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Original Article

Factors Influencing Discharge Destination and Length of Stay in Stroke Patients in Restorative Rehabilitation Institution

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Background: Promoting patients' safe return home at discharge and reducing length of stay in hospital is key for Restorative Rehabilitation Institution (RMI).

Objects: This study was designed to identify the factors influencing the return to home and length of stay among various factors.

Methods: A total of 120 stroke patients (76 males and 44 females) who were hospitalized in an adult inpatient unit of a RMI for more than 2 months were retrospectively analyzed for this study (multivariate logistic regression analyses, $p < 0.001$). As predictor variables for assessing the return to home and length of stay, demographic data (sex, age, duration between onset and admission, length of stay, caregiver after discharge, occupation after discharge, reason for discharge, and household type after discharge) were collected. Additionally, following measurements were selectively collected from patient's medical records: scores of Mini-Mental State Examination Korean version (K-MMSE), modified Barthel Index Korean version (K-MBI), Berg Balance Scale and Functional Ambulation Category were obtained at admission and discharge.

Results: The K-MMSE at admission and K-MBI at discharge were found to be the predictors of return to home. Additionally, K-MBI at admission influenced the length of stay.

Conclusion: This study suggests cognitive functioning at admission and the level of activities of daily living at discharge predicted the return to home and length of stay.

INTRODUCTION

Stroke is one of the main causes of death worldwide. Likewise, In South Korea, it is the fourth most frequent cause of death responsible for 44.7 in 100,000 deaths [1]. Stroke causes severe physical and mental impairments, negatively affecting the activities of daily living (ADL) and causing many patients to depend on others for ADL [2]. Stroke-induced damage of the central nervous system may vary in severity. Additionally, the typical recovery period is noted as 6 months to one year after surgery or treatment [3]. Hence, intensive care is crucial in the early stages after onset as this has a critical impact on recovery and return to home and community [4].

Restorative Rehabilitation Institution (RMI) is the Ministry of Health and Welfare's new system that provides intensive rehabilitation treatment to patients in need of rehabilitation after acute treatment to minimize disabilities caused by diseases and restore functions so that they can return to community as soon as possible [5]. However, patients in South Korea, compared to those in advanced countries, do not receive adequate rehabilitation care despite having a prolonged length of stay due to a lack of appropriate transfer systems, inadequate rehabilitation care, and low reliability of health insurance. Thus, a project to designate and manage RMI took place in 2020 to improve the outdated system [5].

To ensure patients' safe return home at discharge, the development of an organic liaison system with various welfare services such as community-based rehabilitation programs is emphasized. However, early return to community through timely rehabilitation care is often dissatisfactory due to the increased demand for rehabilitation because of the aging population. Thus, RMI at present provide care up to 6 months for those

requiring intensive rehabilitation cares, who meet the criteria for stroke. The institutions, therefore, ensure that functional impairment is minimized through intensive rehabilitation care and therapy to promote an early return to daily life and liaison with regional communities [6].

RMI has a high rate of post-rehabilitation return to community compared to other institutions [7]. However, studies on factors affecting return to home rates and length of stay at RMI are limited. Therefore, this study aims to identify the factors influencing the return to home and length of stay among various factors such as general characteristics, cognitive functions, and physical functions, in patients discharged from a RMI.

MATERIALS AND METHODS

1. Participants

A retrospective analysis was carried out on 120 patients who had been enrolled in the conventional rehabilitation program after being admitted to an Seoul Rehabilitation Hospital in Seoul, South Korea, between April 2020 and July 2021. The 120 patients were selected from a pool of 207 patients who were screened for the study. The inclusion criteria comprised of the following: (1) diagnosed with stroke by a specialist; (2) > 60 days of length of stay after admission; (3) undergoing recovery management that includes integrated planned management; and (4) intact records of admission, discontinuation, and discharge.

Patients with records lacking in certain details of an item or whose whereabouts after discharge were unclear, were excluded. This study was approved by Seoul Rehabilitation Hospital Human Studies Committee (IRB no. SRH2022R-3), and all patients provided informed consent before the analyze.

2. Procedures

Participants were interviewed after discharge and divided into two groups based on the return to home: home return (HR) and other hospital transfer (OHT). All participants were given 180–240 minutes of treatment for 5 days a week through a team approach in various fields. All assessments were performed by a trained clinical therapist at admission and discharge. Factors of interest such as general characteristics, sex, age, duration between onset and admission (DOA), length of stay, caregiver after discharge, occupation after discharge, reason for discharge, and household type after discharge were collected. Additionally, scores of Mini-Mental State Examination Korean version (K-MMSE), modified Barthel Index Korean version (K-MBI), Berg Balance Scale (BBS) and Functional Ambulation Category (FAC) were obtained at admission and discharge.

3. Statistical Analysis

The analyses were performed using IBM SPSS ver. 26.0 (IBM Co.) with the significance level set at $p < 0.05$. The dependent variable was length of stay and return to home after discharge. The independent variables were the general characteristics and clinical test results at admission and discharge. To compare the two groups, a chi-square test was performed for categorical data, and the Mann-Whitney U test was applied to quantitative variables after confirming non-normality through normality testing. The normality of distribution was tested via Kolmogorov–Smirnov test for the independent variables. For variables not showing normal distribution, log conversion was performed. Multiple Imputation with chained equations with 10 imputations was also used for missing data. The criterion of multicollinearity of independent variables was the variance inflation factor > 10 [8,9].

A univariate logistic regression analyses were performed to identify the variables that predicted the return to home after discharge. The factors included sex, age, DOA, length of stay, caregiver after discharge, occupation after discharge, reason for discharge, and household type after discharge, the scores of K-MMSE, K-MBI, BBS, and FAC at admission and discharge. For the variables selected in univariate logistic regression analyses, multivariate logistic regression analyses were performed using the method of backward selection to identify the significant predictors [9].

Lastly, to determine the variables that predict the length of stay, a stepwise multiple linear regression analysis was performed. A univariate linear regression analyses were performed to identify the variables for multiple linear regressing analyses. The factors included sex, age, DOA, length of stay, caregiver after discharge, occupation after discharge, reason for discharge, and household type after discharge, the scores of K-MMSE, K-MBI, BBS, and FAC at admission and discharge.

RESULTS

1. Participant Characteristics

Out of the 120 participants, 77 (64.16%) were in the HR group and 43 (35.83%) were in the OHT group. In the HR group, there were 50 males (64.93%) and 27 females (35.06%), and the mean age was 61.53 ± 13.29 years. In the OHT group, there were 26 males (60.46%) and 17 females (39.53%), and the mean age was 64.48 ± 12.05 years. The between-group variation was not significant for sex or age ($p > 0.05$).

For the DOA, no significant between-group variation was found; 43.92 ± 24.72 days in the HR and 47.90 ± 21.07 days in the OHT group ($p < 0.353$). There was also no significant between-group difference was found for length of stay; 132.81 ± 47.20 days in the HR and 145.51 ± 48.14 days in the OHT group ($p < 0.167$).

The number of participants who stated the reason for discharge as functional improvement was 72 (93.50%) in the HR and 30 (69.76%) in the OHT group, with a significant between-group difference ($p < 0.001$). Additionally, the number of participants who had a caregiver after discharge was 75 (97.40%) in the HR and 41 (95.34%) in the OHT group, with no significant between-group difference ($p < 0.548$; Table 1).

2. Comparison of Cognitive and Physical Functional Assessment Score

1) At admission

The K-MMSE scores were 24.26 ± 6.20 and 18.09 ± 9.75 in the HR and OHT groups, respectively, with significantly higher scores in the HR group ($p < 0.001$). The K-MBI scores were 62.17 ± 22.41 and 40.56 ± 25.86 in the HR and OHT groups, respectively, with significantly higher scores in the HR group ($p < 0.001$). The BBS scores were 35.60 ± 17.01 and 22.35 ± 19.14 in the HR and OHT groups, respectively, with significantly higher scores in the HR group ($p < 0.001$). The FAC scores were distributed at a high range in the HR but a low range in the OHT group, and the between-group differences was significant ($p < 0.001$; Table 2).

Table 1. Participant characteristics between the HR and OHT groups (N = 120)

Variable	HR (n = 77)	OHT (n = 43)	p-value
Sex[a]			0.626
Male	50	26	
Female	27	17	
Age (y)[b]	61.53 ± 13.29	64.48 ± 12.05	0.230
DOA (d)[b]	43.92 ± 24.72	47.90 ± 21.07	0.353
Period of admission (d)[b]	132.81 ± 47.20	145.51 ± 48.14	0.167
Reason for discharge[a]			0.001
Improvement	72	30	
Others	5	13	
Caregiver[a]			0.548
Yes	75	41	
No	2	2	

Values are presented as number or mean ± standard deviation. HR, home return; OHT, other hospital transfer; DOA, duration between onset and admission. [a]Chi-square test, [b]t-test.

Table 2. Differences in clinical measures between the HR and the OHT group at admission (N = 120)

Variable		HR (n = 83)	OHT (n = 47)	p-value
K-MMSE		24.26 ± 6.20	18.09 ± 9.75	< 0.001
K-MBI		62.17 ± 22.41	40.56 ± 25.86	< 0.001
BBS		35.60 ± 17.01	22.35 ± 19.14	< 0.001
FAC	0	9	17	< 0.001
	1	9	10	
	2	18	5	
	3	18	5	
	4	17	2	
	5	6	4	

Values are presented as number or mean ± standard deviation. HR, home return; OHT, other hospital transfer; K-MMSE, Mini-Mental State Examination Korean version; K-MBI, Modified Barthel Index Korean version; BBS, Berg Balance Scale; FAC, Functional Ambulation Category.

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2) At discharge

The K-MMSE score was significantly higher in the HR than in the OHT group (HR: 27.47 ± 3.85, OHT: 22.05 ± 8.42; p < 0.001). The K-MBI score was also significantly higher in the HR than in the OHT group (HR: 87.27 ± 11.92, 62.65 ± 29.17; p < 0.001). The BBS scores were 48.35 ± 11.16 and 35.77 ± 18.01 in the HR and OHT groups, respectively, with significantly higher scores in the HR group (p < 0.001). The FAC scores were distributed at a high range in the HR, and those scattered at a low range were reduced at discharge compared to those at admission. The distribution of FAC scores in the OHT group was shifted to a higher range at discharge compared to that at admission, albeit still lower than in the HR group. The between-group variation was significant (p < 0.001; Table 3).

3. Factors Influencing the Discharge Destination

1) Univariate model

The KS test indicated that not all variables showed normal distribution and no variables had multicollinearity. The percentage of missing data for each variable (13.3% for MBI at admission, 19.2% for BBS at admission). Through univariate logistic regression analyses, the K-MMSE (p < 0.001, OR: 1.102, 95% confidence interval [CI]: 1.046–1.161), K-MBI (p < 0.001, OR: 1.038, 95% CI: 1.019–1.056), BBS (p < 0.001, OR: 1.040, 95% CI: 1.018–1.063) and FAC (p < 0.001, OR: 1.594, 95% CI: 1.222–2.079) at admission, and the K-MMSE (p < 0.001, OR: 1.157, 95% CI: 1.075–1.246), K-MBI (p < 0.001, OR: 1.040, 95% CI: 1.036–1.093), BBS (p < 0.001, OR: 1.060, 95% CI: 1.029–1.092) and FAC (p < 0.001, OR: 2.191, 95% CI: 1.558–3.081) at discharge, were selected as significant variables.

2) Multivariate model

Based on the univariate logistic regression analyses, eight independent variables were used to perform multivariate logistic regression analyses, and the model incorporating the K-MMSE at admission and K-MBI at discharge was selected (Table 4). The Hosmer–Lemeshow fitness test indicated that the selected model was suitable (chi-square = 6.594, df = 8, p < 0.581). The cut-off for the K-MMSE at admission was 22.5 and that for the K-MBI at discharge was 74.5.

4. Factors Influencing the Length of Stay

To determine the variables that influenced the length of stay across age, sex, DOA, caregiver after discharge, occupation after discharge, household type after discharge, and the scores of K-MMSE, K-MBI, BBS, and FAC at admission and discharge as the independent variables, a stepwise multiple linear regression analysis was performed. The following model was obtained (Tables 5, 6).

Length of stay = 164.692 – 0.502 × K-MBI at admission

Higher scores of K-MBI at admission indicated shorter length of stay.

Table 3. Differences in clinical measures between HR and OHT group at discharge (N = 120)

Variable		HR (n = 83)	OHT (n = 47)	p-value
K-MMSE		27.47 ± 3.85	22.05 ± 8.42	< 0.001
K-MBI		87.27 ± 11.92	62.65 ± 29.17	< 0.001
BBS		48.35 ± 11.16	35.77 ± 18.01	< 0.001
FAC	0	0	2	< 0.001
	1	1	8	
	2	4	7	
	3	9	7	
	4	22	10	
	5	41	9	

Values are presented as number or mean ± standard deviation. HR, home return; OHT, other hospital transfer; K-MMSE, Mini-Mental State Examination Korean version; K-MBI, Modified Barthel Index Korean version; BBS, Berg Balance Scale; FAC, Functional Ambulation Category.

Table 4. Logistic regression analysis of factors related HR (N = 120)

	B	95% CI	Odds ratio	p-value
K-MMSE-admission	0.073	1.014–1.141	1.076	0.016
K-MBI-discharge	0.060	1.032–1.092	1.062	< 0.001

HR, home return; CI, confidence interval; K-MMSE, Mini-Mental State Examination Korean version; K-MBI, Modified Barthel Index Korean version.

Table 5. Prediction of HR: sensitivity, specificity, Youden's index, and likelihood ratio

	Optimal cuff off score	Sensitivity	Specificity	Youden's index (J)
K-MMSE-admission	22.50	0.727	0.605	0.332
K-MBI-discharge	74.50	0.857	0.628	0.485

HR, home return; K-MMSE, Mini-Mental State Examination Korean version; K-MBI, Modified Barthel Index Korean version.

Table 6. Regression analysis of factors related to the period of hospitalization (N = 120)

	B	t	p-value	VIF
Constant	164.692	9.868	< 0.001	NA
K-MBI-admission	–0.502	–3.062	0.003	1.000

VIF, variance inflation factor; NA, not available; K-MBI, Modified Barthel Index Korean version.

DISCUSSION

With the recent increase in geriatric disease due to the increase in the aging population, the demand for rehabilitation has increased. RMI have been in operation since 2020 to minimize disabilities through rehabilitation treatments during the period of functional improvement and to promote early return to community. It is essential for a RMI to be based on the predicted time and destination of patient discharge to reduce inefficient management of medical resources and costs. While various studies have been conducted on the determination of the length of stay and discharge destination in stroke patients, none have investigated the predictors of length of stay and discharge destination for the recently established healthcare system of rehabilitation during recovery. Thus, this study identified the general, cognitive, and physical factors associated with the probability of return to home and length of stay in stroke patients discharged from a RMI. The factors that influenced the return to home were the K-MMSE at admission and K-MBI at discharge. There was a high probability to return home faster in those with good cognitive at the time of admission to the RMI and whose ADL at discharge was high from functional improvement.

In previous studies, the level of ADL was viewed as a critical determinant to return home [10-13]. In a previous study, it was found that for each one-unit increase in K-MBI at discharge, the likelihood of returning home increased by 1.03 times (odds ratio = 1.03); the predicted values were similar to this study (odds ratio = 1.062). Additional predictors were the functional independence measure (FIM) score at admission, residence before admission and length of stay [13]. In this study, the level of cognition at admission was identified as an additional predictor. Moreover, most stroke patients show cognitive dysfunction with continuing effects after rehabilitation. In a previous study the FIM and Cognitive-FIM score ≤ 20 was a limiting factor to return home [13]. In this study, the K-MMSE score ≤ 22.5 was the cut-off. This suggests that, for stroke patients, the cognitive functional assessment at admission could serve as the main predictor of the return to home at discharge, supporting the theory that cognitive functions play an important role in determining the return to community [14,15]. Based on this study, the level of cognitive impairment at admission should be considered and intensive trainings should be conducted to increase the level of ADL before discharge to ensure the successful return to home.

Other potential predictors of return to home, although not verified in this study, are the presence or absence of a caregiver after discharge and an improved home environment. Tanwir et al. [16] reported that, in addition to the level of ADL after discharge, caregiver presence was a critical factor in predicting discharge destination. Furthermore, follow-up monitoring of patients discharged from a present center revealed that the main factors influencing the current residence were K-MBI at discharge and improved home environment [17]. An increase of K-MBI at discharge by one increased the probability to return home by 1.05-fold. With an improved home environment, the probability increase by a further 6.87-fold [17]. This implies need for rehabilitation during recovery with caregiver training and promotion of community-based caregiving services. Moreover, an environment for safe ADL should be created before discharge to encourage patients' return to daily life and liaise with their regional communities.

The length of stay was marginally shorter in the HR than in the OHT group; however, the difference was statistical not

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significant and it was not a determinant of return to home. Analyzing the influencing factors, length of stay was shorter when the ADL at admission was higher. This is likely because return to home and length of stay were determined by independent factors following rehabilitation. Previous studies show contrasting results between return to home and length of stay. Noh et al. [18] illustrated that the length of stay was shorter for patients discharged to home. However, Wilson et al. [13] reported that length of stay was longer and attributed this to the tendency of those patients to prolong the rehabilitation period with the anticipation of recovery, despite higher functional levels. As the healthcare system varies in each country and the current healthcare system on recovery guarantees 6 months of hospitalization, patients may complete the full admission period without feeling the need to return to home, which explains the report that length of stay does not predict the return to home.

The study has a few limitations. Firstly, the collected data reflected only the general characteristics, functional, and cognitive aspects of discharged patients not the social aspects such as financial status, home environment, and education or the psychological aspects such as motivation and depression. Secondly, the discharge destination was verified by examining the discharge record, continuous data collection of post-discharge follow-up monitoring was not conducted, preventing an accurate analysis of the patients' states after discharge. Lastly, due to the small sample size and specific focus on individuals hospitalized for a minimum of 60 days, care should be taken in generalizing the results. Further studies should recruit a greater number of participants and include the social and psychological factors in the analyses, with post-discharge follow-up monitoring to verify the combined effects of the healthcare system during recovery on the return to home and community.

CONCLUSIONS

RMI were started with the aim of resolving rehabilitation refugees and promoting community return. The study highlights the crucial influence of cognitive function and ADL on discharge destination and hospitalization duration. It concludes that higher cognitive function and ADL levels at discharge predict a greater likelihood of returning home, while elevated scores on the K-MBI at admission are associated with shorter hospital stays. The research highlights the importance of rehabilitation hospitals providing functional rehabilitation services that focus on the specific needs of each patient. This includes addressing cognitive, language, walking, hand function, balance, and daily living skills. Rehabilitation programs should also be designed to help patients connect with their communities.

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CONFLICTS OF INTEREST

No potential conflicts of interest relevant to this article are reported.

AUTHOR CONTRIBUTION

Conceptualization: GBL, JSL, JSK. Data curation: JSK. Formal analysis: JSK. Investigation: GBL, JSK. Methodology: JSK. Project administration: GBL, JSL, JSK. Resources: JSK. Software: JSK. Supervision: GBL, JSL, JSK. Validation: JSK. Visualization: JSK. Writing – original draft: JSK. Writing – review & editing: JSK.

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