

Timing of inpatient rehabilitation initiation in stroke patients: factors influencing early admission

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Abstract. [Purpose] Early admission to inpatient rehabilitation is critical for reducing post-stroke disability. Assessing admission timing and other trends in inpatient rehabilitation are essential for improving health outcomes. This study is the first to evaluate the timing of admission of stroke patients to inpatient rehabilitation in Turkey. [Subjects and Methods] We retrospectively analyzed acute stroke survivors who were admitted to the inpatient rehabilitation program in the Ministry of Health, Ankara Physical Medicine and Rehabilitation Training and Research Hospital between January 2009 and December 2010. [Results] The mean onset of inpatient rehabilitation was 9.8 ± 6.7 weeks post-stroke in the entire cohort. Occurrence of ischemic stroke and undergoing acute stroke care at a teaching hospital were most strongly associated with early admission. These results did not change after multivariate analysis. [Conclusion] Turkish stroke survivors begin inpatient rehabilitation later than patients in other countries. The type of stroke and type of hospital in which the patient undergoes acute stroke treatment affects early admission.

Key words: Stroke, Inpatient rehabilitation, Early admission

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INTRODUCTION

The incidence of stroke varies widely worldwide. A systematic review of 56 population-based studies showed a decrease in the incidence rate of stroke in developed western countries, but not in developing countries¹⁾. Meanwhile, the disability caused by stroke has been on the rise. According to the disability-adjusted life years (DALYs) reported by the Global Burden of Disease Study 2010 (GBD 2010), stroke is the third leading cause of DALYs worldwide. In 1990, it was the fifth leading cause, and similar rates were reported for the Turkish population by the Turkish Ministry of Health^{2, 3)}.

Stroke has been recognized as having significant deleterious outcomes, thereby limiting the patients' quality of life⁴⁻⁶⁾. Participation in rehabilitation programs following acute stroke has the greatest effect on reduction of disability⁷⁾. Patient characteristics also have a critical effect on the efficacy of inpatient rehabilitation among stroke survivors⁸⁾. Moreover, initiating post-stroke rehabilitation soon after the onset of an acute stroke appears to be the most important factor associated with early discharge from the hospital; in addition, earlier admission is recognized as a relevant

favorable prognostic factor^{9, 10)}. Paolucci et al. reported that admission to inpatient rehabilitation in the first 20 days after stroke was associated with a better functional outcome¹¹⁾. Similarly, Salter et al. reported that patients who underwent stroke rehabilitation within four weeks of stroke onset experienced greater functional gains and shorter lengths of hospital stay¹²⁾. Accordingly, the American Stroke Association has recommended that in medically stable inpatients, rehabilitation can be initiated within two days following stroke onset^{4, 5)}.

There is, however, no international consensus on the optimal timing for initiation of an inpatient rehabilitation program after discharge from an acute stroke care facility. In this context, defining the trends in admission timing to inpatient rehabilitation is essential for improving health outcomes. In particular, early admission to inpatient rehabilitation programs has not been identified among stroke survivors in Turkey. The present study aimed to determine the timing of referral to inpatient rehabilitation among Turkish stroke survivors and to identify factors affecting earlier admission.

SUBJECTS AND METHODS

In this single-center retrospective study, medical and demographic data were tabulated for stroke survivors admitted to the Ministry of Health, Ankara Physical Medicine and Rehabilitation Training and Research Hospital between January 2009 and December 2010. Located in Turkey's capital, this institution is a center of excellence, as it is the largest

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inpatient rehabilitation hospital in Turkey, where patients from all over the country are treated. Only patients who have been previously diagnosed by a neurologist and whose findings have been confirmed by computed tomography or magnetic resonance imaging are admitted here for stroke rehabilitation. This study was approved by the hospital's Medical Ethics Committee.

The present study enrolled stroke patients with relevant clinical identification codes from the International Classification of Diseases, 10th revision (ICD-10). Stroke was defined as an acute cerebrovascular event associated with global or focal neurologic dysfunction lasting more than 24 hours¹³. An experienced physical medicine and rehabilitation (PMR) specialist reviewed all clinical records and confirmed the ICD-10 coding. Patients aged ≥ 35 years, who were admitted for the first time to a PMR program after stroke, were included in this study. Patients who experienced stroke secondary to trauma, surgery, or malignancy were excluded from the study.

The tabulated data included the following characteristics: patients' demographic features, stroke date/time, type of stroke (ischemic stroke, IS; or hemorrhagic stroke, HS), type of first acute stroke care center (teaching hospital, university hospital, or training hospital; or state hospital), presence of hypertension (HTN; self-reported, antihypertensive use, or newly diagnosed at entry), diabetes mellitus (DM; self-reported, use of any hypoglycemic agents, or newly diagnosed at entry), coronary heart diseases (CHD; self-reported or documented), carotid artery disease (self-reported or documented), atrial fibrillation (AF; self-reported or documented), hyperlipidemia (HL; self-reported, use of hypolipidemic medication, or newly diagnosed at entry) and previous transient ischemic attack (TIA, self-reported or documented). Detailed descriptions of current medications were obtained for all the enrollees. Early onset of rehabilitation was defined as registering for an inpatient program within four weeks of experiencing an acute stroke¹². Multiple morbidity was defined as presence of two or more accompanying diseases including HTN, DM, CHD, HL, AF, and carotid artery disease.

The SPSS version 20.0 (SPSS Inc., Chicago, IL, USA) software was used for the statistical analyses. Student's t-test and Mann-Whitney test were used for inter-group comparisons. The results were expressed as mean \pm standard deviation (SD). The multiple binary logistic regression analyses were performed in the samples with information from the acute stroke care facility (77.6 percent of all samples). The dependent variable was earlier onset of the rehabilitation program (coded as 1 = present, 0 = absent). Dichotomous variables were used as independent variables. These included age (<65 y vs. >65 y), sex (coded as 1 = male, 2 = female), etiology of stroke (1 = ischemic, 2 = hemorrhagic), type of acute stroke care center (0 = state hospital, 1 = teaching hospital), recurrent stroke (0 = non-recurrent, 1 = recurrent), bilateral hemiplegia (0 = no, 1 = yes), TIA (0 = no, 1 = yes), HTN (0 = no, 1 = yes), DM (0 = no, 1 = yes), CHD (0 = no, 1 = yes), HL (0 = no, 1 = yes), AF (0 = no, 1 = yes), carotid artery disease (0 = no, 1 = yes) and multiple comorbid diseases (0 = no or one co-morbid disease, 1 = two or more comorbid diseases). Two-tailed p values <0.05 were

accepted as significant.

RESULTS

In the present study, data from 1,002 patients diagnosed with stroke were screened, and 811 patients met the inclusion criteria. Mean patient age was 69.06 ± 11.6 years, and 64.7% of the patients were ≥ 65 years. Slightly more female than male (female, n = 433; male, n = 378) were included. In the study cohort, 88% of the patients (n = 714) were admitted to inpatient rehabilitation following their first stroke. IS accounted for 83.2% (n = 673) of all confirmed stroke diagnoses. Left-sided hemiplegia was diagnosed in 49.0% of patients (n = 397), whereas bilateral hemiplegia was detected in 3.2% (n = 26) of the patients.

Table 1 shows the differences in health characteristics between the male and female patients. The mean age among female was significantly higher than that among male (70.72 ± 11.19 vs. 67.16 ± 11.77 years, $p < 0.001$). Females also had a higher incidence of HTN (94.2% vs. 84.4%, $p < 0.001$), AF (25.4% vs. 17.5%; $p = 0.006$) and multiple morbidity (63.7% vs. 54.2%; $p = 0.008$) than males, whereas CHD was more frequent among men (30.2% vs. 22.9%; $p = 0.02$). No significant gender differences were observed regarding stroke recurrence, TIA history, and the type of acute stroke care facility.

The duration between stroke onset and admission to a rehabilitation program is shown in Table 2. In the entire cohort, the duration between stroke onset and inpatient rehabilitation was 9.82 ± 6.66 weeks; it was 9.59 ± 6.52 weeks in the IS subgroup and 11 ± 7.22 weeks in the HS subgroup ($p = 0.018$). Rehabilitation was initiated 9.06 ± 6.11 weeks following stroke at teaching hospitals and after 10.80 ± 7.19 weeks at state hospitals ($p = 0.02$). Similarly, attending a rehabilitation program in the first four weeks following stroke was significantly higher among patients who received acute stroke care at teaching hospitals vs. other hospitals (40.0% vs. 29.8%, $p = 0.01$) and among patients with IS vs. HS (37% vs. 25.7%, $p = 0.07$). The time period after stroke until admission to a rehabilitation program was not associated with multiple morbidities.

Multiple logistic regressions were performed with early start of rehabilitation (≤ 4 weeks) as the dependent variable and age, etiology of stroke, type of acute stroke care center, recurrent stroke, bilateral hemiplegia, TIA, HTN, DM, CHD, HL, AF, carotid artery diseases, and multiple morbidity as the independent variables. As shown in Table 3, presence of IS, no evidence of dyslipidemia, and admission to a teaching hospital for acute stroke treatment were significantly associated with early admission to an inpatient PMR program.

DISCUSSION

To the best of our knowledge, the present study is the first to evaluate the timing of admission to inpatient rehabilitation programs among Turkish stroke survivors and to evaluate the conditions affecting early admission. In addition, the study reports the health characteristics of stroke patients, using a considerably large sample and based on well-organized records. We found that a majority of Turkish stroke survivors

Table 1. Characteristics of study participants

Variable	Total (n = 811)	Male (n = 378)	Female (n = 433)	
Age, mean (SD), y ^{a)}	69.06 (11.6)	67.2 (11.8)	70.7 (11.2)	***
Young adult, n (%)	276 (34)	155 (41.0)	121 (27.9)	***
Elderly, n (%)	535 (66)	223 (59.0)	312 (71.2)	***
Stroke onset (weeks), mean (SD) ^{a)}	9.8 (6.7)	9.5 (6.1)	10.1 (7.1)	
Bilateral hemiplegic, n (%)	26 (3.2)	16 (4.3)	10 (2.3)	
Ischemic stroke, n (%)	675 (83.2)	317 (83.9)	358 (82.7)	
Recurrent stroke, n (%)	51 (12)	46 (13.6)	61 (10.6)	
TIA, n (%)	49 (6.0)	23 (6.1)	26 (6.0)	
Hypertension, n (%)	727 (89.6)	319 (84.4)	408 (92.2)	***
Coronary heart disease, n (%)	213 (26.3)	114 (30.2)	99 (22.9)	*
Diabetes mellitus, n (%)	263 (32.4)	118 (31.2)	145 (33.5)	
Atrial fibrillation, n (%)	176 (21.7)	66 (17.5)	110 (25.4)	**
Hyperlipidemia, n (%)	176 (21.7)	66 (17.5)	110 (25.4)	**
Carotid artery disease, n (%)	53 (6.5)	20 (5.3)	33 (7.6)	
Comorbidities, n (%)	481 (59.3)	205 (54.2)	276 (63.7)	**

* Statistically significant at $p < 0.05$, ** Statistically significant at $p < 0.01$, *** Statistically significant at $p < 0.001$

^{a)}Mann-Whitney test and χ^2 test were used for other comparisons. SD: standard deviation, TIA: Transient ischemic attack

Please see Materials and Methods for detailed definitions of comorbidities.

Table 2. Comparison of stroke patients admitted to inpatient rehabilitation within 4 weeks of an acute stroke event (early onset) and those admitted later (late onset)

Variable	Early Onset (n = 285)	Late Onset (n = 526)	
Age, mean (SD), y ^{a)}	69.59 (11.77)	68.77 (11.51)	*
Young adult/ Elderly, % (n)	34.1 (94)/35.7 (191)	65.9 (182)/64.3 (344)	
Male/Female, % (n)	34.7 (131)/35.6 (154)	65.3 (247)/64.4 (279)	
Bilateral/Unilateral hemiplegia, % (n) ^{b)}	26.9 (7)/35.8 (278)	73.1 (19)/64.6 (507)	
Ischemic/Hemorrhagic, % (n)	37 (250)/25.7 (35)	63 (425)/74.3 (101)	*
Recurrent/First Stroke, % (n)	42.3 (41)/34.2 (244)	57.7 (56)/65.8 (470)	
Teaching/State Hospital, % (n)	40.0 (173)/29.8 (67)	60 (259)/70.2 (158)	*
Transient Ischemic Attack, % (n)	30.6 (15)/35.4 (270)	69.4 (34)/64.6 (492)	
Hypertension, % (n)	34.9 (254)/36.9 (31)	65.1 (473)/63.1 (53)	
Coronary heart disease, n (%)	37.1 (79)/34.4 (206)	62.9 (134)/65.9 (392)	
Diabetes mellitus, n (%)	36.5 (96)/34.5 (189)	63.5 (167)/65.5 (359)	
Atrial fibrillation, n (%)	39.2 (69)/34 (216)	60.8 (107)/66 (419)	
Hyperlipidemia, n (%)	39.6 (89)/33.4 (196)	60.4 (136)/66.6 (390)	
Carotid artery disease, n (%)	37.7 (20)/35 (265)	62.3 (33)/65 (493)	
Comorbidities, n (%)	36.4 (175)/33.3 (110)	63.6 (306)/66.7 (220)	

* Statistically significant at $p < 0.05$, ^{a)} Student's t-test and χ^2 test were used for other comparisons.

^{b)}Analysis were performed among 77.6 percent of all samples with acute stroke care center data

N: Number, NS: Not Significant, SD: standard deviation, TIA: Transient ischemic attack

Please see Materials and Methods for detailed definitions of comorbidities.

began inpatient stroke rehabilitation after a significant delay following the onset.

Compared to the results of the present study, inpatient stroke rehabilitation began 13 days post-stroke in England (UK), 22 days post-stroke in Belgium, 19 days post-stroke in Switzerland, 16 days post-stroke in Germany, and 10.6 days post-stroke in the United States of America^{14, 15}. Sakurai

et al. showed that the duration from stroke to the onset of inpatient rehabilitation in Japan was approximately 30 days; however, their results do not present the primary or secondary ends of the study, and their results may not represent the actual trend in inpatient rehabilitation admissions in Japan¹⁶. The Putman et al. study reviewed six European stroke rehabilitation units in four European countries (UK,

Table 3. Binary logistic regression analysis for the determinants of early onset of rehabilitation in stroke survivors

Independent Variable	Dependent Variable: Early onset of rehabilitation		
	OR	95% CI	
Age	1.091	0.757–1.572	
Gender	1.003	0.715–1.406	
Etiology of stroke	0.579	0.352–0.952	*
Acute stroke care center	1.595	1.121–2.271	***
Recurrent stroke	1.505	0.913–2.482	
Bilateral hemiplegia	0.857	0.386–3.146	
Transient ischemic attack	0.663	0.328–1.341	
Hypertension	1.171	0.624–2.2	
Diabetes mellitus	1.106	0.695–1.761	
Coronary heart disease	0.728	0.492–1.077	
Hyperlipidemia	1.553	1.002–2.406	*
Carotid artery disease	1.161	0.598–2.254	
Atrial fibrillation	1.186	0.711–1.977	
Multiple comorbid disease	0.757	0.414–1.386	

*Statistically significant at $p < 0.05$,

*** Statistically significant at $p < 0.001$

Belgium, Germany, and Switzerland), and Granger et al. used a uniform data system for medical rehabilitation in the USA between 2000 and 2007; therefore, these results may better represent admission trends in the above-mentioned nations. Our study sample size of 811 patients was larger than that of Putman et al.'s study, which was approximately 500 patients.

The results of the present study also showed that patients who underwent acute stroke treatment in a teaching hospital were more likely to be admitted to an inpatient rehabilitation program within four weeks of a stroke event, while HS patients were more likely to be admitted later. These results did not change after multivariate analysis. Later admission trends found among HS patients in the present study were consistent with trends reported in most but not all earlier studies^{11, 17–19}. The observational designs of these earlier studies on HS patients were limited to factors that may have led to later inpatient rehabilitation admission. It is generally believed that HS patients have better neurological and functional prognoses than non-HS survivors²⁰. Therefore, later admission to inpatient rehabilitation programs may be related with better neurological and functional prognoses among HS patients.

An earlier study conducted in four European countries concluded that older age and presence of comorbid diseases were important criteria for referring stroke patients to a rehabilitation program in Belgium but not in England, Germany, or Switzerland¹⁴. Granger et al. did not analyze the factors related to earlier admission. In the present study, we found no significant relationship among early admission and comorbid diseases. This may be because of a relatively younger population and other health-related characteristics in our Turkish sample. Further studies should be conducted to identify the effects of age and comorbid disease on earlier

admission of patients to inpatient stroke rehabilitation.

Women stroke survivors in the present study were nearly four years older than the men—a result consistent with previous studies, which showed that stroke occurs in men at an earlier age²¹. HTN and AF were more prevalent in women, whereas CHD was predominant in men, which is similar to the findings of other studies^{21, 22}. Although the frequency of HTN in the patients of the present study was consistent with a previous report²³, it was higher than the findings in many earlier studies^{21, 22}. One of the causes of this discrepancy could be an already higher prevalence of HTN in the Turkish population. One study demonstrated that the prevalence of HTN among elderly Turkish individuals is approximately 60–80%²⁴. Moreover, optimum blood pressure (BP) rates in Turkey were found in as little as 8.1% of the population. The low rate of effective BP control may be associated with this result. Data from the National Health and Nutrition Examination Survey (NHANES) 2007–2008 cohort revealed that BP is controlled in an estimated 50.1% of all patients with HTN²⁵. According to the BP control rate and cardiovascular risk profile (BP-CARE) study, BP control rates in eastern Europe vary between 16% and 51% (average, 27.1%)²⁶.

The present study has several limitations. First, although our hospital is the biggest national inpatient rehabilitation hospital in Turkey and admits patients from all over the country, our sample cannot be considered as representative of the population of Turkish stroke survivors. Second, the study may not represent all patients with stroke admitted to our hospital, because the number of patients enrolled was dependent on the quality of ICD-10 coding in our hospital dataset. Third, we lacked detailed information on whether the stroke patients enrolled in our study had not been referred to inpatient rehabilitation following acute stroke treatment earlier than when they actually began rehabilitation or whether the patients refused to be admitted to the inpatient rehabilitation program at an earlier time even if they were referred from an acute stroke treatment facility. Fourth, we did not evaluate admission trends among stroke survivors.

In conclusion, the present study confirms that Turkish stroke survivors begin inpatient rehabilitation program later than patients in other countries. Patients diagnosed with HS are unlikely to be admitted early to inpatient rehabilitation programs, whereas undergoing acute stroke care in a teaching hospital is positively associated with early referral to post-stroke inpatient rehabilitation.

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