FIM improvement of subjects aged 70 years or older in all four groups decreased in approximately the same way. (2) For patients aged 69 years or younger, (a) the correlation between age and FIM improvement was small, (b) FIM improvement for cerebral hemorrhage was significantly greater than for cerebral infarction, and (c) no clear statistical difference was seen for FIM improvement based on gender.

The present study concludes that no statistical significance can be seen in FIM improvement based on gender. However, Gargano et al. [9] reported that based on an investigation of 270 stroke patients (cerebral infarction, cerebral hemorrhage, transient ischemic attack), the ratio of females who had a Barthel index score of 95 points or higher three months later was lower than males. Paolucci et al. [10] matched age and severity with 440 patients who had cerebral infarction, and performed a logistic regression analysis. They reported that the functional prognosis of females was poorer compared to males (the percentage of cane use was high, and many patients had a Barthel index score ranging from 50 to 90). By contrast, Appelros et al. [11] reviewed the outcomes of stroke by gender differences and found the reason why female stroke patients had poor outcomes was because they included many elderly patients with severe symptoms. They found that the effects of gender difference on patient outcomes were small.

The present study concludes that FIM improvement for cerebral hemorrhage is significantly greater than for cerebral infarction in patients aged 69 or younger. Paolucci et al. [12] comparatively matched age, gender, and Barthel index score at the time of admission for 135 cerebral infarction patients and 135 cerebral hemorrhage patients, and reported that Barthel index effectiveness was significantly greater for the cerebral hemorrhage group. Katrak et al. [13] also reported that compared to cerebral infarction patients (589 patients) cerebral hemorrhage patients (129 patients) had lower FIM at the time of admission but higher FIM gain. A multivariate analysis revealed that stroke type was a significant predictor variable for FIM gain. By contrast, Jørgensen et al. [14] reported that when the severity of symptoms at the time of admission was divided into three groups (mild, moderate, and severe), no difference in Barthel index scores at the time of discharge between cerebral hemorrhage (88 patients) and cerebral infarction (912 patients) was noted.

As the age of subjects increased, the ratio of females with cerebral infarction also increased. If we assume that FIM improvement was greatly influenced by stroke type and gender, then it is not appropriate to merge the different groups together as a single stroke group. The results of the present study show that when examining FIM improvement in stroke patients, there is no great need for distinguishing patients by gender, but cerebral infarction and cerebral hemorrhage should be differentiated in patients aged 69 years or younger. However, because various reports exist concerning the effects of stroke type and gender on ADL improvement, an exact method of assessment is needed to verify which results are correct in order to reach a future conclusion.

ADL gain is affected by both ADL at time of admission and age. For this reason, when examining the two factors of stroke type and gender on ADL improvement, the relationships of four factors with ADL improvement (stroke type, gender, ADL at time of admission, and age) should be investigated. The techniques used in the present study (age stratification and use of a corrected FIM effectiveness score to correct the effects of FIM at time of admission) are useful for future research concerning the relationship between various factors and FIM improvement [5, 15, 16].

The problems of the present study are as follows: first, although 3,034 subjects participated in the study, when many subjects are stratified, the number of subjects decreases, leading to reduced reliability of the mean values. Second, multicenter studies have shown that the difference in quality of hospital rehabilitation can affect results [17]. Third, the factors for affecting FIM improvement include not only stroke type, gender, and FIM at the time of admission, but also various other factors. For this reason, we cannot definitively conclude that the factors seen in the compared groups were identical.

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