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Original article

Impact of functional independence and sociodemographic factors on post-stroke discharge destination in a super-aged rural community in Japan

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Abstract

Objective: This study aimed to clarify the factors influencing the discharge destination of stroke patients in a super-aged rural community in Japan, focusing on functional independence and sociodemographic factors.

Patients and Methods: We enrolled patients recovering from stroke with supratentorial lesions who were admitted to our convalescent rehabilitation hospital. The motor components of the Functional Independence Measure (FIM-motor) were assessed for each patient at admission and discharge as explanatory variables. An increase in the FIM-motor scores during hospitalization was also recorded. Additionally, sociodemographic data such as sex, age, and clinical characteristics, such as type of stroke, history of stroke, days from stroke onset to transfer to our convalescent rehabilitation hospital, total duration of hospital stay including acute care, number of co-resident household members, living with a spouse, and number of children were collected. As target values, discharge outcomes were categorized into two groups: returning home and going to a nursing home. Logistic regression analysis was performed.

Results: The study sample comprised 160 patients (mean age ± standard deviation, 74.80 ± 12.19 years). Of these, 114 were discharged to their homes, and 46 were transferred to nursing homes. The results of multivariate logistic regression analysis indicated that higher FIM-motor scores at discharge, greater number of co-resident household members, and living with one's spouse were the most powerful predictors of a higher probability of returning home.

Conclusion: This study demonstrated that functional independence levels and the number of co-resident household members were crucial factors in predicting the discharge destination of patients after stroke in a super-aged rural community in Japan. These findings imply that for older patients with lower functional independence, supportive social networks are essential for home discharge, offering clues for providing long-term healthcare in super-aged rural communities worldwide.

Key words: destination, disability, older adults, household, independence

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Introduction

Stroke is a common cause of disability[1]. Typically, stroke survivors have hemiplegia and/or cognitive impairments that negatively affect functional independence in activities of daily living (ADL)[2]. Rehabilitation is often prescribed to these patients to recover functional independence[3, 4]. One of the goals of stroke rehabilitation is home discharge[5]. Previous studies have reported that approximately 70–85% of stroke survivors achieve home discharge[5–8], and approximately 50% of these patients require some form of assistance in ADL after returning home[9–12]. In most cases, such assistance is provided by family members[9, 10, 13]. Therefore, improving functional independence in ADL and receiving strong social support, particularly from family members, are crucial factors in achieving successful home discharge[6, 14–16].

Similar to many other developed countries, Japan is facing a significant social challenge as its older adult popula-

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tion continues to grow rapidly[17]. Furthermore, older adults account for a larger proportion of the population in rural areas than in urban areas[18]. This demographic change is further exacerbated by the declining birth rate, which has been decreasing over the last five decades, dropping below 2.0 around 1970 and falling to around 1.3 in 2005, when the natural change rate of the population became negative for the first time since the end of the 19th century[19]. The decline in the birth rate affected the size of households, with the average number of household members decreasing from 3.41 in 1970 to 2.27 in 2020[19]. As mentioned earlier, providing adequate social support, including assistance from family members, is crucial for patients with stroke to achieve home discharge. These sociodemographic changes, especially the rapid increase in the older adult population and the decline in household members, have had a direct impact on the discharge destination of stroke patients[20]. However, few studies have examined this issue in super-aged rural communities.

We conducted a survey in a rural community in Japan to investigate the impact of functional independence and sociodemographic factors on the discharge destinations of patients after stroke. As rural communities in Japan can serve as an example of a super-aged society[17], the findings of this study might be useful as an index of stroke discharge destinations in most developed countries.

Patients and Methods

In this study, we enrolled stroke patients admitted to our convalescent rehabilitation hospital[5] in a rural area of Japan between November 2018 and March 2023. In accordance with the Japanese guidelines for the treatment of stroke[21], patients received up to 180 min/day of physical, occupational, and/or speech therapy during hospitalization. The inclusion criteria were as follows: ability to walk and function independently within the local community before stroke onset and no dementia. Consistent with previous studies on stroke outcomes[20, 22], patients with subarachnoid hemorrhage or cerebellar-brain stem lesions were excluded. Patients who subsequently required acute medical services due to stroke recurrence, angina pectoris, or other unrelated conditions were excluded. Informed consent for participation was obtained using the opt-out method. The study protocol was approved by the Institutional Review Board of the Hyogo Medical University (No. 4462).

We collected patient data using the motor component of the Functional Independence Measure (FIM-motor), a widely used evaluation tool in rehabilitation medicine[23]. The FIM-motor consists of 13 items graded on a seven-point scale, ranging from 1 (total assistance) to 7 (complete independence). These 13 items included eating, grooming, bathing, dressing the upper body, dressing the lower body, toileting, bladder management, bowel management, transfer to bed/chair/wheelchair, transfer to toilet, transfer to tub/shower, walking or wheelchair propulsion, and stair climbing. The total score of these 13 items (ranging from 13 to 91) served as an index of functional independence in ADL. We also collected patient data, including age, sex, stroke type (hemorrhagic or ischemic), stroke history (recurrence), number of days from stroke onset to transfer to our convalescent rehabilitation hospital, total hospitalization days, including acute care, number of co-resident household members, living with a spouse, and number of children.

Logistic regression analysis was employed for the main analytical procedures. The objective was to assess the probability of a dichotomous outcome—discharge to one's own home or a nursing home, in relation to each explanatory variable (detailed in Table 1). For the analysis, we assigned numerical values to the following categorical variables: male=1, female=0 for sex; hemorrhagic=1, ischemic=0 for

Table 1 Patient profiles (N=160)

Explanatory variable		
Age (years)	74.80 ± 12.19	Mean ± SD
Sex	95/65	Male/female
Type of stroke	62/98	Hemorrhagic/ischemic
Past history of stroke	27/133	Yes/no
Days from onset (days)	29.89 ± 14.39	Mean ± SD
Total hospitalization (days)	127.66 ± 56.42	Mean ± SD
FIM-motor admission	39.63 ± 22.20	Mean ± SD
FIM-motor discharge	63.89 ± 26.04	Mean ± SD
FIM-motor increase	24.26 ± 18.23	Mean ± SD
Household members (n)	2.31 ± 1.19	Mean ± SD
Spouse	96/64	With/without
Children (n)	1.75 ± 1.03	Mean ± SD

FIM-motor: the motor component of the Functional Independence Measure; SD: standard deviation.

the type of stroke; yes=1, no=0 for history of stroke; living with a spouse=1, living without a spouse=0 for living with a spouse. First, to assess the association between the explanatory variables and the outcome, we performed a univariate logistic analysis for each explanatory variable. Second, to assess the predictive power of the explanatory variables that were detected as statistically significant, we performed a multivariate logistic regression analysis (forward stepwise selection). Third, to examine multiple collinearities among the explanatory variables, we conducted Spearman's rank correlation tests between all possible pairs of explanatory variables. All statistical analyses were performed using the JMP software package (SAS Institute, Cary, NC, USA), and *P*-values <0.05 were considered statistically significant. In addition, a descriptive survey was conducted on sex differences among individuals living alone.

Results

Patient characteristics are shown in Table 1. The analytical database consisted of 160 patients (95 men, 65 women), with a mean age ± standard deviation of 74.80 ± 12.19 years. Of these, 114 were discharged to their homes, and 46 were transferred to nursing homes. Table 2 presents the results of the univariate logistic regression analysis of the associations between explanatory variables and discharge destinations. The results revealed the following explanatory variables with statistically significant findings: age, number of days from stroke onset to transfer, total hospitalization days, FIM-motor scores at admission and discharge and their increase, number of co-resident household members, and living with a spouse (Table 2). A multivariate logistic regression analysis was performed using these variables. As shown in Table 3, the results indicated that the FIM-motor score at discharge, the number of co-resident household members, and living with a spouse were powerful predictors of home discharge. Figure 1 illustrates the logistic probability curves of the three explanatory variables (Tables 2 and 3).

Table 4 presents the results of the correlation analyses between the pairs of explanatory variables. Female sex was associated with older age. Higher FIM-motor scores at discharge strongly correlated with higher FIM-motor scores at admission (correlation coefficient=0.7985) and fewer days from stroke onset to transfer. In contrast, lower FIM-motor

Table 2 Results from univariate logistic regression analyses of explanatory variables for discharge destination of stroke patients

Explanatory variable	Parameter Estimates	Standard error	Intercept	*P*-value
Age	**0.0706**	**0.0187**	**−6.3431**	**<0.0001**
Sex (M/F)	−0.4145	0.3528	−0.6702	0.2407
Type of stroke	−0.5082	0.3724	−0.7239	0.1659
Past history of stroke	0.4606	0.4437	−0.9912	0.3061
Days from onset (days)	**0.0326**	**0.0123**	**−1.9234**	**0.0069**
Total hospitalization (days)	**0.0153**	**0.0036**	**−3.0005**	**<0.0001**
FIM-motor admission	**−0.0658**	**0.0131**	**1.2787**	**<0.0001**
FIM-motor discharge	**−0.0608**	**0.0091**	**2.6223**	**<0.0001**
FIM-motor increase	**−0.0504**	**0.0119**	**0.1452**	**<0.0001**
Household members (*n*)	**−0.6981**	**0.2066**	**0.5613**	**0.0001**
Spouse	**−1.3482**	**0.3668**	**−0.1881**	**0.0002**
Children (*n*)	−0.0720	0.1700	−0.7828	0.6716

Of the 160 patients, 114 were discharged to home and 46 to a nursing home. Bold type indicates statistically significant items. Numerical values were assigned to sex (male=1, female=0), type of stroke (hemorrhagic=1, ischemic=0), past history of stroke (yes=1, no=0), spouse (living with a spouse=1, without=0). FIM-motor: the motor component of the Functional Independence Measure.

Table 3 Results from multivariate logistic regression analysis

Explanatory variable	Estimate	Standard error	χ^2	*P*-value
FIM-motor discharge	−0.0736	0.0123	35.9200	<0.0001
Spouse	−1.9828	0.6277	9.9800	0.0016
Household members	−0.5820	0.2926	3.9600	0.0467
Intercept	5.5289	1.0686	26.7700	< 0.0001
R^2	0.4645			

FIM-motor: the motor component of the Functional Independence Measure.

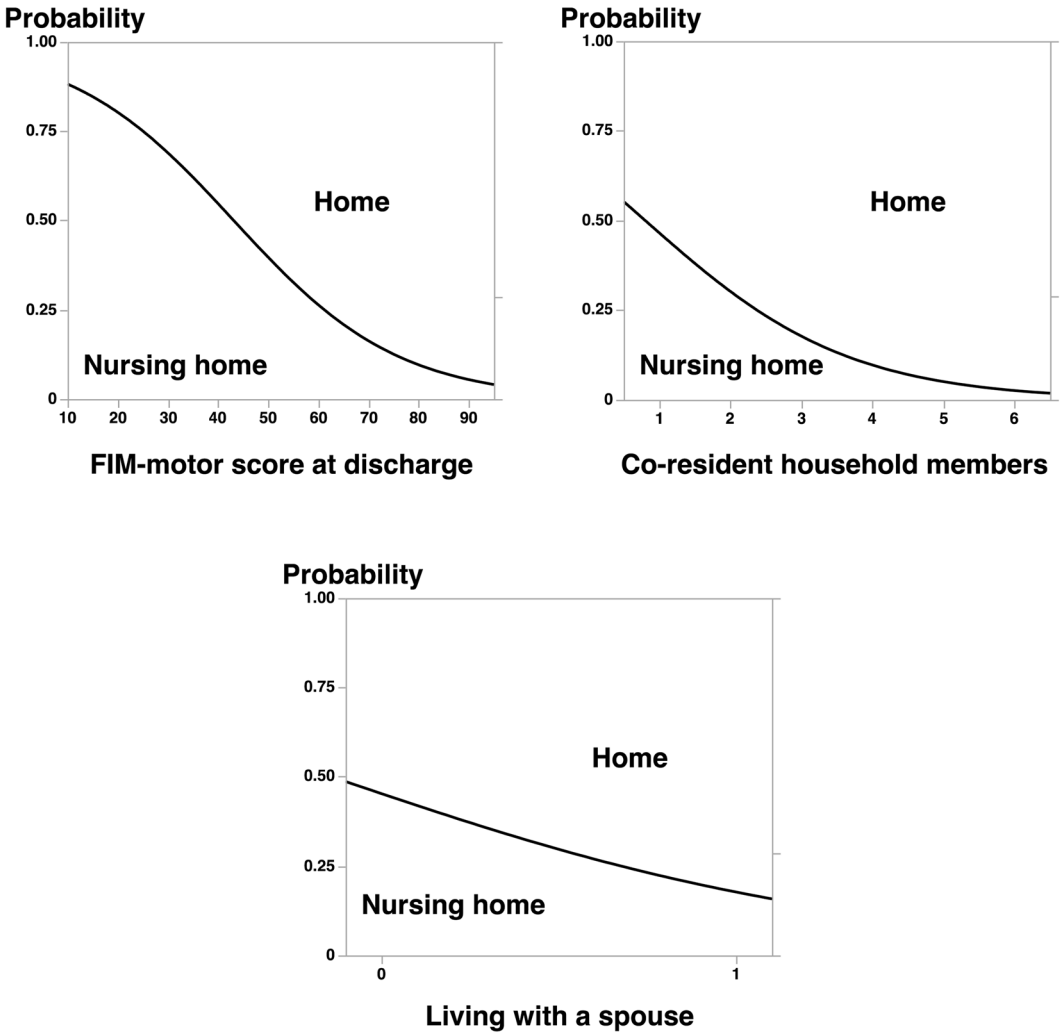

Figure 1 Logistic probability curves for FIM-motor score at discharge, number of co-resident household members, and living with a spouse.
The vertical axis indicates probability, which represents the likelihood of home discharge, while the horizontal axis represents the values of each explanatory variable. The distance from each curve to the top of the graph indicates the probability of home discharge.

scores at discharge were associated with older age and history of stroke (recurrence); these factors also undermined the increase in FIM-motor scores. Hemorrhagic stroke cases were associated with a greater increase in FIM-motor scores and longer total hospitalization. Living with a spouse was associated with younger age and male sex. In addition, the results of the descriptive survey on living alone were as follows: 21 of the 95 male patients and 18 of the 65 female patients lived alone.

Discussion

In this study, we collected data on the discharge destinations of 160 patients who experienced supratentorial stroke. Among these patients, 71.3% (114 cases) were discharged to their homes, and 28.7% (46 cases) were transferred to nursing homes. Logistic regression analyses revealed that a higher FIM-motor score at discharge, living with a spouse, and having greater number of co-resident household members were the most powerful predictors of returning home. However, our findings indicated little association between the number of children and discharge destination.

This study builds on our previous study[20] which collected data between 2007 and 2009 in an urban area of Nishinomiya City in Hyogo Prefecture. The population demographics at that time were as follows[24]: total population was 482,640 (227,660 male and 254,980 female citizens), and the number of households was 202,648. The population ≥65 years was 19.1%, and the city area is 100.18 km^2. However, the current study was conducted in a rural area,

Table 4 Results of correlation analysis of all possible pairs of explanatory variables (refer to Table 1)

Explanatory variable		Coefficient	*P*-value
Sex	Age	−0.3020	0.0001
FIM-motor discharge	FIM-motor admission	0.7985	<0.0001
	Total hospitalization days	−0.6054	<0.0001
	Age	−0.3969	<0.0001
	Days from stroke onset	−0.3060	<0.0001
	Past history of stroke	−0.2279	0.0037
FIM-motor admission	Total hospitalization days	−0.6563	<0.0001
	Age	−0.2419	0.0021
	Days from stroke onset	−0.2067	0.0087
FIM-motor increase	FIM-motor discharge	0.3490	<0.0001
	Past history of stroke	−0.2049	0.0093
	Age	−0.2004	0.0110
	Type of stroke	0.1605	0.0427
Spouse	Household members	0.4472	<0.0001
	Age	−0.3010	0.0001
	Sex	0.2338	0.0029
Total hospitalization days	Days from stroke onset	0.4540	<0.0001
	Type of stroke	0.1593	0.0442
Children	Household members	0.1747	0.0272
	Past history of stroke	−0.1700	0.0316

For clarity, only correlations that reached statistical significance are shown. Numerical values were assigned to sex (male=1, female=0), type of stroke (hemorrhagic=1, ischemic=0), past history of stroke (yes=1, no=0), spouse (living with a spouse=1, without=0). FIM-motor, the motor component of the Functional Independence Measure.

Tambasasayama City, in Hyogo prefecture. The population demographics in 2022 are as follows[25]: total population was 39,993 (19,167 male and 20,826 female citizens), and the number of households was 17,693. The population ≥ 65 years was 28.0%, and the area is 377.59 km^2. These two areas differ significantly in terms of population demographics. However, the main finding that functional independence levels and the number of co-resident household members are critical factors in discharge destinations was nearly identical between the previous urban study and the present rural study, suggesting that these two factors were crucial beyond the differences between urban and rural areas.

Nonetheless, the key findings indicating that functional independence levels and the number of co-resident household members are pivotal factors in determining the discharge destination remained highly consistent between the previous urban study and the current rural study, with some clear differences between them. First, the mean age of the study populations was distinctly different: 74.80 years in the present study vs. 69.71 years in the previous study. The Japanese medical insurance system categorizes patients aged >75 years into different groups in terms of long-term health care[26]. Although the difference in the mean ages of the two populations was only approximately 5 years, this is not a trivial difference. Nevertheless, the main contributory factors for returning home were nearly the same, suggesting that the findings of the present study might apply to the general population of most developed countries confronting the issue of rapid growth of the older adult population. Second, in our previous study[20], we observed that female patients were twice as likely to live alone as male patients: 35.9% (23/64) of female patients vs. 17.2% (17/99) of male patients. In the present study, this tendency was less evident, with 27.7% (18/65) of the female patients and 22.2% (21/95) of the male patients living alone. Rural areas may be a more difficult place for older women to live alone, partly because there are fewer public transportation services.

In the present study, we used FIM-motor scores to measure functional independence. Our findings align with those of previous studies that identified functional independence as the primary determinant influencing the discharge destination[6, 12, 14, 20]. Consistent with the results of other studies[20, 27], we found that the FIM-motor score at admission served as a robust predictor of the score at discharge (correlation coefficient, 0.7985; Table 4). This strong correlation suggests that the initial functional independence of patients plays a crucial role in determining their eventual discharge destination. However, FIM-motor scores at admission were

not among the most powerful predictors (Table 3), which can be attributed to multiple collinearity issues. From this perspective, the FIM-motor score at admission was as strong a predictor as the FIM-motor score at discharge for determining the discharge destination[20].

Previous studies have emphasized the importance of having dedicated caregivers when determining the appropriate discharge destination for stroke patients[28, 29]. In Japan, family members are traditionally the primary caregivers of patients[20]. However, in recent decades, Japan has undergone sociodemographic changes, including a growing older adult population and declining household sizes[18, 19]. From a social perspective, the burden of care for stroke patients is expected to increase. Our findings suggest that more stroke patients can be discharged to their homes by establishing social care networks that provide professional support.

This study had several limitations. First, although we included patients with recurrent stroke, we sampled only those who were independent before stroke onset. However, according to a recent review, the recurrence rate of ischemic cases ranges from 5.7 to 51.3%[30]. After recurrence, patients with stroke generally experience a more severe decline in functional independence[31]. Although we included some patients with a history of stroke, our sample covered a very limited population of patients with stroke. Second, our database consisted of patients fully independent in ADL before stroke. Therefore, patients with severe dementia, such as those with Alzheimer's disease, were excluded[32]. However, in reality, dementia is one of the most common comorbidities in the older adult population. Additionally, the sample size of our study was limited. Third, patients with subarachnoid hemorrhage or brainstem/cerebellar lesions were not included because their symptoms, such as altered consciousness and ataxia, differed from those observed in patients with supratentorial intramedullary lesions. Taken together, these limitations suggest that careful consideration should be given when generalizing the findings of this study to a broader population of older post-stroke patients.

Conclusion

In this study, we surveyed the discharge destinations of stroke patients living in rural Japan. Our sample consisted of 160 patients, approximately 70% of whom were discharged home, while the remaining 30% were transferred to nursing facilities. The results of the logistic regression analyses revealed that higher levels of functional independence, living with a spouse, and larger household size were the most influential factors in predicting return home. However, our findings indicated a minimal correlation between the number of children and discharge destination. Given that rural communities in Japan are representative of super-aged societies, the results of this study provide a useful reference for predicting stroke discharge destinations in most developed countries.

Conflict of interest: None.

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Ethics approval and consent to participate: The study protocol was approved by the Institutional Review Board of the Hyogo Medical University (No. 4462). Informed consent was obtained from the hospital website using the opt-out method.

Consent for publication: Consent was obtained from all co-authors.

Data availability statement: The dataset for this study is not publicly available because of ethical approval.

Author contributions: Iwasa S conducted the data collection, analysis, and writing of the manuscript. Uchiyama Y participated in data analysis and manuscript review. Tauchi Y collected the data. Koyama T conducted the data analysis and manuscript writing. Domen K designed the study and managed the entire process. All the authors have read and approved the final manuscript.

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