# Early versus late rehabilitation for stroke survivors: A prospective study

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## Article Info

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## Abstract

The aim of this study was to examine the optimum time of rehabilitation initiation after stroke in terms of disabilities, mobility and fall risk assessment. Data were collected prospectively at seven tertiary level health care centers in Bangladesh during the 36 months period from 2013 to 2016. All respondents were divided into four groups based on the initiation of rehabilitation as: a) 0-24 hours, b) 25-72 hours, c) 4-7 days and d) 8-60 days. Results show that significant improvement on stroke recovery, disabilities reduction, improvement in mobility restriction and reduction of fall risks in all the four groups but more improvement was observed in 0-24 hour's group during follow-up after 3 and 12 weeks. On multinomial logistic regression analysis, the independent factors shows the mobility restriction and fall risk were more in the younger patients, male gender, married, hemorrhagic lesion and bilateral stroke.

## Introduction

Stroke is one of the top leading causes of death and disability in the Western countries.[1,2] The rehabilitation of stroke survivor is a complex customized process planned for restoring the function of disabled to perform daily living activities and providing patient education, training and support for the stroke patient and the care giver family member(s).[3] The magnitude of stroke related disabilities are high. The current data supporting the effectiveness of rehabilitative interventions, time point for rehabilitation initiation are limited.[4-6] Many researches are being conducted for the innovative rehabilitation for stroke survivor. It is recommended, the stroke rehabilitation starts as soon as the diagnosis is made and non-progressive. Some studies suggest that the outcome is better in stroke survivor who was mobilized and encouraged to resume self-care activities as soon as the possible after stroke.[7-9] The better clinical outcomes are accomplished when the patient is treated in a comprehensive rehabilitation unit.[10,11] There are also controversial issues like the outcomes of rehabilitation in relation to age,[12,13] stroke severity, the severity of the stroke disability[14,15] and the optimal duration [3] of intensive hospital rehabilitation. The rehabilitation is a complex continuous ongoing and changing process of multidisciplnary medical, physical, psychological and social measures.[16] The objective of this study was to examine the optimum time of rehabilitation initiation after stroke in terms of disabilities, mobility and fall risk assessment at various time point.

## Materials and Methods

This multicentre study was conducted in seven tertiary level hospitals in Bangladesh (Bangabandhu Sheikh Mujib Medical University, Dhaka Medical College, Feni Diabetic Hospital, BIRDEM General Hospital, SPRC & Neurology Hospital, Rangpur Medical College and Shaheed Suhrawardi Medical College) among the stroke patients diagnosed by the physicians, radiologically confirmed by computed tomography and Magnetic resonance imaging. Initially 235 respondents were enrolled according to the census method respecting inclusion and exclusion criteria. Recurrent stroke and severe other co-morbidity like the aspiration pneumonia, acute heart failure was excluded from the study. Within the one week, 15 patients dropped out from the study due to the transfer to another hospital, voluntarily withdrawal from the hospital and died due to complications of stroke. Finally, we consider 220 patients as the sample size. Data were collected prospectively for 36 months period from 2013 to 2016. All the respondents were divided into four groups based on the duration of stroke and rehabilitation: a) 0-24 hours (very early); b) 25-72 hours (early); c) 4-7 days (intermediate) and d) 8-60 days (late). The dependent variables were the severity of the stroke, disability, mobility and fall risk. Independent variables

are the age, sex, occupation, body mass index, site of lesion, duration of stroke, co-morbidity, rehabilitative interventions, NIH score.

**Patient Monitoring**

The patients were evaluated at each center by the treating physiatrist during enrollment, after 3 and 12 weeks. Just after admission, the treating physician performed a complete clinical examination and recorded on the data sheet. Socio-demographic data of the patients and the time between occurrence of stroke and commencement of rehabilitations was recorded. Stroke severity was assessed by NIHS scale. Stroke survivals residual disabilities,[17, 18] mobility restriction and fall risk were assessed by using modified Barthel index, Rivermead mobility index and Berg balance scale respectively during the enrollment in this study. All clinically relevant events including death, acute illnesses and admissions to the other hospital for stroke recurrences or other complications happening during the study period were recorded. Any interruption in the rehabilitation process which lasted for 1 week or more was also recorded. The stroke severity, stroke survivals residual disabilities, mobility restriction and fall risk were assessed using the NIHS scale, modified Barthel index, Rivermead mobility index and Berg balance scale after 3 and 12 weeks follow-up. The patients who did not come for the scheduled follow-up impulsively were communicated by mobile phone. If the patient died, the information was also collected concerning the date of death and its possible cause.

**Statistical Analysis**

The outcomes among the groups were compared by the cross tabulation tests. Multivariable analysis was done using logistic regression to find out the independent association between the variables. The Statistical Package for the Social Sciences (SPSS16.0) was used for computing the data.

## Results

The mean age was 62.5 years. About 52% were male. The women were older. Surprisingly, all respondent were right handed. Left cerebral lesion was predominant in both gender 57% and 52% in female and male respectively. The incidence of ischemic stroke was a bit more than that of the hemorrhagic stroke. Approximately 95% respondents were hypertensive whereas 39% were diabetic. The mean and median NIHS score was 11.0 and 11.8 respectively during enrolment. Among all respondents, approximately 11, 45, 25 and 18% were belongs to the very early, early, intermediate and late group of the patients. On multinomial logistic regression analysis (Table I), factors independently associated with more disabilities, mobility restriction and fall risk included younger age (<60years) (aOR=0.43, CI=0.22-0.89; aOR=0.02, CI=0.07-0.04 and aOR=0.17, CI=0.007-0.04), male patient (aOR=0.21, CI=0.04-0.96; aOR=3.03, CI=1.14-8.01 and aOR=3.03, CI=1.14-8.01), having 6-10 class education (aOR=6.57, CI=1.19-36.29; aOR=8.39, CI=1.71-41.15 and aOR=8.39, CI=1.71-41.15), hemorrhagic stroke (aOR=0.21, CI=0.06-0.72; aOR=2.31, CI=1.18-4.52) and bilateral lesion (aOR=122.43, CI=24.48-612.22 and (aOR=122.43, CI=24.48-612.22) at twelve week's follow up after rehabilitation initiation assessed with modified Barthel Index, Rivermead mobility Index and Berg Balance Scale respectively. During enrollment, the stroke severity was mild 22.7%, moderate 63.6% and severe 13.6% on NIHSS score (Table II). None was in full recovery state during

**Table I**

**Multiple logistic regression analysis**

| | Modified Barthel index for disability | | Rivermead mobility Index (High to moderate mobility restriction) | | Rivermead Mobility Index (High to medium fall risk) | |
|---|---|---|---|---|---|---|
| Covariates | Adjusted OR | 95% CI | Adjusted OR | 95% CI | Adjusted OR | 95% CI |
| Age <60 years | 0.43 | 0.22-0.89 | 0.02 | 0.07-0.04 | 0.17 | 0.007-0.04 |
| Male | 0.21 | 0.04-0.96 | 3.03 | 1.14-8.01 | 3.03 | 1.14-8.01 |
| Education 6-10 class | 6.57 | 1.19-36.29 | 8.39 | 1.71-41.15 | 8.39 | 1.71-41.15 |
| Married | 2.29 | 0.67-7.94 | 0.03 | 0.01-0.07 | 0.03 | 0.008-0.07 |
| Hemorrhagic | 0.21 | 0.06-0.72 | 2.31 | 1.18-4.52 | 2.31 | 1.18-4.52 |
| Stroke site cerebellar | 0.21 | 0.03-1.13 | 1.16 | 0.24-5.64 | 1.16 | 0.24-5.64 |
| Bilateral | 7.04 | 1.94-25.53 | 122.43 | 24.48-612.22 | 122.43 | 24.48-612.22 |
| Enrolment week 3 | 1.83 | 0.83-4.02 | 5.28 | 2.62-10.64 | 5.28 | 2.62-10.64 |
| Enrolment week 12 | 17.31 | 8.39-35.71 | 25.57 | 11.36-57.53 | 25.57 | 11.36-57.53 |

Reference categories: Age >60, Female, Education other than class 6-10, Other than married, Ischemic stroke, Stroke site cerebrum and during enrollment respectively

**Table II**

**Modified Barthel index for disability; Rivermead mobility index for mobility and Berg balance scale for fall risk assessment at different time point**

| | During enrollment | | | | p value | After 3 weeks | | | | p value | After 12 weeks | | | | p value |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Very Early | Early | Interme-diate | Late | | Very Early | Early | Interme-diate | Late | | Very Early | Early | Interme-diate | Late | |
| *Severity of stroke* | | | | | | | | | | | | | | | |
| Full recovered | 0 | 0 | 0 | 0 | 0.001 | 5 | 25 | 0 | 5 | <0.001 | 10 | 30 | 5 | 10 | 0.009 |
| Mild | 5 | 35 | 5 | 5 | | 5 | 40 | 35 | 30 | | 15 | 55 | 40 | 25 | |
| Moderate | 20 | 50 | 40 | 30 | | 15 | 25 | 15 | 0 | | 0 | 10 | 10 | 5 | |
| Severe | 0 | 15 | 10 | 5 | | 0 | 10 | 5 | 5 | | 0 | 5 | 0 | 0 | |
| *Severity of dependence on modified Barthel index* | | | | | | | | | | | | | | | |
| Total dependence | 15 | 55 | 25 | 20 | 0.011 | 0 | 30 | 20 | 0 | <0.001 | 0 | 5 | 0 | 0 | <0.001 |
| Sever dependence | 10 | 35 | 30 | 20 | | 15 | 45 | 25 | 35 | | 0 | 25 | 30 | 0 | |
| Moderate De-pendence | 0 | 10 | 0 | 0 | | 10 | 15 | 10 | 5 | | 15 | 50 | 15 | 30 | |
| Slight Independ-ent | 0 | 0 | 0 | 0 | | 0 | 5 | 0 | 0 | | 5 | 10 | 0 | 5 | |
| Independent | 0 | 0 | 0 | 0 | | 0 | 5 | 0 | 0 | | 5 | 10 | 10 | 5 | |
| *Mobility assessment on Rivermead mobility index* | | | | | | | | | | | | | | | |
| High restriction | 20 | 75 | 50 | 40 | <0.001 | 15 | 50 | 45 | 30 | <0.001 | 10 | 30 | 10 | 10 | <0.001 |
| Moderate re-striction | 5 | 15 | 0 | 0 | | 5 | 25 | 0 | 10 | | 0 | 0 | 20 | 20 | |
| Low restriction | 0 | 10 | 5 | 0 | | 5 | 25 | 10 | 0 | | 15 | 70 | 25 | 10 | |
| *Severity of fall risk on Berg balance scale* | | | | | | | | | | | | | | | |
| High fall risk | 15 | 75 | 50 | 40 | <0.001 | 10 | 45 | 45 | 35 | <0.001 | 0 | 15 | 10 | 0 | <0.001 |
| Medium fall risk | 5 | 15 | 0 | 0 | | 5 | 30 | 5 | 5 | | 10 | 25 | 30 | 25 | |
| Low fall risk | 5 | 10 | 5 | 0 | | 10 | 25 | 5 | 0 | | 15 | 60 | 15 | 15 | |

enrollment among all respondents. During follow up after 12 weeks 40, 30, 9 and 25% respondents were fully recovered in 'very early', 'early', 'intermediate' and 'late' group respectively. The observed improvement is statistically significant where p value was 0.009. Residual disabilities were assessed with modified Barthel index (shown in Table II). Among all respondent 60, 55, 45 and 50% were total dependent in very early', 'early', 'intermediate' and 'late' group respectively and none was independent state during enrollment among all respondents in modified Barthel Index. During follow up after 12 weeks 0, 30, 36 and 0% respondents were total dependent in 'very early', 'early', 'intermediate' and 'late' group respectively whereas 20, 10, 18 and 12.5% respondents were Independent in 'very early', 'early', 'intermediate' and 'late' group respectively. Improvements were observed among respondents of all four groups but further significant improvement is observed in very early patients group where p value was 0.000 in the modified Barthel index at 3 and 12 weeks follow-up. Mobility was assessed with Rivermead mobility index (Table II). Among all respondent 60, 55, 45 and 50% were high mobility restriction in very early', 'early', 'intermediate' and 'late' group respectively during enrollment. During follow-up after 12 weeks 0, 5, 0 and 0% respondents were high mobility restriction in 'very early', 'early', 'intermediate' and 'late' group respectively. Improvements were observed among respondents of all four groups but further significant improvement is observed in very early patients group where p value was 0.000 in Rivermead mobility index at 3 and 12 weeks follow-up. Fall risk was also assessed with Berg balance scale. Among all respondent 60, 75, 90 and 100% had high fall risk in very early', 'early', 'intermediate' and 'late' group respectively. During follow up after 12 weeks 0, 15, 18 and 0% respondents had high fall risk in 'very early', 'early', 'intermediate' and 'late' group respectively. Improvements were observed among respondents of all four groups but further significant improvement is observed in very early patients group where p value was 0.000 in the modified Barthel index at 3 and 12 weeks follow-up.

## Discussion

In this study, the disabilities, fall risk and mobility of patients undergoing post stroke rehabilitation at the four time points for very early, early, intermediate and late rehabilitation were investigated. The mortality is increased with age and the severity of stroke. The causes of mortality of the study population were aspiration pneumonia, stroke severity and other comorbidities which are similar to the findings of previous studies.[6] The risk of death is increased for the patients treated in 24 hours than those who were treated after 24 hours or more after stroke. The reasons behind this finding may be due to severity of stroke and associated other co-morbidities. Rehabilitation failures were significantly more common in patients with more severe disabilities during enrolment and older respondents. The pressure ulceration was associated with rehabilitation failure which is independent from age and disability. From the literature, it is known that pressure ulcers were poor prognostic indicator and were independent from the severity of disability. That's why, increased risk carried by patient was not warranted by a reduced consequent of pressure ulcer. This surveillance denotes that the risk increase in these respondents might be a result of the unenthusiastic hindrance with the rehabilitation program, which might have been sporadic, tardy, or abridged due to pressure ulcers. Strokes due to lesion in the left hemisphere had enhanced improvement than that of the right hemisphere. Accepting this difference, one hypothesis might be that lesions in the non-dominant hemisphere may cause attention deficit or hemispatial neglect. Due to unawareness about attention deficit; a reduced amount of participation in rehabilitation program and perilous deeds are observed in patients who may otherwise emerge relatively competent to physical performance. The mean age in years was 62.5. About 52% were male. Mean age of the stroke patients is similar to stroke registry in Bangladesh and Pakistan.[19, 20] According to stroke registry in USA the mean age of stroke is 71 years [21]. The women were older. Surprisingly, all respondent were right handed. Left cerebral lesion was predominant in both gender 57% and 52% in female and male respectively. A bit lower percentage of female stroke patients implies either a low prevalence of stroke among women or a limited access of women stroke patient to the tertiary care hospital which is similar to stroke registry in Bangladesh. The incidence of ischemic stroke was a bit more than that of the hemorrhagic stroke. The major risk factors are hypertension and diabetes mellitus which supports findings of previous studies that dyslipidemia, hypertension, and diabetes are important risk factors for stroke.[22-24] Similarly these two important risk factors are more common among stroke patients in Bangladesh and in Pakistan. During enrollment, the stroke severity was mild 22.7%, moderate 63.6% and severe 13.6% on NIHSS score. Recently a study was conducted among Bangladeshi population and the authors showed that 17.8% had severe stroke (NIHS scores greater than 14). The patients who had undergone into rehabilitation programs within 24 hours after stroke had better outcomes than did those who undergone after 24 hours or later. This result supports findings of preceding studies and ropes the clinical inkling of physicians that it is easier to rehabilitate patients who initiated physical bustle earlier after an acute stroke because these patients boast less physical limitations, such as spasticity,

muscular and joint functional limitation. However, patients who initiate the rehabilitation after 24 hours or later are not all necessarily restricted in their movements. It is due to advantage of brain plasticity that can take in early rehabilitation. Brain functions restoration may decline with time if the patient is not inspired to restart his/her daily living activities through appropriate rehabilitative interventions.[25] In this study, we didn't find any clean cut idea about the best possible duration of rehabilitation, and the design of this study confines us from sketch any compact conclusions. Actually, duration of rehabilitation is mostly prejudiced by its results. Patients who have shown optimal improvement in shorter times and blocked their rehabilitation untimely, achieved improvement might not persist over time. Community based rehabilitation is advised for those patients. These findings are similar with the results of a previous study[3] and they strongly suggest that this item should be more properly addressed by interventional studies.

## Conclusion

This study provides insight into the clinical observation about the optimum time of commencement of rehabilitation for stroke survivors. It is observed that commencement of rehabilitation for stroke survivors at earliest time provides better outcome. Factors independently associated with disabilities, mobility restriction and fall risk included younger age (<60 years), male patient, having 6-10 class education, hemorrhagic stroke, and bilateral lesion at twelve week's follow-up after rehabilitation initiation assessed with modified Barthel index, Rivermead mobility index and Berg Balance scale respectively.

## Ethical Issue

The protocol was proved by the Institution Review Board of the Bangabandhu Sheikh Mujib Medical University (No. BSMMU/2014/789 dated 25-01-2014). The written informed consent was obtained from the patient or his/her attendant.

## Conflict of interest

Any of the authors have no competing interests regarding financial and or other interest conducting this research.

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