



Original Article

Association between patients' state upon admission and decline in activities of daily living

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Abstract. [Purpose] In this study, we aimed to determine the components of activities of daily living that decline easily during hospitalization. [Participants and Methods] We performed a prospective cohort study of 2,819 inpatients who were hospitalized and discharged. We prospectively evaluated the Barthel Index at admission and discharge, age, length of hospital stay, clinical department, and rehabilitation type. We divided the inpatients into two groups based on the Barthel Index score at admission and compared the items of the index at admission and discharge to analyze the characteristics of decline in activities of daily living. [Results] Forty-nine inpatients (2.0%) had declined in activities of daily living. There were no significant between-group differences in age, length of hospital stay, clinical department, or ratio of individual rehabilitation. However, transfer and toilet use remarkably decreased in the group with Barthel Index scores at admission <85, and bathing and ascending/descending remarkably decreased in the group with Barthel Index at admission ≥85. [Conclusion] The characteristics of decrease in each activity of daily living vary, and our results suggested the components that easily declined when inpatients were divided based on their performance of activities of daily living at admission.

Key words: Activities of daily living, Barthel Index, Activities of daily living decline

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INTRODUCTION

We provide rehabilitation for inpatients to improve their activities of daily living (ADL). Although inpatients are hospitalized for the treatment of illness, hospitalization has a detrimental effect on patients' condition. One of those detrimental effects is deconditioning, which is a complex process of physiological changes that often results in functional decline¹⁾. Function includes movement and ADL. Hospitalization can result in complications that are unrelated to the condition that led to the admission, even if the condition is cured or repaired²⁾. Furthermore, acute hospitalization can result in significant functional decline that is unrelated to a specific neurologic or orthopedic insult³⁾. About 31% of inpatients experienced ADL decline compared with the baseline levels at preadmission⁴⁾. Functional decline occurs early, starting from admission, and 65% of inpatients experienced functional decline in mobility within 3 days of admission⁵⁾. Functional decline that is associated with acute hospitalization has been described as part of a clinical sequela that was historically termed as not only "deconditioning" but also "hospital-associated deconditioning"^{3, 6)}.

Functional decline due to hospital-associated deconditioning increases the length of hospital stay⁷⁾ and is a factor that hinders functional recovery after discharge⁸⁾. Functional decline at discharge was associated with poor 1 year functional mobility thereafter⁹⁾. Therefore, functional decline caused by hospital-associated deconditioning should be prevented by

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appropriate rehabilitation. Inpatients' functional status is an important predictor of hospital outcomes¹⁰, and recovery and prevention of functional decline during hospitalization are important targets for clinical intervention¹¹. Evidence indicated favorable functional recovery of inpatients with hospital-associated deconditioning who participate in acute inpatient rehabilitation³.

Identifying patients at risk for functional decline is the first step in assessing the degree of risk to determine the risk factors and prevent functional decline¹². Concerning risk factors of functional decline, many inpatients' function at discharge is worse than their function at admission, and the risk of functional decline increases markedly with age^{2, 13}. The variables that are most often identified as predictors of functional decline are age and lower ADL, followed by lower cognitive function, lower preadmission instrumental ADL, depression, and hospital length of stay¹². We suggested that functional decline was correlated to inpatients' diseases and conditions such as pain, low postoperative physical fitness, malignant neoplasm, and new-onset cerebral stroke¹⁴. Several studies have investigated the risk factors of functional decline. In identifying patients at risk for functional decline, it is important to analyze what ADL can worsen during hospitalization. However, to our knowledge, only a few reports have analyzed the components of functional decline in detail. Therefore, this study aimed to determine the components of ADL decline during hospitalization to predict which ADL component can easily decline.

PARTICIPANTS AND METHODS

We included inpatients who were admitted to the ward of a hospital in Gunma after September 2014 and discharged from the hospital by March 2016. The ward was a mixed unit, consisting of several clinical departments for surgery, cardiovascular disease, and cerebrovascular surgery. Individual or exclusive rehabilitation was provided to all inpatients in this ward. In conventional rehabilitation therapy, individual exercises are often provided to individual inpatients, termed as "individual rehabilitation therapy" to prevent hospital-associated deconditioning. Individual rehabilitation is ordered by the rehabilitation doctor for inpatients with functional disorder caused by illness and hospital-associated deconditioning. An exclusive rehabilitation therapy does not provide one-on-one exercise, but it is implemented to manage inpatients' functioning through consultation, education, and group exercises. An exclusive working physical and occupational therapist evaluates and instructs inpatients and their families on how to perform ADL, prepares an environment to prevent falls, offers information to inpatients and their families to achieve a safe and comfortable living environment not only during hospitalization but also after discharge, and participates in conferences held in wards to collaborate with other specialists in the management of inpatients' conditions.

To analyze ADL decline, deceased participants were excluded, even if we could collect enough data from their medical records. A total of 2,819 inpatients were hospitalized and discharged. Of these 2,819 inpatients, 359 were excluded because they died before hospital discharge (n=127) or not enough data could be extracted from their medical records (n=232); subsequently, 2,460 inpatients were included.

As a prospective cohort study, inpatients were assessed for their Barthel Index¹⁵, both at admission and discharge. The Barthel Index evaluates the ADL in 10 items: feeding, transfer, grooming, toilet use, bathing, mobility, ascending/descending stairs, dressing, bowel control, and bladder control. Each item was evaluated in increments of 5 points, with the lowest score being 0 and the highest score ranging from 5 to 15 points depending on the item. The total score ranged from 0 to 100, with a higher score indicating better ADL.

The Barthel Index is calculated easily and is a widely accepted measurement. Given that inpatients' abilities could be evaluated using the Barthel Index, we were able to investigate ADL decline in these individuals. A Barthel Index at discharge that was >5 points lower than that at admission indicated ADL decline. The participants in this study were inpatients with ADL decline. We obtained information from medical records about the inpatients' age, lengths of hospital stay, clinical department, and rehabilitation type (individual or exclusive rehabilitation therapy).

To analyze the differences between the item scores of the Barthel Index at admission and discharge, the Wilcoxon signed-rank test was used. Participants were divided into two groups according to their Barthel Index at admission to analyze in detail the characteristics of ADL decline, that is, Barthel Index <85 (low ADL group) or Barthel Index ≥85 (high ADL group). Barthel Index of ≥85 was indicated as a cutoff to define successful rehabilitation for stroke¹⁶, hip fracture¹⁷⁻¹⁹, and chronic obstructive pulmonary disease²⁰. To analyze the differences between the two groups, t-test was used for age and length of hospital stay, and χ^2 test was used to determine the clinical department and proportion of individual rehabilitation. The Wilcoxon signed-rank test was used to analyze the difference between item scores at admission and discharge between the two groups. The number of participants whose item score at discharge was >5 points lower than that at admission were recorded, and the proportion of participants with reduction item in the two groups were calculated. Data analyses were conducted using SPSS version 24.0 for Windows (SPSS Japan Inc., Tokyo, Japan), and a p-value of 0.05 indicated statistical significance.

All procedures were approved by the Ethics Committee of our hospital (reference number 188), and the study was performed in accordance with the ethical principles of the Declaration of Helsinki. We obtained inpatients' consent to participate in the research upon admission.

RESULTS

There were 49 participants with ADL decline (2.0% of the total inpatients). The mean age of the participants was 75.3 years, and the mean length of hospital stay was 37.9 days (Table 1). The median Barthel Index at admission and discharge was 70.0 and 35.0, respectively. All 10 items of the Barthel Index significantly differed at admission and discharge (Table 2). There were significant differences in all items of the Barthel Index.

Participants were divided into two groups based on the Barthel Index at admission, that is, <85 group (low ADL group; n=27) and ≥85 group (high ADL group, n=22). There was no participant with zero Barthel Index at admission because there was no decrease in Barthel Index at discharge. No significant differences in the mean age, length of hospital stay, clinical department, and percentage of individual rehabilitation were observed (Table 3). With regard to the items of the Barthel Index, many items had significant differences in scores between admission and discharge (Table 4). The reduction rate in all participants ranged from 24.5% (feeding and grooming) to 46.9% (dressing, Table 5). The tendencies of score reduction vary between the two groups. In the low ADL group, transfer and toilet use had more than 50% of reduction at admission. Meanwhile, in the high ADL group, bathing and ascending/descending stairs had more than 50% of reduction. Items with declining scores varied based on the participants' Barthel Index at admission.

DISCUSSION

In this study, to prevent ADL decline effectively by predicting which component declines easily, we analyzed components of ADL decline of inpatients. The scores of all items of the Barthel Index at discharge decreased from the score at admission and showed significant difference. The characteristics of items of the Barthel Index were still unclear. Therefore, we could not determine clearly which ADL item easily declined in all participants.

To analyze which item of ADL easily declines, we classified the participants' ability level at admission. We divided them into two groups based on the Barthel Index at admission as follows: the low ADL group has Barthel Index <85 and the high

Table 1. Characteristics of inpatients with decline in activities of daily living (n=49)

Age (years)	75.3 ± 10.2 (50–92)
Length of hospital stay (days)	37.9 ± 30.8 (4–144)
Clinical department	
Surgery	22 (44.9)
Cardiovascular disease	24 (49.0)
Cerebrovascular surgery	3 (6.1)
Provided individual rehabilitation	34 (69.4)
Barthel Index	
At admission	70.0 [37.5–100.0]
At discharge	35.0 [10.0–82.5]

Values are presented as mean ± SD (range), n (%), or median [1st quartile–3rd quartile].

Table 3. Characteristics of the inpatients divided in the two groups by the Barthel Index at admission

	Barthel Index at admission	
	5–80 (n=27)	85–100 (n=22)
Age (years)	76.3 ± 9.9	74.0 ± 10.1
Length of hospital stay (days)	36.8 ± 30.2	39.2 ± 30.7
Clinical department		
Surgery	14 (41.7)	8 (63.6)
Cardiovascular disease	10 (41.7)	14 (27.3)
Cerebrovascular surgery	3 (16.7)	0 (9.1)
Provided individual rehabilitation (%)	19 (70.4)	15 (68.2)

Values are presented as mean ± SD or n (%).

Table 2. Difference in Barthel Index at admission and discharge

	At admission	At discharge
Feeding	10.0 [10.0–10.0]	10.0* [5.0–10.0]
Transfer	15.0 [10.0–15.0]	10.0** [0.0–15.0]
Grooming	5.0 [0.0–5.0]	0.0** [0.0–5.0]
Toilet use	10.0 [5.0–10.0]	5.0** [0.0–10.0]
Bathing	0.0 [0.0–5.0]	0.0** [0.0–0.0]
Mobility	10.0 [0.0–15.0]	0.0** [0.0–15.0]
Ascending /descending stairs	0.0 [0.0–10.0]	0.0** [0.0–0.0]
Dressing	10.0 [5.0–10.0]	5.0** [0.0–10.0]
Bowel control	10.0 [5.0–10.0]	5.0** [0.0–10.0]
Bladder control	10.0 [5.0–10.0]	5.0** [0.0–10.0]

Values are presented as median [1st quartile–3rd quartile]. *p<0.05, **p<0.01.

Table 4. Median score of the items of the Barthel Index in the two groups divided by the Barthel Index at admission

	5–80 (n=27)		85–100 (n=22)	
	At admission	At discharge	At admission	At discharge
Feeding	10.0 [5.0–10.0]	5.0 [5.0–10.0]	10.0 [10.0–10.0]	10.0 [10.0–10.0]
Transfer	10.0 [5.0–10.0]	5.0** [0.0–10.0]	15.0 [15.0–15.0]	15.0* [10.0–15.0]
Grooming	0.0 [0.0–5.0]	0.0* [0.0–0.0]	5.0 [5.0–5.0]	5.0** [0.0–5.0]
Toilet use	5.0 [0.0–5.0]	0.0** [0.0–5.0]	10.0 [10.0–10.0]	10.0* [5.0–10.0]
Bathing	0.0 [0.0–0.0]	0.0 [0.0–0.0]	5.0 [5.0–5.0]	0.0** [0.0–0.0]
Mobility	0.0 [0.0–5.0]	0.0 [0.0–0.0]	15.0 [15.0–15.0]	15.0** [0.0–15.0]
Ascending/descending stairs	0.0 [0.0–0.0]	0.0 [0.0–0.0]	10.0 [10.0–10.0]	2.5** [0.0–5.0]
Dressing	5.0 [5.0–5.0]	5.0** [0.0–5.0]	10.0 [10.0–10.0]	10.0** [5.0–10.0]
Bowel control	5.0 [5.0–10.0]	0.0** [0.0–5.0]	10.0 [10.0–10.0]	10.0** [0.0–10.0]
Bladder control	5.0 [0.0–10.0]	0.0** [0.0–5.0]	10.0 [10.0–10.0]	10.0* [3.8–10.0]
Total	40.0 [25.0–60.0]	20.0** [10.0–40.0]	100.0 [100.0–100.0]	85.0** [48.8–90.0]

Values are presented as median [1st quartile–3rd quartile].

*p<0.05, **p<0.01.

Table 5. Inpatients with reduction items divided in the two groups by the Barthel Index at admission

Item	Total (n=49)	Barthel Index at admission	
		5–80 (n=27)	85–100 (n=22)
Feeding	12 (24.5)	9 (33.3)	3 (13.6)
Transfer	22 (44.9)	16 (59.3)	6 (27.3)
Grooming	12 (24.5)	5 (18.5)	7 (31.8)
Toilet use	21 (42.9)	14 (51.9)	7 (31.8)
Bathing	17 (34.7)	0 (0.0)	17 (77.3)
Mobility	13 (26.5)	5 (18.5)	8 (36.4)
Ascending/descending stairs	17 (34.7)	1 (3.7)	16 (72.7)
Dressing	23 (46.9)	13 (48.1)	10 (45.5)
Bowel control	21 (42.9)	13 (48.1)	8 (36.4)
Bladder control	18 (36.7)	11 (40.7)	7 (31.8)

Values are presented as n (%).

ADL group has Barthel Index ≥ 85 . There were no significant differences in age, length of hospital stay, clinical department, and ratio of provided individual rehabilitation between the two groups, indicating that the two groups had almost similar characteristics. However, there were significant differences in the score of items at admission and discharge. In the low ADL group, the rate of decline in bathing, mobility, and ascending/descending stairs did not show significant difference. However, in the high ADL group, the rate of decline in all items, except feeding, showed significant difference. Only the independent group had significant difference in bathing, mobility, and ascending/descending stairs. The proportion of participants with reduction item was also different between the two groups. The low ADL group had decreased Barthel Index of more than 50% in transfer and toilet use, and the high ADL group had decreased Barthel Index of more than 50% in bathing and ascending/

descending stairs. Participants in the high ADL group at admission were able to take a bath and ascend/descend stairs, but these tasks were difficult and were not performed by the participants in the low ADL group. For example, physical movement required during bathing is more difficult than that during other ADLs because it requires walking, standing and sitting on a wet floor, and striding across for bathing. If swallowing function is not an issue, the patient needs only to sit on chair safely and exert upper limb effort for independent feeding. Bathing may be more difficult than feeding. Bathing, mobility, and ascending/descending stairs require locomotion stability to prevent fall and require complex movement compared to other items. We suggested that the level of independence of inpatients at admission influenced their score reduction in all items. In the low ADL group, patient's ability to transfer and use the toilet can easily decrease during hospitalization, and we should consider basic ADLs, such as transfer and toilet use than bathing or ascending/descending stairs. Conversely, we should consider bathing and ascending/descending stairs of inpatients with high ADL. Previous studies^{4, 10, 21}) indicated that ambulatory function or the ability to perform basic ADL, or both, declined in at least one-third of older (70 years old) inpatients. Hirsch et al.⁵) suggested that a statistically significant decline in the overall functional score and individual scores for mobility, transfer, toileting, feeding, and grooming. At this time, we could only show the individual characteristics, not the overall characteristics, by dividing participants according to their state at admission.

This study had several limitations. First, we could not perform a multivariate analysis because the number of participants was insufficient. Among inpatients, one of the detrimental effects is hospital-associated deconditioning, which causes a complex process of physiological changes that can affect multiple systems within the body and often result in functional decline¹). The relationship between ADL and idiopathic pulmonary fibrosis was examined^{22, 23}). Koyama et al.²⁴) analyzed ADL decrease in idiopathic pulmonary fibrosis survivors with acute exacerbation and suggested that persistent hypoxemia was related to ADL decline. We simply investigated the tendency of ADL decline at this time; thus, a large sample size is needed to increase the accuracy of the analysis for ADL decline. Second, the relationship between ADL decline and detailed components of rehabilitation was not inspected. Because rehabilitation during hospitalization was provided to improve ADL of inpatients with hospital-associated deconditioning, volume and components of rehabilitation were related to ADL decline. The effectiveness of specific inpatient rehabilitation interventions to reduce functional decline with hospital-associated deconditioning has not yet been investigated²⁵). Finally, we analyzed inpatients in within a limited period. Improvement of ADL should not stop at discharge, and ADL may be improved after discharge.

In this study, we indicated the declining components of ADL in inpatients. The characteristics of decrease of each ADL varied, and we suggested which components can easily decline when inpatients were divided according to their ability to performing ADL at admission. To prevent functional decline effectively, we have to understand this relationship to predict which component can easily decline. Further studies with a larger sample size and investigations in other rehabilitation facilities are expected to provide more evidenced-based strategies to prevent functional decline.

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We have no financial or personal relationships to disclose.

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