Original

Relationship between FIM at Admission and Falls in a Convalescent Rehabilitation Ward

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Abstract

Background: The lower Functional Independence Measure (FIM) scores at admission have been shown to be a valid predictor of the risk of falling.

Objectives: The purpose of this study was to investigate which stratified group by FIM scores at admission was more prone to fall.

Design: Retrospective cohort study.

Setting: A convalescent rehabilitation ward in a hospital in Japan.

Participants: Adult consecutive inpatients between April 2013 and March 2019.

Methods: The inpatients were classified into five or six groups based on FIM scores, and the risk of falling was compared between the lowest FIM group and the other groups. Statistics on the risk of falling were made by survival analysis. $P< 0.05$ was set to denote statistical significance.

Results: This study comprised of 1,148 inpatients and there were 173 inpatients who had at least one fall. There was no difference in the risk of falling among the groups of total and cognitive FIM compared with the each lowest FIM group. In contrast, the risk of falling in the motor FIM group scored 39 to 51 was significantly higher than in the lowest motor FIM group scored 13 to 25 (p=0.038 (Holm's test), Hazard Ratio=1.887 (95%IC 1.207–2.950; p=0.005)). In addition a significant trend of falls was not observed for total, motor, and cognitive FIM group in the order by FIM scores. The results of this study indicated that there was a non-linear relationship between FIM groups and the risk of falling.

Conclusions: The intermediate motor FIM group at admission, in particular scored 39 to 51, might have greater risk of falling and should be instituted the appropriate falls prevention strategies in the convalescent rehabilitation ward.

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—Key words—

FIM, convalescent rehabilitation ward, fall

Introduction

A rehabilitation hospital represents a particular situation where the aim of admission is to restore function and promote independence and mobility, while balancing these needs with maintaining patient safety. Therefore, much higher fall rates were reported on inpatients rehabilitation units. Then the assessment of fall risk with appropriate scales might be a very useful aid to planning the level of restoring functional autonomy[1)–3)]. The Functional Independence Measure (FIM)[4)] is a measurement of the degree of independence on patients of activities of daily living (ADLs). The inpatients with the lower total and motor FIM scores at admission in a rehabilitation setting were reported to predict an increased likelihood of fall[1)5)6)]. On the other hand, some studies reported that patients with very low FIM scores might fall less than patients in an intermediate group[1)7)8)]. Therefore, this study was designed to clarify which FIM score range at admission was more prone to fall in a convalescent rehabilitation ward.

Methods

This retrospective cohort study comprised of consecutive inpatients admitted to the convalescent (Kaifukuki) rehabilitation ward[9] between April 2013 and March 2019 who were followed until discharge. The indication for hospitalization in the ward was legally limited to the disabled patients on whom acute phase treatment has been completed in diagnosis of such orthopedic disorders (fracture, after hip or knee replacement surgery, others), neurological disorders (stroke, others), or disuse syndrome (debility following prolonged bed rest after pneumonia or surgery, others). A fall was defined as 'an event which results in a person coming to rest inadvertently on the ground or floor or other lower level' by the World Health Organization[10]. The information included age, gender, history of falling, diagnostic category at admission, days from onset to admission, length of stay, and FIM at admission were collected from clinical records. Data of falls that occurred during rehabilitation stay were extracted from clinical records including the dedicated hospital's accident reports. The FIM has 18 categories subdivided into motor and cognitive items. Each item is graded from 1 (complete dependence) to 7 (complete independence). The total FIM score (range, 18–126) consists of 13 motor (range, 13–91) and 5 cognitive items (range, 5–35). The inpatients were divided into six groups by FIM scores[7]. The FIM scores are taken from the first 3 days of admission (72 hours of the patient's stay).

Statistical analysis

Initially, variables were checked for normality distribution using the Kolmogorov-Smirnov test. Continuous variables with normal and skewed distribution were expressed as mean ± standard deviation (SD) and median [25%, 75%], respectively. Categorical variables were expressed as number. The faller and non faller characteristics was compared using the Mann-Whitney test to match nonparametric variables and Student's t-test to match continuous variables with normal distribution, and Fisher's exact test was used for categorical variables. The Kaplan-Meier method of survival (fall-free period) estimation was used to describe the risk of falling during rehabilitation stay (dependent variable) as a function of time (days). The time from admission to the first fall (if any) was calculated for each case. If no fall occurred during hospitalization, observation were censored at the time of discharge. Comparison between patients with the lowest FIM group and the other groups was made using the log-rank test and post hoc analysis using Holm's test. Moreover, Cox proportional hazard model for fall was performed to compute the hazard ratio (HR) with 95 % confidence intervals (CI) in comparison to the lowest FIM group. In addition, log-rank trend test were performed to test the trend in the FIM group order. P values below 0.05 were used for determining significance throughout the analyses found in the present study. All statistical analyses were performed with EZR version 1.41 (Saitama Medical Center, Jichi Medical University, Saitama, Japan), which is a graphical user interface for R (The R Foundation for Statistical Computing, Vienna, Austria)[11]. This study was approved by the Research Ethics Committee of the Chuzan Hospital. The author declared that there was no conflict of interests.

Results

The characteristics of the entire study sample (1,148 inpatients) and the comparison between faller and non faller characteristics were presented in Table 1. The median age of inpatients was 81 years, and 680 (59.2%) of inpatients were females. There were 173 (15.1%) inpatients who had at least one fall and 223 fall events (i.e.137 inpatients fell once, 26 fell twice, 6 fell three times, and 4 fell four times). Fall rate was 2.85 falls per 1,000 occupied bed days (OBDs). The median length of time from disease onset to rehabilitation admission and rehabilitation stay (length of stay) were 21 and 70, respectively. The average period until the first fall was 41.7 ± 30.8 (1–146) days. Most falls occurred in the patient's room (142 falls) and the lavatory (26 falls). Five fallers suffered serious injuries including a dislocated hip replacement (1 case) and four fractures that were the patella (1 case), fibula (1 case), supracondylar humerus (1 case), and femoral neck (1 case).

When faller and non faller variables were compared, there was no difference for age, history of falling, motor FIM score at admission, (total, motor, and cognitive) FIM score at discharge. On the other hand, in the fallers there was a significant high ratio of male and neurological inpatients[1] and a significance worse score on the total and cognitive FIM score at admission, and significantly longer both days from onset to admission and

Table 1 Characteristics of the study population

Variable	Overall (n = 1,148)	Fallers (n = 173)	Non Fallers (n = 975)	p-value
Age, years median	81 [73, 86]	81 [70, 87]	81 [74, 86]	0.773
Gender Male/Female	468/680	87/86	381/594	0.007
Diagnostic category				0.005
Orthopedic conditions	605	73	532	
Neurological disorders	396	78	318	
Disuse syndrome	147	22	125	
History of falling	711	105	606	0.734
Days from onset to admission	21 [15, 33]	23 [16, 36]	20 [14.5, 32]	0.015
Length of stay (days)	70 [38.75, 88]	86 [66, 108]	66 [36, 87]	＜0.001
Total FIM score at admission	69 [47, 88]	64.0 ± 22.1	70 [48, 89]	0.043
motor FIM score at admission	47 [28, 60]	42.5 ± 16.6	47 [28, 61]	0.096
cognitive FIM score at admission	24 [17, 29]	21.6 ± 7.6	24 [17, 30]	0.021
Total FIM score at discharge	94 [66, 113]	86.3 ± 24.4	96 [64, 115]	0.083
Motor FIM score at discharge	67.5 [46, 83]	61.7 ± 18.3	69 [45, 84]	0.076
Cognitive FIM score at discharge	27 [20, 32]	24.5 ± 7.5	27 [20, 33]	0.155

Continuous variables with normal and skewed distribution were expressed as mean ± standard deviation and median [25%, 75%], respectively. Categorical variables were expressed as number.

Table 2 The results of survival analyses

I. Total FIM score: Log-rank p-value 0.154, Log-rank trend p-value 0.28							
Group	FIM range	n	Fallers	Holm p-value	HR	95% CI	HR p-value
A	18–35	158	21				
B	36–53	202	40	1.000	1.490	0.879–2.529	0.139
C	54–71	242	41	1.000	1.351	0.797–2.289	0.264
D	72–89	291	47	1.000	1.249	0.745–2.092	0.399
E	90–126	255	24	1.000	0.825	0.458–1.485	0.521
II. Motor FIM score: Log-rank p-value 0.001, Log-rank trend p-value 0.31							
Group	FIM range	n	Fallers	Holm p-value	HR	95% CI	HR p-value
A	13–25	249	32				
B	26–38	186	39	0.108	1.825	1.141–2.919	0.012
C	39–51	243	50	0.038	1.887	1.207–2.950	0.005
D	52–64	290	38	1.000	1.143	0.713–1.832	0.580
E	65–91	180	14	0.924	0.741	0.394–1.392	0.351
III. Cognitive FIM score: Log-rank p-value 0.161, Log-rank trend p-value 0.12							
Group	FIM range	n	Fallers	Holm p-value	HR	95% CI	HR p-value
A	5–9	73	9				
B	10–14	131	27	1.000	1.743	0.818–3.714	0.150
C	15–19	182	32	1.000	1.463	0.698–3.069	0.314
D	20–24	241	42	1.000	1.374	0.667–2.830	0.389
E	25–29	239	26	1.000	0.898	0.420–1.920	0.781
F	30–35	282	37	1.000	1.129	0.543–2.348	0.745

HR is the hazard ratio of FIM group in comparison the each lowest FIM group A.

length of stay[1].

Initially, the inpatients were divided into six groups by FIM scores[7], but there were few inpatients with a high total FIM group scored 108 to 126 (32 inpatients) and a high motor FIM group scored 78 to 91 (17 inpatients) because inpatients with high activity would not be hospitalized. Therefore, five score categories by total FIM scores (A: 18–35, B: 36–53, C: 54–71, D72–89, E90–126) and motor FIM scores (A: 13–25, B: 26–38, C: 39–51, D: 52–64, E: 65–91) at admission were selected to an adequate number of observations in each category. On the other hand, cognitive FIM scores was stratified into six groups (A: 5–9, B: 10–14, C: 15–19, D: 20–24, E: 25–29, F: 30–35).

The results of survival analyses were presented in Table 2. The survival analyses revealed that there was no difference among the groups of total and cognitive FIM compared with each the lowest FIM group, in addition among the groups. On the other hand, the risk of falling in the motor FIM group C scored 39 to 51 was sig-

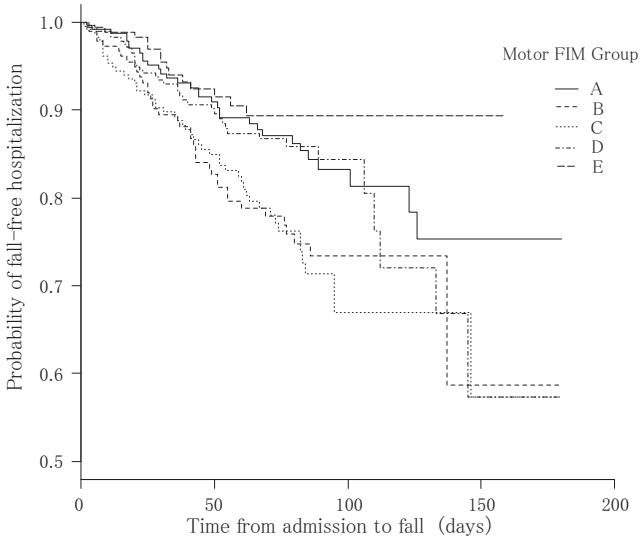

Fig. 1 Probabilities of fall-free hospitalization according to five motor FIM score groups.
Line graph shows Kaplan-Meier curves for fall risk as a function of time in 1,148 inpatients assigned to motor FIM groups. The motor FIM at admission was stratified into five groups as follows: A 13–25, B 26–38, C 39–51, D 52–64, and E 65–91.

nificantly higher than in the lowest motor FIM group A scored 13 to 25 (P=0.038 (Holm's test), HR=1.887 (95% IC 1.207–2.950; p=0.005)). In addition, the risk of falling in the motor FIM group B scored 26 to 38 was significantly higher than in the motor FIM group E scored 65 to 91 (P=0.020 (Holm's test), HR=2.464 (95%IC 1.337–4.539; p=0.004)), and the risk of falling in the motor FIM group C scored 39 to 51 was significantly higher than in the motor FIM group E scored 65 to 91 (P=0.014 (Holm's test), HR=2.548 (95%IC 1.408–4.609; p=0.002)). The risk of falling as a function of the time of observation using motor FIM at admission is shown in Fig. 1. A significant trend of the risk of falling was not observed in the following total, motor, and cognitive FIM group order: A, B, C, D, E and F (P> 0.05). Therefore, each FIM group had a non-linear association with risk of falling.

Discussion

It is very important to identify inpatients at a high risk for falling at admission to prevent the occurrence of falls in the hospital setting. Complex multifactorial problems due to interaction between physiological, behavioral, and environmental factors contribute to risk for falling[12]. Vieira et al. reported that carpet flooring, vertigo, being an amputee, confusion, cognitive impairment, stroke, sleep disturbance, anticonvulsants, tranquilizers and antihypertensive medications, ages between 71 and 80, previous falls, and need for transfer assistance are risk factors for geriatric patient falls in rehabilitation hospital settings[13]. As some risk factors affect ADLs in hospitalized patients, it is considered that assessing ADLs might be useful to predict falls. Previous research has suggested that total FIM admission scores might be effective for fall risk prediction[1)6)]. In addition, the motor FIM score at admission might be effective predictor of falls in rehabilitation patients[2)7)]. This study suggests that admission motor FIM scores between 39 and 51 might have greater risk of falling in rehabilitation stays. Suzuki et al. reported the highest rate of falls for the group with admission motor FIM scores was the group with those scores between 26 and 38 in stroke inpatients[7], but it was differed from the results of this study. One of the reasons might be that non-stroke inpatients were included. Several other studies have suggested a non-linear relationship between mobility and likelihood of falling[1)5)7)8)]. Therefore, fall risk seems to be related to a moderate level of disability because seriously dependent inpatients receive more assistance in ADLs and so are less prone to falls[1)]. Though some studies reported lower cognitive function were associated with a high risk for falls[5)7)], low cognitive FIM group was not valid predictor of the risk of falling in this study. One of the reasons might be successful in multifactorial fall reduction programs for inpatients with cognitive

dysfunction because the rate of falls in this study were lower than those previously reported for geriatric rehabilitation inpatients[13].

Study Limitations

Several limitations of this study needed to be acknowledged. First, this study did not specifically address patients who fell multiple times and whose admission diagnosis. Second, FIM group was not compared the prediction accuracy against other fall risk assessment tools. Third, the association between falls and FIM subscales and between falls and combination of motor FIM group and cognitive FIM group were not investigated. Salomon reported that patients who fell had significantly lower FIM expression scores ($p=0.02$)[2]. Fusco-Gessick and Cournan found that the sum of two FIM subscales (Toileting and Expression) could be used to predict which inpatients might fall during their stay in a rehabilitation hospital[3]. Further research might need to be validated to FIM subscale score at admission for prediction of the risk of falling.

Conclusions

This study found a non-linear relationship between the risk of falling and FIM groups statistically. There was no difference among the groups of total and cognitive FIM compared with each of the lowest FIM group. In contrast, the risk of falls was significantly higher in the motor FIM group scored 39 to 51 compared with the lowest motor FIM group scored 13 to 25. Therefore, the intermediate motor FIM group at admission in particular scored 39 to 51, might have greater risk of falling and should be instituted the appropriate fall prevention strategies in the convalescent rehabilitation ward.

References

1) Saverino A, Benevolo E, Ottonello M, et al: Falls in a rehabilitation setting: Functional independence and fall risk. Eura Medicophys 42 (3): 179—184, 2006.
2) Salamon LA, Victory M, Bobay K: Identification of patients at risk for falls in an inpatient rehabilitation program. Rehabil Nurs 37 (6): 292—297, 2012.
3) Fusco-Gessick B, Cournan M: Using functional independence measure subscales to predict falls — Papid assessment. Rehabil Nurs 44 (4): 236—244, 2019.
4) Liu M, Sonoda S, Domen K: FIM. Functional Evaluation of Stroke Patients. Chino N, editor. Tokyo, Springer-Verlag, 1997, pp 41—96, Japanese.
5) Lee JE, Stokic DS: Risk factors for falls during inpatient rehabilitation. Am J Phys Med Rehabil 87 (5): 341—353, 2008.
6) Forrest G, Huss S, Patel V, et al: Falls on an inpatient rehabilitation unit: Risk assessment and prevention. Rehabil Nurs 37 (2): 56—61, 2012.
7) Suzuki T, Sonoda S, Misawa K, et al: Incidence and consequence of falls in inpatient rehabilitation of stroke patients. Exp Aging Res 31 (4): 457—469, 2005.
8) Petitpierre NJ, Trombetti A, Carroll I, et al: The FIM® instrument to identify patients at risk of falling in geriatric wards: A 10 year retrospective study. Age Ageing 39 (3): 326—331, 2010.
9) Okamoto T, Ando S, Sonoda S, et al: "Kaifukuki Rehabilitation Ward" in Japan. Jpn J Rehabil Med 51 (10): 629—633, 2014.
10) Falls. https://www.who.int/news-room/fact-sheets/detail/halls (accessed 2019-8-9).
11) Kanda Y: Investigation of the freely-available easy-to-use software "EZR" (Easy R) for medical statistics. Bone Marrow Transplant 48 (3): 452—458, 2013.
12) Rajagopalan R, Litvan I, Jung TP: Fall prediction and prevention systems: recent trends, challenges, and future research directions. Sensors 17 (11): 2509—2516, 2017.
13) Vieira ER, Freund-Heritage R, da Costa BR: Risk factors for geriatric patient falls in rehabilitation hospital settings: a systematic review. Clin Rehabil 25 (9): 788—799, 2011.

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回復期リハビリテーション病棟での入院時 FIM と転倒との関連

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—キーワード—
FIM，回復期リハビリテーション病棟，転倒

入院時の機能的自立度評価（FIM）が低いと転倒予測に有用であると報告されている．そのため，回復期リハビリテーション病棟では，どのような入院時 FIM 点数の患者が転倒しやすいのかについて後ろ向きコホート研究を行った．対象は 2013 年 4 月から 2019 年 3 月までの間，回復期リハビリテーション病棟に連続入院した成人患者とした．入院患者は FIM 点数により 5 または 6 つの群に分類し，生存分析を用いて転倒リスクを FIM 最低点数の患者群と比較した．有意水準は 5% とした．入院患者 1,148 人中 173 人が少なくとも 1 回以上転倒していた．FIM 総点や FIM 認知点数の各群は各最低点数群と転倒リスクに有意差はなかったが，FIM 運動点数（39〜51）群は FIM 運動最低点数（13〜25）群より有意に転倒リスクが高かった（p=0.038（Holm テスト），ハザード比 1.887（95%IC 1.207〜2.950；p=0.005））．また転倒リスクと各 FIM 点数群の順番に有意な関連はなかった．この結果より転倒リスクと各 FIM 点数群の順番には直線的な関係はないことが明らかになった．回復期リハビリテーション病棟では中等度の運動障害，特に入院時の FIM 運動点数が 39〜51 の患者群が転倒リスクが高かったので，この患者群には適切な転倒予防対策が必要である．

［COI 開示］本論文に関して開示すべき COI 状態はない

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