

Weekend versus Weekday Admission and In-Hospital Mortality from Ischemic Stroke in Japan

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Background: The initial treatment of acute ischemic stroke critically affects patient outcome. Patient outcome may also be associated with the day of hospital admission due to differences in the number of the hospital staff between weekdays and weekends. We aimed to assess the effect of weekend admission on in-hospital mortality among patients with ischemic stroke in Japan. *Methods:* We analyzed patients with ischemic stroke from a large nationwide administrative dataset. The patients were grouped according to the treatment ward to which they were initially admitted: a general medical ward (GMW) or an intensive or stroke care unit (S-ICU). The primary outcome, in-hospital mortality, was compared between the patients admitted on a weekday versus weekend according to the initial treatment ward. A generalized estimated equation was applied for multivariate analysis. *Results:* In total, 47,885 patients were included in the study. Of these patients, 32.0% were admitted to an S-ICU and 27.8% were admitted to a GMW on a weekend. The estimated in-hospital mortality rate was significantly higher among the patients admitted to a GMW on a weekend compared with those admitted on a weekday (7.9% versus 7.0%), but this difference was not significant after adjusting for the patients' background characteristics. The estimated in-hospital mortality rates of the patients admitted to an S-ICU were similar between weekend and weekday admissions (10.0% versus 9.9%). *Conclusions:* No significant effect of weekend admission in-hospital mortality was observed in our study population regardless of the initial treatment ward. **Key Words:** Weekend effect—hospital mortality—ischemic stroke—Japan—generalized estimated equation.
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Introduction

Initial treatment is critical for the acute management of stroke, impacting patient mortality and quality of life. However, the efficacy of initial stroke treatment may be

associated with the day of admission because the number of hospital staff may decrease during the weekend, causing delays in initiating treatment. Previous studies have investigated how this difference in the day of admission, which has been recognized as the “weekend effect,” impacts the outcomes of patients with stroke. The weekend effect on other diseases, such as myocardial infarction and pulmonary embolism, has also been investigated.^{1,2}

Evidence for the weekend effect on stroke is inconsistent. For example, studies in North America suggested that the weekend effect alters patient mortality, even after risk adjustment³⁻⁵; a Scottish study demonstrated increased mortality due to weekend admission⁶; and a Japanese study of 1134 patients at 10 stroke centers demonstrated that weekend admission impacts patient outcomes, including in-hospital mortality and the modified Rankin Scale (mRS).⁷ However, several other studies did not observe a weekend effect on mortality.⁸⁻¹³ Interestingly, the results of these studies are inconsistent in

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Received June 10, 2015; revision received July 29, 2015; accepted August 9, 2015.

Source of funding: This study was supported by a Grant-in-Aid for Research on Policy Planning and Evaluation from the Ministry of Health, Labour and Welfare, Japan (H26-Seisaku-Shitei-011).

The authors declare that they have no conflict of interest.

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<http://dx.doi.org/10.1016/j.jstrokecerebrovasdis.2015.08.010>

terms of other outcomes, such as thrombotic use, length of stay (LOS), and mRS score.¹¹⁻¹³

In our previous study, we compared the efficacy of initial stroke treatment provided in a stroke care unit (SCU) to that provided in a general medical ward (GMW).¹⁴ According to the Japanese National Health Insurance fee table, the hospital staff in a GMW is allowed to decrease on weekends, whereas intensive units, such as intensive care units and SCUs, require the same level of hospital staffing regardless of the day and time. American studies suggested that weekend effects were overcome by treating patients in a comprehensive stroke center.⁸⁻¹⁰ Therefore, we hypothesized that the weekend effect would be different between the treatment wards to which the patients were initially admitted. Because a previous Japanese study investigated a stroke center,⁷ we designed our study to compare the weekend effects according to the treatment ward using nationwide administrative data.

In the present study, we investigated whether the weekend effect influenced the outcomes of the acute management of patients with ischemic stroke and whether the weekend effect was associated with the type of treatment ward.

Methods

Study Population and Data Sources

The data source for this study was the Diagnostic Procedure Code (DPC) dataset, which consists of administrative data gathered during acute phase hospitalization and is used for reimbursement in Japan. The DPC data, which include patient background information such as age, sex, comorbidities, and disease severities, are classified according to the most resource-consuming disease during hospitalization. We identified patients who were diagnosed with ischemic stroke (based on the 10th version of the International Classification of Disease code I63) as the most resource-consuming disease and who were discharged between 2010 and 2011. During this study period, 50.4% of the hospitals in Japan adopted the DPC and its reimbursement system, and our data included approximately 68% of these hospitals. We included patients who were aged 15 years or older and who were hospitalized within 1 day of disease onset. We excluded patients who died before hospitalization. This study was approved by the ethics committee of Tokyo Medical and Dental University.

Outcomes and Variables of Interest

The primary outcome was in-hospital mortality, and the secondary outcomes were the mRS score at discharge, the LOS, and the total cost of hospitalization. We investigated whether in-hospital mortality or each secondary outcome was associated with the date of admission (weekend compared to weekday). Our definition of weekend

admission was hospitalization on Saturday or Sunday or on a national holiday, including the year-end and New Year holidays. The previous study showed that early intensive treatment at an SCU was significantly associated with a reduced risk of in-hospital mortality compared to treatment at a GMW.¹⁴ Additionally, it was considered that patient background may be different between those initially admitted to an intensive treatment ward and a general ward. Therefore, the analysis was independently conducted according to the type of ward, either an intensive treatment ward or GMW. We selected intensive or stroke care units (S-ICUs) as intensive treatment wards for this analysis. For example, a patient admitted to an intensive care unit on a weekend was categorized in the intensive treatment group. Most of the patients who were initially treated at an intensive care ward were transferred to a general ward after several days and were treated at the general ward until discharge.

We stratified LOS and cost of hospitalization according to their mean values as employed in a recent study¹²; we also defined mRS score as a binary outcome. A patient exhibiting an mRS score of 2 or less at discharge was defined as experiencing a favorable outcome.

Statistical Analysis

The patients' disposition was examined according to the day of the week. We compared the patients' background characteristics between weekend and weekday hospitalizations according to the type of treatment ward at admission. The continuous variables were expressed as the means and standard deviations, and differences were assessed using the *t*-test. The categorical variables were compared using the chi-square test or Fisher's test. Then, the unadjusted in-hospital mortality rate, the mRS score at discharge, cost, and LOS were calculated according to the type of treatment ward and were compared between weekend and weekday admissions. For multivariate analysis, the patients' background characteristics, the treatment volume of the hospital, and the population size in the region of the hospital were used as adjustment variables. Both treatment volume and population size were categorized into quartiles. We applied a generalized estimated equation with a robust estimator to assess the relationship between weekend admission and the outcomes considering hospital-level correlation. The significance level was defined as a *P* value of less than .05.

Results

A total of 47,885 patients were fulfilled our inclusion criteria. Among these patients, 12,503 patients were admitted to an S-ICU; 32.0% of whom were admitted on a weekend; and 35,382 patients were admitted to a GMW, 27.8% of whom were admitted on a weekend (Table 1). The number of patients admitted to a GMW on a

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