

Do falls experienced during in-patient stroke rehabilitation affect length of stay, functional status, and discharge destination?

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Abstract

Objective—To compare length of stay, functional status, and discharge destination between individuals who fell during in-patient stroke rehabilitation and those who did not fall.

Design—Retrospective cohort study.

Setting—Rehabilitation hospital.

Participants—Individuals who fell during in-patient stroke rehabilitation (n=106; fallers group; mean age=67.8 years, SD=12.9; mean time post-stroke=26.4 days, SD=28.3) were matched to individuals who did not fall (n=106; non-fallers group; mean age=67.3 years, SD=13.6; mean time post-stroke=21.9 days, SD=28.8) on age and functional status (N=212).

Interventions—Not applicable.

Main outcome measures—Total length of stay, Functional Independence Measure (FIM) assessed at discharge, and discharge destination.

Results—The mean length of stay for fallers was 11 days longer than non-fallers (p=0.0017). Non-fallers and fallers did not differ on discharge total FIM scores (p=0.19), and both groups were discharged home after in-patient rehabilitation (non-fallers: 77%; fallers: 74%; p=0.52).

Conclusions—This study suggests that falls experienced during in-patient stroke rehabilitation may have contributed to a longer length of stay; however, falls did not impact discharge functional status or discharge destination.

Keywords

Accidental Falls; Rehabilitation; Stroke

Falls are common post-stroke, with 12–47% of individuals falling at least once during in-patient stroke rehabilitation.^{1–5} Individual risk factors for falls among stroke survivors are numerous and interrelated,⁶ and can include impaired performance of activities of daily living,^{1,3,4} inability to transfer,⁷ decreased balance control,^{5,8} and not following instructions.^{2,9} Falls after stroke can have significant immediate physical and psychological consequences,¹⁰ including injuries^{2–4,11} such as hip fractures,¹² fear of falling,¹³ reduced physical activity,¹¹ and depression.¹⁴ In-hospital falls have been identified as one of the most common medical complications after stroke,^{15,16} which can negatively influence stroke rehabilitation and recovery.²

In-patient rehabilitation is a health care setting where patients are focused on improving function and maximizing their abilities. It is typically delivered during the sub-acute stage of stroke recovery (i.e. less than three months post-stroke) when patients are likely to receive the most benefit from intensive therapy.^{17,18} Unfortunately, there is limited available evidence for the effectiveness of falls prevention interventions after stroke across acute care, rehabilitation, community, and institutional care settings.^{19,20} Thus, the incidence of falls will remain of concern, as it may not be possible to prevent every fall.

Little evidence exists on the impact of falls on rehabilitation outcomes; therefore, it is important to understand the effect that falls have on the course of patient recovery and delivery of care during the critical sub-acute phase of stroke. The primary objective of this study was to compare length of stay, functional status, and discharge destination between individuals who fell during in-patient stroke rehabilitation and those who did not fall. It was hypothesized that patients who fell would have poorer recovery compared to those who did not fall. This would be demonstrated by a longer length of stay, worse functional outcomes at discharge, and less likely to be discharged home following the rehabilitation stay among individuals who fell.

METHODS

Study design

A retrospective cohort study involving a chart review was conducted. The chart review involved consecutive admissions to the specialized stroke unit at the Toronto Rehabilitation Institute from October 1, 2009 to September 30, 2012. The Toronto Rehabilitation Institute Research Ethics Board approved this study, and a waiver of patient consent for the purpose of this review was obtained.

Participants

The in-patient stroke rehabilitation unit housed 20 to 23 beds during the time of data collection, and admitted patients who were medically stable and had the endurance to participate in the program. Patients received multidisciplinary care including individualized physiotherapy, occupational therapy, and speech-language therapy for one hour per discipline per day, five days per week over a typical length of stay of four to six weeks. Excluding duplicate admissions for another stroke and individuals without imaging (n=20), 504 patients with confirmed stroke were admitted to the stroke unit during the three year

period. Patients were excluded from the analysis if they were not living at home before their acute stroke hospitalization (n=18), and/or if their Functional Independence Measure (FIM)²¹ scores on admission were missing (n=17). The study sample was created by matching all individuals who fell at least once during in-patient rehabilitation (i.e., “fallers”) with a randomly-selected sample of individuals who did not fall (i.e., “non-fallers”). A fall was defined as any time an individual came to rest unintentionally on the ground, floor, or other lower level.²² Matching was necessary because, on average, fallers and non-fallers tend to differ on measures of function and impairment on admission that are predictive of the current study’s primary outcomes.^{5,23} The sample of non-fallers was matched to fallers by stratified random sampling according to the Rehabilitation Patient Group and age. The Rehabilitation Patient Group algorithm was developed to provide a case-mix classification system to estimate in-patient rehabilitation costs, and is often used to determine length of stay (LOS) (i.e., one of the primary outcomes).²⁴ Admission FIM scores and age (i.e. <40, 40–59, 60–79 and >80 years) were used to stratify all individuals. Due to the distribution of the study sample, the two lowest Rehabilitation Patient Group categories from the original algorithm were combined, representing patients with a motor score of 12 to 38, leaving six possible Rehabilitation Patient Group categories (Figure 1).

Data extraction

All data were recorded in patients’ clinical charts during their rehabilitation stay by clinical staff (medical and allied health professionals), and extracted by trained research staff using a chart review form. Data were checked for inconsistencies and logical errors that may have arisen due to errors in extraction and were corrected, as necessary. The following variables were extracted to describe the cohort: age, sex, Berg Balance Scale (BBS)²⁵ score on admission, and the date and type of stroke. Falls experienced during in-patient rehabilitation were captured from hospital incident reports, nursing notes, and patient interviews that were part of routine care at discharge from rehabilitation.²⁶ Where available, information on each fall was recorded, which included details of the activity undertaken at the time of fall, where and when the fall occurred, and if any injury resulted. During the in-patient rehabilitation length of stay, patients may have had the opportunity to go home on a weekend pass; therefore, any falls that took place in the home of the patient were also included. Details of falls experienced on a weekend pass were collected through patient interviews, as these events were not recorded by the hospital incident reporting system. The three primary outcomes of this study are described below.

Length of stay (LOS) was determined by the total number of days spent on the in-patient stroke rehabilitation service (i.e. the number of days between admission and discharge date). Occasionally, patients were placed on alternate level of care (ALC; i.e. when patients no longer required the level of care provided in the given hospital setting) while waiting for a discharge plan to be finalized (e.g. if the patient was on a waiting list for long-term care). Thus, a patient’s discharge date was the date that the patient left the rehabilitation hospital permanently. If a patient was temporarily transferred to another location for at least one overnight stay (e.g. to an acute care facility for treatment), LOS was adjusted by subtracting the number of days spent off the stroke unit.

Functional status was measured at admission and discharge from rehabilitation using the Functional Independence Measure (FIM).²¹ The FIM instrument is a standardized measure of motor and cognitive disability, and rates an individual's level of independence in 18 tasks on a scale from 1 to 7, with 1 corresponding to full dependence, and 7 corresponding to complete independence. Total FIM scores can range from 18 to 126; the motor domain ranges from 13 to 91 and the cognitive domain ranges from 5 to 35. The FIM has been studied extensively and has been found to have acceptable inter-rater and test-retest reliability in rehabilitation populations.²⁷ The minimal clinically important difference for the FIM is a 22-point change, which reflects a significant improvement in functional independence among patients with stroke.²⁸

Discharge destination after in-patient rehabilitation was defined dichotomously, home or not home. If an individual was not discharged home, other possible discharge destinations included a retirement home, acute care hospital (transferred and did not return to the rehabilitation facility), convalescent care (for additional therapy), long-term care, and another rehabilitation facility (to be closer to home).

Statistical analysis

Characteristics of non-fallers and fallers were compared on admission to in-patient rehabilitation using the Mann-Whitney U test for continuous or ordinal data, and the chi-square or Fisher's exact test for nominal data. The alpha level for comparing baseline characteristics of the two groups was set at 0.05. To test the outcomes of interest, non-fallers and fallers were compared on LOS, discharge FIM scores using the Mann-Whitney U test, and discharge destination (i.e. home or not home) was compared using the chi-square test. Non-parametric testing (i.e. Mann-Whitney U test) was necessary for LOS and FIM scores after assumptions of normality were violated (i.e. Shapiro-Wilk test, quantile-quantile plot). To examine the three primary outcome measures, a one-tailed test was used and an alpha was set at 0.017 (i.e., Bonferonni-corrected for multiple comparisons; 0.05 divided by three primary outcome measures). Statistical analyses were carried out using SAS version 9.2.

RESULTS

Of the 469 patients attending in-patient stroke rehabilitation, 113 patients (24%) were classified as fallers; therefore, a pool of 356 patients was available to select a matched sample of non-fallers. A final sample of 212 participants (106 non-fallers and 106 fallers) was included in the analysis; seven fallers were excluded because no non-faller match was found. Over half (51%) of the participants were in the lowest Rehabilitation Patient Group category, representing severe disability. There were no significant differences on demographic and stroke characteristics between non-fallers and fallers on admission to rehabilitation (Table 1).

A total of 157 falls were recorded, and 31/106 fallers (29%) fell more than once. The average time from admission to an individual's first fall was 20.5 days (SD=18.3 days), and 30/157 falls (19%) took place within the first week of rehabilitation (Figure 2). Circumstances of in-patient falls are presented in Table 2. Fifty-four falls of the 157 falls

(34%) occurred during transfers (e.g. from bed to wheelchair), 78/157 falls (50%) took place in the patient's room in the hospital, and no injury was observed in 106/157 falls (68%).

The average LOS for fallers was 11 days longer than non-fallers ($W(1)=9963$, $Z=-2.97$, $p=0.0017$; Table 3). Fourteen patients were placed on ALC and when removing these patients and their matched pairs, differences in LOS remained highly significant between non-fallers and fallers (non-fallers: 42.4 days; fallers: 51.1 days; $W(1)=7858$, $Z=-2.75$, $p=0.0033$). There were no differences in discharge total FIM scores between non-fallers and fallers ($W(1)=10981.5$, $Z=0.87$, $p=0.19$). When analyzed on FIM subscales, the groups did not significantly differ at discharge on the FIM motor subscale ($W(1)=11181$, $Z=1.33$, $p=0.093$) or the FIM cognitive subscale ($W(1)=10333$, $Z=-0.64$, $p=0.26$). Likewise, a similar proportion of non-fallers and fallers were discharged home after in-patient rehabilitation (non-fallers: 77%; fallers: 74%; $p=0.52$; Table 3). Details of the breakdown of discharge destination are provided in Table 3.

There were 24/106 fallers (23%) who experienced an injury. When the injured fallers and their non-faller matches were analyzed separately, LOS was no longer significantly different between the two groups (non-fallers: 40.9 days; fallers: 53.6 days; $W(1)=515$, $Z=-1.5$, $p=0.071$). For the total FIM scores at discharge, the injured fallers had a higher but not statistically significant mean score than their non-faller matches (non-fallers: 91.9 points; fallers: 99.1 points; $W(1)=528$, $Z=-0.5$, $p=0.31$).

DISCUSSION

In support of the hypothesis, patients who fell had a longer length of stay (LOS) than those who did not fall. The course of rehabilitation may have been extended for fallers due to setbacks in physical recovery that required additional resources or modifications to discharge planning. It is also possible that fallers were fearful of experiencing another fall, which in turn influenced recovery and hospital LOS.²⁹ Waiting periods for patients on alternate level of care (ALC) may have contributed to a prolonged LOS, where active rehabilitation and discharge planning is complete.

Contrary to the hypothesis, both groups had similar functional scores at discharge from rehabilitation, despite the increased LOS for fallers. A potential reason for this result could be that the rehabilitation team kept the patient beyond the targeted discharge date in order for the patient to reach an appropriate functional level before discharge. Since groups were similar on functional status on admission, this finding suggests that fallers required more time to achieve the same level of function as non-fallers. This level of functional improvement was clinically significant, as both groups, on average surpassed the minimal clinically important difference of 22 points on the FIM.²⁸ With a limited number of rehabilitation beds available, information regarding the impact of falls is essential to optimize efficiency of in-patient stroke rehabilitation services. Even though fallers had a longer LOS, and thus greater costs associated with care,²⁴ small improvements in functional status may have significant benefits in quality of life and future health care utilization. Likewise, there were no differences in the proportion of individuals who returned home following their rehabilitation stay between non-fallers and fallers. Participants included in

this study lived at home prior to hospitalization for stroke; therefore, it would be expected that individuals would return to their premorbid residence when their medical and functional status improved, and their rehabilitation goals were met.

Both groups of non-fallers and fallers in this study averaged a longer LOS than the median LOS for stroke rehabilitation in Canada (i.e., 35 days).³⁰ This was likely because the sample of individuals included in this analysis represents a lower-functioning subset of the institution's stroke rehabilitation unit, as measured by the FIM (e.g., see Table 1). Thus, the results of this study apply to lower-functioning individuals receiving in-patient rehabilitation post-stroke. With greater dependence in performing activities of daily living, these stroke survivors are at high risk of falling;^{1,3,4} however, individuals in the current study were able to achieve benefits from in-patient rehabilitation with a longer LOS.^{31,32}

Similarly, it appears as though fallers were admitted to rehabilitation later post-stroke than non-fallers, which may have been due to a longer LOS in acute care as a result of comorbidities or medical complexities. In addition, fallers averaged lower balance scores than non-fallers as measured by the Berg Balance Scale (BBS) on admission. Data on discharge suggests that fallers continued to have lower BBS scores than non-fallers but this was not statistically significant ($p=0.057$). Since balance impairment is an important risk factor for falls among individuals with stroke,^{5,14,33,34} and balance is essential for performing activities of daily living, those who were more affected by stroke (and therefore more prone to falls) required longer in-patient treatment.

Overall, the rate of falls was within the range of other studies reporting falls during in-patient stroke rehabilitation (i.e. 113 out of 469 patients fell; rate: 24%). The proportion of fallers with more than one fall ('multiple fallers'; rate: 29%) was in line with other studies of patients attending stroke rehabilitation (rates: 5–51%),^{1,2,4,5} as was the presence of injuries (rates: 8–29%).^{2–5} Falls while transferring are common in the in-patient rehabilitation setting,^{2,3} and typically take place in the patient's room or bathroom,^{2–4,35} which was the case in the current study. Falls were most prevalent during the first week of admission to rehabilitation, as reported in previous studies,^{3,36} making this a critical time point. There was also an increase in the frequency of falls in the fourth week of stay (i.e. 21–27 days from admission). Falls may have become more frequent as individuals recovered and may correspond with increased levels of mobility and exposure to risk-taking activities.³⁵

Lastly, the sub-analysis of injured fallers revealed that there was no statistically significant difference in LOS between injured fallers and their non-faller matches. Even though injured fallers stayed an average 12.7 days longer, this result may have been due to a low sample size ($n=48$). Interestingly, the injured fallers finished with a higher, though not significantly different, mean FIM score; however, this may have been as a result of the additional time on the unit.

This research study is unique because it is the first to our knowledge to examine the link between falls during in-patient stroke rehabilitation and their impact on length of stay and functional status at discharge. Compared to earlier uncontrolled efforts aimed at determining the consequences of falls in the stroke rehabilitation population,^{1,4,5} the current study

matched on admission FIM using the Rehabilitation Patient Group classification and age to ensure that the groups were comparable on admission and, therefore, the main difference between groups was the occurrence of a fall during in-patient rehabilitation.

Study Limitations

This study has several potential limitations. Data were collected from a single hospital and may not be representative of other rehabilitation centres. The retrospective nature of the methodology limited data collection to what was available in the medical chart, and this information extracted from medical charts was written for purposes other than research.³⁷ For instance, there are factors other than falls that may have contributed to an increased LOS, such as comorbidities and psychosocial status that were not measured in the present study. In addition, injuries were classified dichotomously, as there were not enough details available to measure the severity among the types of injury; therefore, all falls were treated equally. Finally, the incidence of falls may have been low as a result of underreporting due to unwitnessed falls or events that staff did not perceive as reportable.

CONCLUSIONS

The results of this study suggest that falls may extend in-patient stroke rehabilitation length of stay. Longer length of stay can influence the overall individual recovery path of the patient, and have large economic consequences to the health care system. However, individuals who fell achieved a similar functional level at discharge and were equally likely to be discharged home compared to those who did not fall. These results shed light on how stroke recovery may be impacted by falls during this critical time for rehabilitation after stroke.

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List of Abbreviations

ALC	Alternate level of care
BBS	Berg Balance Scale
LOS	Length of stay

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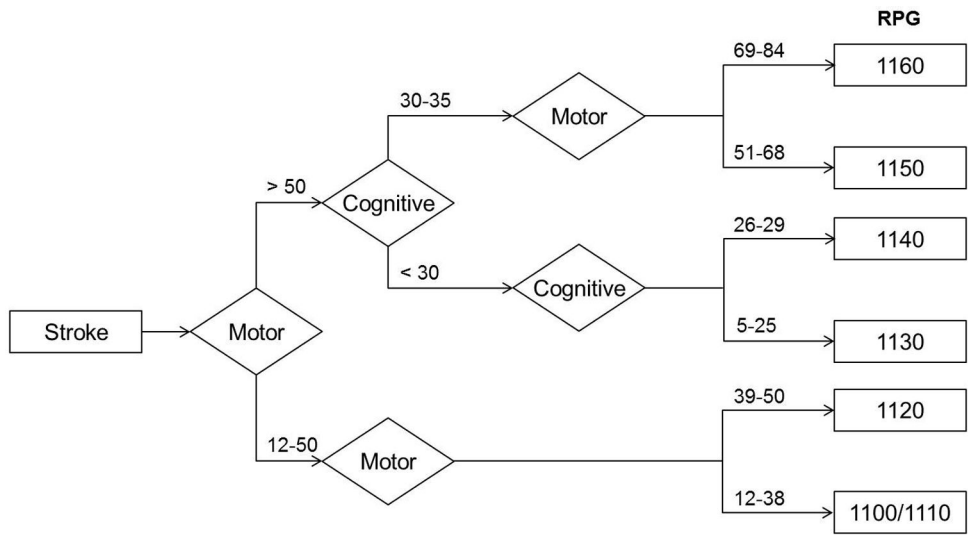


Figure 1.

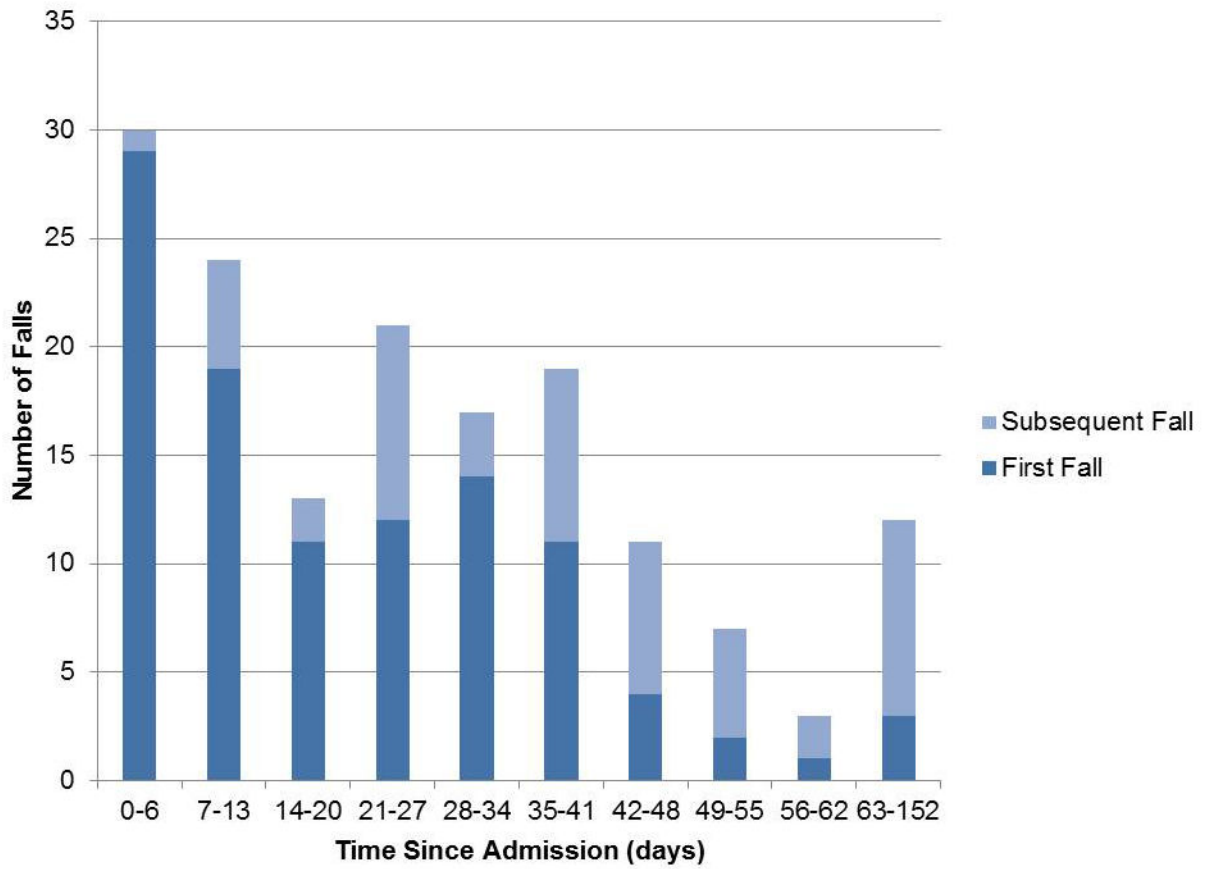


Figure 2.

Table 1

Participant characteristics on admission to rehabilitation.

Characteristic	Patients not included (n=257)	Study sample		p value
		Non-fallers (n=106)	Fallers (n=106)	
Age (years)	69.4 (13.6)	67.3 (13.6)	67.8 (12.9)	0.90
Number of women	117 (46)	48 (45)	47 (44)	0.89
Time post-stroke (days)	20.2 (28.9)	21.9 (28.8)	26.4 (28.3)	0.078
Type of stroke				
Ischemic	205 (80)	81 (76)	81 (76)	0.44
Hemorrhagic	36 (14)	19 (18)	14 (13)	
Ischemic & hemorrhagic	3 (1)	1 (1)	1 (1)	
Transforming to hemorrhagic	13 (5)	5 (5)	10 (9)	
Total FIM (points)	88.4 (18.5)	65 (21)	61.9 (18.1)	0.34
Motor	64 (16.5)	43.1 (18.3)	61.9 (18.1)	0.21
Cognitive	24.4 (5.9)	21.9 (6.5)	21.6 (5.9)	0.38
Berg Balance Scale (0–56 points)	35.7 (16.4)*	19.1 (15.5)	14.6 (13.9)	0.059

NOTE: Values are means (standard deviation) for continuous or ordinal variables, and counts (% rounded to the nearest integer) for categorical variables. The p value is for the Mann-Whitney U test, chi-square or Fisher's exact test comparing non-fallers to fallers on admission.

* Berg Balance Scale scores missing for two patients.

Table 2

Circumstances of in-patient falls (n=157 falls).

	Frequency (%)
Activity at time of fall	
Transferring	54 (34)
Reaching, bending or turning	30 (19)
Walking	14 (9)
Sitting	9 (6)
Standing	9 (6)
Lying	2 (1)
Not available	39 (25)
Location of fall	
Hospital	137 (87)
Patient's room	78
Bathroom, tub room	41
Common area	10
Therapy area	8
Home of patient	11 (7)
Bedroom	5
Bathroom	3
Kitchen	1
Outdoors	1
Not specified	1
Not available	9 (6)
Injury after fall	
No injury	106 (68)
Cuts or bruises	17 (11)
Pain (e.g. back, hip, shoulder)	6 (4)
Hit head *	3 (1)
Head injury	2 (1)
Not available	23 (15)

NOTE: Values are counts (% rounded to the nearest integer) for categorical variables.

* No confirmed head injury; however, the interdisciplinary team initiated a head injury routine as per protocol.

Table 3

Differences in outcome measures at discharge from in-patient stroke rehabilitation.

Outcome measure	<i>n</i>	Non-fallers	<i>n</i>	Fallers	p value
Length of stay (days)	106	43.8 (24.8)	106	54.8 (29.7)	0.0017*
Total FIM (points)	102	97.3 (21)	105	96.4 (18.5)	0.19
Motor		69.8 (17.3)		68.4 (14.8)	0.093
Cognitive		27.5 (5.6)		28 (5.5)	0.26
Discharge destination	106		106		0.52
Home		82 (77)		78 (74)	
Not home		24 (23)		28 (26)	
Retirement home		7 (7)		3 (3)	
Acute care		6 (6)		4 (4)	
Convalescent care		6 (6)		8 (8)	
Long-term care		4 (4)		13 (12)	
Another rehab facility		1 (1)		0 (0)	

NOTE: Values are means (standard deviation) for continuous or ordinal variables, and counts (% rounded to the nearest integer) for categorical variables. The p value is for the Mann-Whitney U test and for the chi-square test comparing both groups at discharge.

* p value is significant, where $p < 0.017$ (Bonferroni-corrected for multiple comparisons).