Changes in the physical activity of acute stroke survivors between inpatient and community living with early supported discharge: an observational cohort study

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Abstract

Objective To describe and compare patterns of physical activity among stroke survivors during their hospital stay and community living with early supported discharge.

Design Observational cohort study of physical activity before and after early supported discharge.

Setting UK National Health Service stroke units and participants' homes.

Participants Forty-one stroke survivors, aged 69 (standard deviation 11) years, with a median Modified Rivermead Mobility Index of 33.5 [interquartile range (IQR) 25.8 to 35.3].

Main outcome measures The primary outcome measures were time spent in sitting/standing/walking and number of steps taken, as recorded by a physical activity monitor.

Results There were statistical differences ($P<0.001$) for all categories of physical activity. After early supported discharge to the community, participants took more than twice the number of steps [median 842 (IQR 1110) vs 2260 (IQR 3459] and spent more than double the time in standing [median 102 (IQR 124) minutes vs 196 (IQR 219) minutes] compared with their hospital stay.

Conclusion Community living with early supported discharge promoted higher levels of physical activity in medically stable stroke survivors. The near-doubling of activity may serve as a guideline for what is achievable during stroke rehabilitation.

Clinical Trial Registration UKCRN 15472.

Keywords: Observational study; Stroke; Rehabilitation; Walking; Physical fitness

<A>Introduction

The physical rehabilitation of stroke survivors is based around movement [1]. This physical activity is central to the recovery of motor skills impaired by stroke, with evidence of the positive relationship between activity and recovery continuing to emerge [2]. Physical activity is also a recognised factor in preventing future health problems, with recommendations of 20 to 60 minutes of moderate-intensity physical activity on 3 to 5 days per week during the rehabilitation period [3]. Furthermore, physical activity is important for the prevention of early medical complications associated with immobility [4]. Recent work, however, has quantified very sedentary behaviours among stroke survivors [5,6]. A recent behavioural mapping exercise categorised 74% of daytime activity as ‘sedentary’ in stroke patients (*n*=104) during their stay at a rehabilitation facility [7], and these observations are echoed across the general stroke population [8].

Early supported discharge is now the preferred option for stroke survivors who are medically stable and can be supported at home. A recent meta-analysis produced robust evidence that survivors with mild-to-moderate disability receiving early supported discharge with a co-ordinated multidisciplinary team had better functional outcomes at follow-up (median 6 months, range 3 to 12 months) than survivors receiving conventional, inpatient care [9]. What is not known is the mechanism through which this improved response occurs, with possible factors including less dependency on carers and a more tailored care and rehabilitation package [9]. It is possible that, through re-engagement with familiar domestic and social roles, a stroke survivor naturally increases the intensity and frequency of their physical activity, with the consequent positive effect on motor recovery and physical health. On the other hand, early supported discharge may have a deleterious effect on a stroke survivor’s physical activity through reduced contact with rehabilitation therapists. Any change in physical activity is likely to be affected by a range of medical and demographic factors, such as severity of stroke, co-morbidities and age.

Technological advances in body-worn sensors, such as accelerometers, provide simple, widely accepted solutions for measuring physical activity in clinical populations such as stroke survivors [10]. The activPal [Paltechnologies, Glasgow, UK] has been validated across a number of healthy (children, adults and older adults) and clinical populations, and has been applied successfully to stroke populations [6]. This instrument categorises physical activity into four behaviours: lying, sitting, standing and walking. The activPal has the capacity to record data over 14 days at 10 Hz. The major advantage of this instrument is that it is small (credit-card sized) and lightweight (<15 grams). Being applied to the thigh, it also minimises intrusion for the participant.

In order to better understand the effect of early supported discharge on physical activity, a cohort observational study of stroke survivors before and after early supported discharge was designed.

<B>Primary aim

The primary aim of this study was to quantify the physical activity behaviour of stroke survivors discharged from the acute hospital setting to community living with early supported discharge.

<B>Secondary aims

The secondary aims were: (1) to compare levels of physical activity between inpatients and those living in the community with early supported discharge; and (2) to investigate participant and service factors that may influence physical activity (i.e. changes in mobility levels and time delay to discharge).

<A>**Methods**

<B>Design

This was an observational cohort study of the physical activity behaviours of stroke survivors before and after discharge from an acute hospital to the community with early supported discharge. The protocol and informed consent process were approved by the West of Scotland Research Ethics Committee (13/WS/0150).

<B>Participants

Potential participants were identified by the clinical team and recruited by a clinical trials nurse from two acute hospital sites within the Lanarkshire Health Board area using the following inclusion criteria: clinical diagnosis of stroke, medically stable and referred for early supported discharge, with a discharge date arranged in the near future but not within the following 48 hours. Patients considered to be lacking in capacity to provide informed consent due to significant language problems or cognitive impairment were excluded. A target sample size of 40 was considered feasible while providing sufficient data to identify and test statistical patterns within the dataset.

<B>Data collection

Following informed consent and during their inpatient stay, a research nurse fixed a single tri-axial accelerometer (PalTechnologies, Glasgow, UK) to each participant's thigh (non-paretic side, for consistency) using waterproof materials. Data were sampled at 20 Hz and categorised, using manufacturer software (PalTechnologies), into four physical activity behaviours: (1) time (minutes) spent sitting or lying; (2) time (minutes) spent standing; (3) time (minutes) spent walking; and (4) number of steps taken. The following baseline data were recorded: (1) mobility, using the Modified Rivermead Mobility Index [11]; (2) stroke type (haemorrhagic or infarct); and (3) demographic data, including age, sex and if they lived alone. After 48 continuous hours of data collection, excluding weekend hours, the accelerometer was removed and the data were downloaded. A follow-up home visit was arranged once the participant had been discharged with the early supported discharge team. At this visit, which was arranged within 1 week of discharge, the Modified Rivermead Mobility Index was recorded and the accelerometer was fixed to the participant's thigh, following the same protocol as above, for a further 48 hours. The number of therapy sessions during each of the observational periods (hospital and early supported discharge) was recorded from the medical notes.

<B>Statistical analysis

Data were first assessed for normality using histogram plots and Ryan Joiner tests. This showed that the data were not normally distributed (Ryan Joiner values ranged between 0.79 and 0.95; $P<0.01$). Accordingly, to address the primary aim, the data were described using median and interquartile range (IQR). For the secondary aims, the data were tested for significant differences using the Wilcoxon signed rank test. The influence of factors such as time delay (number of days between measurement periods) and change in mobility (difference between Modified Rivermead Mobility Index scores at baseline and at home visit) were assessed with scatterplots and tested with Spearman's rank correlation coefficient, as the distribution of the data did not lend it to regression analysis.

<A>Results

Forty-one participants were recruited and consented from 169 patients who were discharged home with early supported discharge during the study recruitment period. Participants had an average age of 68 [standard deviation (SD) 11] years, height of 1.7 (SD 0.2) m and weight of 74.1 (SD 19.2) kg. Nineteen participants were male and 14 lived on their own during the period of observation. All participants had been diagnosed with a recent stroke; the majority (38/41) had suffered an infarct stroke and three had suffered a haemorrhagic stroke. Median length of inpatient hospital stay was 44 (IQR 18 to 62) days. Mobility varied between 9 and 40 (maximum possible score) on the Modified Rivermead Mobility Index, with a median of 33.5 (IQR 25.8 to 35.3). Data from both assessment periods were not available for four participants due to a technical fault (*n*=1), voluntary withdrawal (*n*=2, skin irritation and feeling unwell), and not being able to contact participants after hospital discharge (*n*=1); data from these participants were omitted from the analysis. The number of rehabilitation sessions during the data collection period was slightly higher in the stroke unit [mean number of sessions in the 48-hour period 3 (SD 1.3)] compared with early supported discharge [mean number of sessions 2 (SD 0.8)]. The average time delay between measurement sessions (hospital and community) was 9 (SD 4) days.

During their hospital stay, participants spent a median of 1381 (IQR 1345 to 1418) minutes per day (95.9%) in sedentary positions (sitting/lying) including periods of sleep, with a median of 51 (IQR 22 to 128) minutes per day (3.5%) spent standing and 11 (IQR 5 to 14) minutes per day (0.7%) spent walking. Following early supported discharge, participants approximately doubled this level of activity with a median of 100 (IQR 51 to 178) minutes per day (7.0%) standing and 26 (IQR 13 to 42) minutes per day (1.8%) walking. Consequently, the cohort spent less time in sedentary behaviours at home, with a median of 1349 (IQR 1256 to 1402) minutes per day lying/sitting. The number of steps taken per day showed similar differences between locations; a median of 474 steps (IQR 189 to 773) were taken in hospital compared with 1193 (IQR 512 to 2856) at home (see Table 1 and Fig. 1).

These differences in physical activity between the two locations were found to be statistically significant (*P*<0.001), according to the Wilcoxon signed ranked test.

<insert Table 1 and Figure 1 near here>

No relationship was evident between changes in physical activity and either change in Modified Rivermead Mobility Index or time difference between the observation periods. Spearman's ranked correlation coefficients ranged between 0.17 and 0.31.

<A>Discussion

To the authors' knowledge, this is the first study to measure physical activity behaviour in acute stroke survivors before and after discharge from a stroke unit to early supported discharge. Very low levels of physical activity were recorded among these medically stable stroke survivors during their inpatient stay, with a daily median of 51 minutes standing and 11 minutes walking. Following discharge home with early supported discharge, there was an approximate doubling of activity for these same stroke survivors. These increases were not statistically associated with changes in mobility or time between measurements.

These results support previous findings of low levels of physical activity in acute stroke units [5,6]. Reasons for this are likely to be caused by organisational as well as patient constraints. One factor, identified by Bernhardt *et al.* [5], was the amount of time spent alone during the day (average of 60%); a factor that may explain some of the positive effect of early supported discharge on physical activity, where social experiences are more likely to occur. Of course, the requirement to attend to personal and domestic activities may also be important. The higher levels of physical activity recorded during early supported discharge are consistent with reports of one to two upright hours per day from chronic stroke survivors living in the community [12], but still remain below recommended levels for health [13].

A major goal for the rehabilitation of stroke survivors is to return to the type and level of physical activity associated with living in the community [14]. These results suggest that early supported discharge helps stroke survivors attain this goal. Askim *et al.* demonstrated that stroke survivors can be physically active for up to 20% of waking time; a value that approximates the amount attained by the stroke participants in this study during their early supported discharge experience [15]. At the very least, the levels of activity attained by acute stroke survivors during early supported discharge (approximately 2 hours of standing activity per day) could be a useful target for rehabilitation teams.

This study has some limitations. The authors did not have ethical approval to keep a screening log of stroke patients who were not approached to enter the study, and therefore it is not known how many of the 169 patients discharged with early supported discharge during the recruitment period were eligible for the study. As subjects with significant cognitive and language difficulties were excluded from this study, it is not known whether these patients would gain similar benefits from community discharge with early supported discharge teams as other stroke subjects. A time delay of 9 days between measurement sessions introduces the factor of recovery time, although this was not supported by the supplementary analyses. The long median inpatient duration of stay (longer than most stroke patients) suggests that the authors may have selected a more chronic group of discharges, perhaps at a plateau in their recovery. Finally, the early supported discharge service used in this study is highly developed, so these results may not be generalisable to other settings and services.

Future studies may consider measuring over even longer periods to improve data validity, and using control groups to explore the risk of bias with this type of measurement. They should include subjects discharged from hospital much earlier post stroke, and from a variety of services using different early supported discharge team models. The positive effect of early supported discharge found in this observational study should be confirmed with larger samples that include participants with cognitive and language deficits (with appropriate ethical arrangements in place). Future work should also include interviews and behavioural diaries; in this way, the motivation behind the reported increase in physical activity can be better determined to the benefit of future interventions.

<A>Conclusion

This observational cohort study found that stroke survivors double their levels of physical activity when moving from hospital-based rehabilitation to community living with early supported discharge. This improvement was unrelated to changes in mobility or time delay between data collection periods. These findings support the use of early supported discharge in stroke care, and provide practical physical activity targets for stroke units prior to discharge.

Ethical approval: Ethical approval for the study was granted by the West of Scotland Ethics Committee (REC 3), Reference 13/WS/0150.

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Conflict of interest: None declared.

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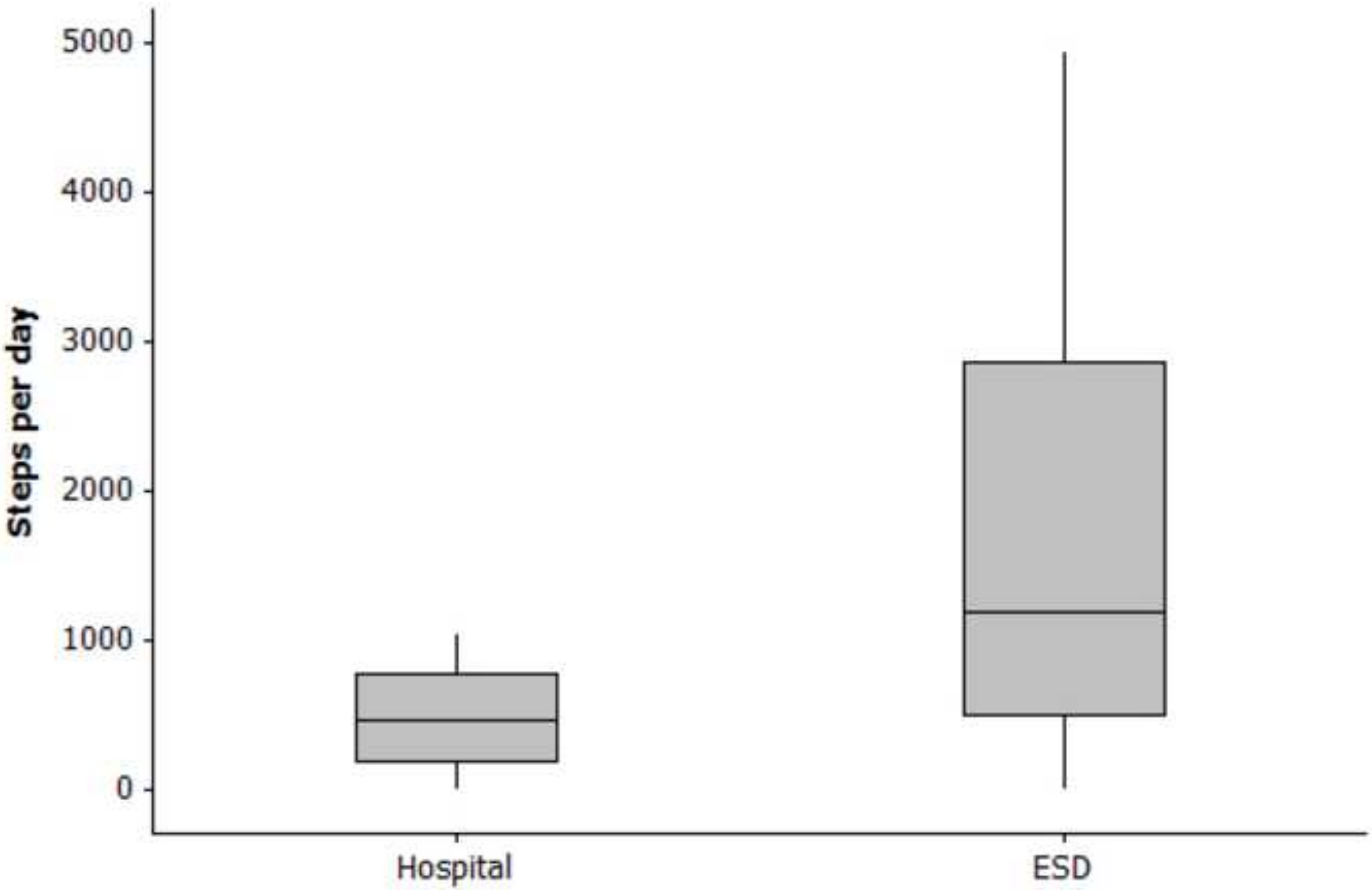
Table 1

Median (interquartile range) physical activity during hospital and community periods

Activity	Hospital	Community	Median difference (95% CI)
Sitting/lying time (minutes/day)	1381 (1345 to 1418)	1349 (1256 to 1402)	-47 (-81 to -6)
Standing time (minutes/day)	51 (22 to 128)	100 (51 to 178)	28 (11 to 68)
Stepping time (minutes/day)	11 (5 to 14)	26 (13 to 42)	14.0 (6 to 18)
Number of steps	474 (189 to 773)	1193 (512 to 2856)	636 (262 to 931)

CI, confidence interval.

Fig. 1. Boxplot of number of steps taken during hospital and early supported discharge (ESD) periods.


5000
4000
3000
2000
1000
0
Steps per day
Hospital
ESD

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