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Factors Influencing the Outcome of Acute Rehabilitation: Functional Independence Measure Assessment at Discharge

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Abstract. [Purpose] The purpose of this study was to identify factors related to the discharge destination of 126 patients who underwent acute rehabilitation. [Subjects and Methods] We assessed Activities of Daily Living (ADL) of 126 patients, based on the Functional Independence Measure (FIM) score at discharge and analyzed whether the FIM score was useful for predicting the outcome by discriminant analysis. [Results] The correct classification rate of our model was 93.7%. Control of excretion, self care, and transfer were the factors with the greatest influence on the outcome. When our model was tested with 40 patients for validation, the correct classification rate was 77.5%. [Conclusion] ADL is a useful indicator of the discharge destination of patients undergoing acute rehabilitation. Further research is needed to improve our model, so that it includes disease characteristics and social factors.
Key words: Acute rehabilitation, Outcomes at the time of hospital discharge, Functional Independence Measure (FIM)

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INTRODUCTION

The objectives of acute rehabilitation are to prevent disuse syndrome, improve Activities of Daily Living (ADL), and plan for patients, return to the community. Our hospital has a multidisciplinary rehabilitation team that intervenes when patients require such management.

It is difficult for patients to remain for long in a hospital after completing their treatment, but some patients are unable to return home. Also, reduction of the length of stay is being encouraged at acute hospitals, so we must provide patients with rehabilitation programs that achieve the desired functional outcome.

A number of studies have reported on the importance of ADL in achieving discharge from hospital to home. Arlene et al.[1] reported that independence with respect to ADL and active medical problems were the key predictors of the discharge destination of patients admitted to a combined geriatric medicine/ psychiatric unit. Denti et al.[2] reported that the ADL level at admission was the most powerful predictor of the functional outcome of elderly stroke patients. Many studies[3, 4] have addressed prediction of the outcome of patients discharged to convalescence at a rehabilitation unit. However, outcome studies of acute-phase rehabilitation have mainly been conducted of patients with cerebrovascular disease[5, 6], and there have been few studies investing other diseases such as pneumonia[7] or critically ill patients admitted to an intensive care unit (ICU)[8, 9]. As a result, less is known about the outcome of acute rehabilitation of patients with such diseases. So a mathematical model based on ADL for such patients would help to clarify their likely outcomes and assist in determining the appropriate discharge destination.

The Functional Independence Measure (FIM)[10] has been used at our hospital to assess ADL, since it not only evaluates physical activities, but also cognitive function. Because the purpose of FIM is to predict the duration for which care will be needed, it is suitable for assessing the functional outcome.

The objectives of this study were to determine whether the ADL level attained at discharge can be used to predict the outcome for acute patients and to identify the FIM items that are most important as predictors by statistical analysis. Accordingly, we assessed ADL at discharge using FIM and analyzed items related to returning home by discriminant analysis.

METHODS

This study used a retrospective design and the subject were 126 patients admitted to our hospital from January 2009 to June 2010 who underwent rehabilitation (Table 1). All of the patients had lived at home before admission. We divided the patients into two groups: patients discharged to home (home group, n=85) and patients requiring long-term care in a nursing home or other facilities (other group, n=41). Patients who died in hospital were excluded. The following demographic parameters were investigated: age, sex, disease, length of stay, and length of rehabilitation.

Table 1. Comparison of demographic factors

	Study population (n=126)	Home group (n=85)	Other group (n=41)
Age	80.2 ± 10.7 (60–98)	78.9 ± 11.2	82.8 ± 8.95
Sex (male/female)	57/69	36/49	21/20
Disease category:			
Cerebrovascular disease	19	7	12
Musculoskeletal disease	19	13	6
Respiratory disease	22	11	11
Disuse syndrome, Cancer	15	12	3
Cardiovascular disease	26	22	4
Other diseases	25	20	5
Length of stay (days)	33.6 ± 23.9 (5–111)	27.3 ± 17.0	46.8 ± 30.3**
Length of rehabilitation (days)	24.2 ± 22.4 (2–92)	17.2 ± 15.2	38.6 ± 27.7**
Total FIM score	85.7 ± 32.8 (18–126)	103.7 ± 17.4	48.5 ± 25.0*

*: $p<0.05$, **: $p<0.01$

We assessed the degree of independence and need for assistance with ADL using the Functional Independence Measure (FIM)[10]. This scale consists of 18 items that cover, self care (eating, grooming, bathing, dressing the upper body, dressing the lower body, and toileting), control of excretion (bladder control, and bowel control), transfer (transfer to bed/chair/wheelchair, to toilet, and to bath/shower), locomotion (walking, wheelchair, and stairs), communication (comprehension, and expression), and social cognition (social interaction, problem-solving, and memory). The score for each item ranges from 1 (total dependence) to 7 (total independence) and the maximum total FIM score is 126. All patients were assessed just before discharge.

Data were analyzed using SPSS software (17.0 J for Windows). Statistical analyses were performed using Student's *t*-test for between-group age, length of stay, and length of rehabilitation. The X^2 test was used to compare the sex distribution between groups, and the Mann-Whitney test was used to compare of the 6 domains and 18 items of FIM. In addition, the age, length of stay, length of rehabilitation, and 6 FIM domains were subjected to discriminant analysis to identify the factors most strongly correlated with the discharge outcome and the model that had the highest correct prediction rate was determined.

Moreover, to confirm the precision of our model, we entered the FIM scores of 40 inpatients who underwent rehabilitation after July 2010 into the model and predicted outcome. Differences of demographic data and FIM scores between the population group and test group were examined using Student's *t*-test or the Mann-Whitney test, while the X^2 test was employed to compare the sex distribution and the outcome. In all analyses, $p<0.05$ was considered statistically significant.

Written informed consent was obtained from all patients before they were enrolled in the study. We obtained data from each patient's medical record and from rehabilitation reports. We encoded personal information to make it impossible to identify any of the subjects.

Table 2. Comparison of the 6 domains of FIM

	Home group (n=85)	Other group (n=41)
Self care	35.1	14.2**
Control of excresion	13.3	4.5**
Transfer	16.4	7.4**
Locomotion	9.1	4.0**
Communication	12.1	8.0**
Social cognition	17.7	10.4**

**: $p<0.01$

RESULTS

Table 1 shows the demographic and clinical characteristics of the two groups. There were significant differences in age, length of stay, length of rehabilitation, and total FIM score at discharge between the two groups. There were also significant differences between the two groups in the 6 domains of FIM (Table 2) and for the 18 items of FIM (Table 3).

When 4 variables (age, length of stay, length of rehabilitation, and total FIM score) were selected, the following discriminant model was obtained and the correct classification rate was 89.7%.

$Z_1=0.033X_1+0.016X_2-0.023X_3+0.053X_4-7.181$

Where X_1 is age, X_2 is length of stay, X_3 is length of rehabilitation, X_4 is the total FIM score.

The characteristic value of the model was 0.813 and there was a significant difference of Wilks' λ between the 2 groups ($X^2=131.847$, $p<0.05$). The normalized coefficients were 0.348 for age, 0.360 for length of stay, −0.453 for length of rehabilitation, and 1.068 for the total FIM score.

Using only age and the total FIM score, the following discriminant model was obtained and the correct classification rate was also 89.7%.

$Z_2=0.036X_1+0.055X_2-7.609$

Where X_1 is age and X_2 is the total FIM score.

Table 3. Comparison of the 18 items of FIM

	Home group (n=85)	Other group (n=41)
Eating	6.5	3.3**
Grooming	6.1	3.0**
Bathing	4.1	1.2**
Dressing the upper body	6.1	2.3**
Dressing the lower body	6.0	2.1**
Toileting	6.4	2.3**
Bladder control	6.8	2.3**
Bowel control	6.5	2.2**
Transfer to bed/chair/wheelchair	6.0	3.2**
Transfer to toilet	6.3	2.8**
Transfer to bath/shower	4.4	1.3**
Walking/wheelchair	5.4	2.7**
Stairs	3.8	1.3**
Comprehension	6.1	4.0**
Expression	6.1	4.0**
Social interaction	6.3	4.2**
Problem-solving	5.7	3.2**
Memory	5.7	3.1**

**: $p<0.01$

The characteristic value of the model was 0.808 and there was a significant difference of Wilks'λ between the 2 groups (X^2=130.088, $p<0.05$). The normalized coefficients were 0.379 for age, and 1.114 for the total FIM score.

When the 6 FIM domains were selected, the highest correct classification rate (93.7%) was obtained.

$Z_3=0.102X_1+0.318X_2-0.112X_3+0.045X_4+0.035X_5-0.089X_6-4.034$

Where X_1 is self care, X_2 is control of excretion, X_3 is transfer, X_4 is locomotion, X_5 is communication, and X_6 is social cognition.

The characteristic value of the model was 0.863 and there was a significant difference of Wilks' λ between the 2 groups (X^2=165.441, $p<0.05$). The normalized coefficients were 0.751 for self care, 0.833 for control of excretion, −0.451 for transfer, 0.154 for locomotion, 0.095 for communication, and −0.372 for social cognition.

Table 4 shows a comparison of demographic factors between the population group and the test group. There were no differences in the demographic variables or the 6 domains and 18 items of FIM.

When we substituted the FIM score at discharge in equation Z_3, 31 out of 40 (77.5%) patients were classified correctly and 9 were not. We further analyzed the misclassification of patients who were not discharged as predicted by the model.

Four patients actually went home when the model selected them for discharge to long-term care. Three of them were suffering from terminal illnesses and their families were willing to perform home care. The other patient went home briefly, but was readmitted to our hospital because of the burden of care and was then transferred to another institution.

Five patients actually went to a nursing home when the model predicted discharge to home. Two patients went to rented housing for the elderly because they couldn't live alone and 3 other patients went to nursing homes because their families were unable to take care of them.

DISCUSSION

Patients with stroke have been the chief focus of previous outcome studies that employed discriminant analysis. In a previous study[6], bathing, bowel control, toileting, social interaction, dressing the lower body, and eating were selected as initial FIM items that predicted the outcome with 70% accuracy for patients with acute stroke. Smith et al.[11] reported that a discriminant function training model including 8 statistically significant variables (such as the total FIM instrument score, age, function-related group, and marital status) correctly classified 85.1% of patients with functional impairment at discharge after rehabilitation. In the present study, however, the subjects had various diseases,

Table 4. Demographic factors of all patients and the test group

	Study population (n=126)	Test group (n=40)
Age	80.2 ± 10.7 (60–98)	80.4 ± 9.45
Sex (male/female)	57/69	23/17
Disease category:		
Cerebrovascular disease	19	5
Musculoskeletal disease	19	6
Respiratory disease	22	7
Disuse syndrome, Cancer	15	4
Cardiovascular disease	26	7
Other diseases	25	11
Outcome	Home 85/Other 41	Home 29/Other 11
Length of stay (days)	33.6 ± 23.9 (5–111)	37.6 ± 23.7
Length of rehabilitation (days)	24.2 ± 22.4 (2–92)	26.1 ± 20.1
Total FIM score	85.7 ± 32.8 (18–126)	103.7 ± 17.4

so we analyzed ADL at discharge. As a result, our model correctly classified 93.7% of patients, which was a better outcome than in previous studies, so we have demonstrated that assessing ADL is effective for predicting the discharge status in the acute care setting.

Control of excretion, self care, and transfer were the FIM domains with the highest coefficients. This result was similar to those of other studies of patients with stroke, indicating the validity of our model. Mauthe et al.[6] reported that self care (including bathing, toileting, dressing the lower body, and eating) was closely related to home discharge, while Smith et al.[12] reported on the importance of dressing the lower body for achieving home discharge. In the present study, the relation between control of excretion and home discharge was noted, as was the case in another study[6], and Uematsu et al.[13] reported that toilet transfer was the factor with the greatest influence on discharge destination of patients with stroke.

We used the 6 FIM domains for analysis in this study, and confirmed the importance of excretion control for home discharge. Excretion needs more frequent care than other ADL and the burden related to excretion is likely to be heavy because it can occur at any time of day. Moreover, it is difficult for some families to care for excretion because of privacy issues.

In this study, locomotion was less important excretion, self care and transfer. If locomotion is insufficient, a patient can still live at home by adjusting to the environment, provided that self care is adequate, so active rehabilitation is needed to improve transfer and self care ability.

In our validation study of the model, the actual correct classification rate was 77.5%, which was lower than that initially obtained. To our knowledge, no validation studies employing new patients have been reported in the rehabilitation field, so it is difficult to compare this result with those of other studies.

When the patients misclassified as needing care by our model were investigated, several of them had terminal illness, but their families were willing to care for them at home. Conversely, those misclassified as home discharge included patients who were unable to live alone and those who could not receive care from their families, so these misclassifications were related to lack of family support. It is difficult to assess social factors numerically, so we did not analyze such factors in detail. It is a limitation of our study. However, previous studies have shown that living with the family before admission[2], living alone[12], and the number of co-resident household members[14] are powerful predictors of home discharge. Further research is needed to analyze the influence of these factors on the discharge destination.

In conclusion, ADL can be used the in the acute care setting to assist in determining the appropriate discharge destination by employing our mathematical model. Adequate control of excretion, self care, and transfer ability were the most important predictors of the discharge destination according to our discriminant analysis. Further research is needed to improve our mathematical model so that it includes the influence of disease characteristics and social factors.

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