Physical activity by elderly patients undergoing inpatient rehabilitation is low: an observational study

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Question: Are there differences in physical activity between older adults undergoing inpatient rehabilitation and those living in the community? Are there differences in physical activity within and between these two groups on weekdays compared to weekends? Are there differences in physical activity within and between these two groups over the day? **Design**: An observational study. **Participants**: Twenty-five elderly patients (aged 81 years) undergoing rehabilitation and 25 age- and gender-matched community-dwelling people (aged 80 years). **Outcome measures**: The Positional Activity Logger was used to measure the frequency and duration of time spent upright (uptime), over three consecutive days, including a weekend day. **Results**: The inpatient group achieved a median daily uptime of 1.3 hours which was significantly less than the community group's median of 5.5 hours ($p < 0.001$). Uptime for inpatients was significantly greater on weekdays (1.6 hours) when therapy was available than on weekend days (1.1 hours) when therapy was generally not available ($p < 0.001$), whereas uptime for community participants was no different on weekdays (5.9 hours) than on weekend days (4.8 hours) ($p = 0.05$). Median uptime was significantly less for the inpatient group than for the community group at all times of day ($p < 0.001$). **Conclusion**: Elderly patients undergoing rehabilitation spend much of the day less physically active than their community peers. **[Smith P, Galea M, Woodward M, Said C, Dorevitch M (2008) Physical activity by elderly patients undergoing rehabilitation is low: an observational study. *Australian Journal of Physiotherapy* 54: 209–213]**

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Introduction

Inpatient rehabilitation units provide treatment programs designed to optimise functioning and, wherever possible, return people to their own homes. Traditionally inpatient rehabilitation is provided on weekdays and during business hours; thus many patients undergoing rehabilitation spend a significant proportion of their waking time inactive, or involved in activities that contribute little to their recovery (Lincoln et al 1989, Mackey et al 1996, Tinson 1989). The importance of physical activity in the treatment of the hospitalised elderly inpatient has received increasing attention (Creditor 1993, McCusker et al 2002), but unfortunately many aspects of hospital-based activity are still poorly understood. There is evidence, however, that the hospital environment does not necessarily promote normal activity patterns (Brown et al 2004). Since the aim of rehabilitation is to prepare people for function on discharge from hospital it is of interest to compare activity patterns of inpatients with those of community-dwelling older adults. Obtaining an accurate measurement of the levels and patterns of physical activity achieved over several days by both inpatients and their community-dwelling peers would be a step towards evaluating the current rehabilitation service and developing recommendations for minimum physical activity levels for patients.

For the older person, time spent in the upright position, or 'uptime', could be an important indicator of function and recovery (Bernhardt et al 2005). Uptime provides a measure of a person's ability to stand, walk, and move around in the upright position (Eldridge et al 2003a). The Positional Activity Logger Version 1[a], is a lightweight, battery-operated, automated position sensor, which measures the frequency and duration of uptime versus downtime (sitting or lying) (Eldridge et al 2003b). The device can be worn for several days. This activity logger and its earlier version the 'Uptimer' have also been used in investigations of inpatient physical activity in children (Pirpiris and Graham 2004), adults (Browning et al 2007), and the elderly (Bernhardt et al 2005).

The specific research questions for this study were:
1. Are there differences in physical activity between older adults undergoing inpatient rehabilitation and those living in the community?
2. Are there differences in physical activity within and between these two groups on weekdays compared to weekends?
3. Are there differences in physical activity within and between these two groups over the day?

Method

Design

We conducted an observational study of physical activity of elderly inpatients undergoing rehabilitation across three days, including a weekend day, in comparison with community-dwelling age- and gender-matched people. A convenience sample of hospital inpatients was recruited from consecutive rehabilitation admissions to the two sub-acute wards managed by the Aged Care Service of Austin Health, Melbourne. This is a traditional Monday–Friday service. In addition, there is a limited three-hour service on Saturday, primarily to assess new patients admitted on Fridays or Saturdays. Data were collected from inpatients as soon after admission as possible and from community participants in their own homes. Measures of mobility were collected on the day of attachment of the activity logger. Participants wore the activity logger for three consecutive days, including a weekend day (or public holiday). To avoid bias, participants and ward staff were blinded to the purpose of the study, and participants treated by the physiotherapy investigator were excluded.

Participants

To be eligible, inpatients had to be 70 years or older, capable of giving informed consent, and to have a planned discharge destination of home. They were excluded if they: were medically unstable; were non-ambulant; had a history of skin allergy to tape or adhesive surgical dressings; had an unhealed leg wound, local skin condition, or pressure area over the attachment sites of the activity logger; had sensory loss over the attachment sites of the activity logger; or were undergoing radiotherapy.

An equal number of healthy age- and gender-matched people living in the community were also recruited from an advertisement in a local newspaper, visitors to the aged-care wards, veteran exercise groups, or friends of participants. They were excluded if they: had been an inpatient in the previous month; were unable to walk independently with or without a single-point stick; or had any neurological, cardiovascular, or orthopaedic condition limiting their mobility.

In order to describe and compare the groups, measures of mobility were collected. The Human Activity Profile (Fix and Daughton 1988) is a self-administered questionnaire designed to measure physical activity. Participants from the inpatient group were asked to give answers based on when they were well, prior to their admission to hospital, to enable comparison with the community group. Where possible, participants completed a 10 m Walk Test (Hill et al 2001). Other measures of mobility collected were Functional Ambulation Classification scores (Holden et al 1986) and Functional Independence Measure scores for ambulation and transfers from bed to chair (Hall et al 1993, Keith et al 1987).

Measurement of physical activity

Physical activity was measured as uptime using the Positional Activity Logger Version 1. It was attached to the lateral aspect of the participant's thigh as described by Eldridge et al (2003b). To protect the skin, three sheets of hypoallergenic Tegaderm®b waterproof adhesive dressing were used to hold the activity logger in place, allowing participants to shower. Uptime was measured from 00:00–24:00 each day. Data from the activity logger were downloaded to a computer for analysis using custom software (Gorman 2004). Average daily uptime was calculated by dividing total uptime in minutes by the number of days. Uptime for weekdays, weekend days, and three eight-hour periods, 01:00–09:00, 09:00–17:00 (which included participation in physiotherapy), and 17:00–01:00 was analysed. These time periods were determined *a priori*.

Data analysis

All data were tested for normality using the Shapiro-Wilk test. For parametric data, independent or paired t-tests were used for comparisons. For non-parametric data, Wilcoxon Signed Rank Test and Mann-Whitney U test were used, and 95% confidence intervals for median scores were estimated using the method described by Bland (2000). A Bonferroni correction was used to adjust the α level of significance in the case of multiple comparisons. For this study $\alpha = 0.05$ divided by 14 resulted in an alpha of 0.004.

Table 1. Characteristics of participants.

Characteristic	Inpatient group n = 25	Community group n = 25
Age *(yr)*, mean (SD)	81.0 (6.7)	80.1 (5.8)
Gender, n male (%)	16 (64)	16 (64)
Length of stay *(d)*, mean (SD)	18.7 (14.6)	N/A
Major diagnostic groups, n (%)		
Neurological	7 (28)	N/A
Musculoskeletal	9 (36)	
Cardiovascular and respiratory	2 (8)	
Other	7 (28)	
Human Activity Profile (Adjusted Activity Score *1 to 94*), med (IQR)	53 (39)	58 (17)
FIM Ambulation *(1 to 7)*, med (IQR)	5 (2)	7 (0)
FIM Transfers *(1 to 7)*, med (IQR)	6 (3)	7 (0)
FAC *(1 to 6)*, med (IQR)	5 (2)	6 (0)
Living arrangements, n (%)		
Lives alone	12 (48)	8 (32)
Lives with spouse	9 (36)	16 (64)
Lives with child	4 (16)	1 (4)
Gait velocity *(m/s)*, mean (SD)	0.62 (0.24)*	1.19 (0.25)
Stride length *(m)*, mean (SD)	0.8 (0.3)*	1.2 (0.3)
Gait aid used when tested, n (%)		
Nil	4 (16)	22 (88)
Walking stick	2 (8)	3 (12)
Frame	19 (76)	0 (0)

FIM = Functional Independence Measure, FAC = Functional Ambulation Classification; *n = 24 as one patient was unable to complete the 10m Walk Test

Table 2. Median (95% CI) minutes of uptime per day in inpatient and community groups over weekdays and weekend days for different times of day.

Time	Any day		Weekday		Weekend day	
	Inpatient group	Community group	Inpatient group	Community group	Inpatient group	Community group
00:00–24:00	78.6 (55.6 to 94.1)	331.0 (290.4 to 364.8)	94.3 (63.4 to 100.6)	352.5 (294.3 to 521.7)	63.3 (38.1 to 69.3)	287.3 (254.9 to 333.9)
01:00–09:00	15.1 (11.3 to 18.3)	76.3 (68.1 to 86.7)	14.8 (10.6 to 25.9)	81.2 (73.6 to 98.4)	9.4 (6.4 to 16.9)	72.9 (43.3 to 87.7)
09:00–17:00	49.6 (42.8 to 57.7)	175.3 (154.4 to 209.0)	56.7 (43.8 to 74.3)	182.8 (158.5 to 220.0)	32.4 (22.2 to 45.4)	161.6 (140.7 to 190.2)
17:00–01:00	11.3 (5.4 to 20.4)	77.0 (62.7 to 84.2)	13.8 (4.7 to 22.3)	77.3 (66.5 to 90.7)	8.1 (4.1 to 16.4)	58.9 (50.5 to 73.9)

Results

Participants

The flow of participants through the study is illustrated in Figure 1. Notably, 716 inpatients were screened, of whom 584 were ineligible for the study, and only 32 of the remaining 132 consented. The two main reasons for exclusion were non-competence to give consent (45%) and presence of a pressure area, ulcer, or wound (23%). Seven inpatients were withdrawn from the study after commencement of data collection. Two participants developed skin irritation (red welt) along the edge of the Tegaderm® dressing. One participant suffered a seizure requiring admission to intensive care and one participant became unwell, developing gastroenteritis. The activity logger reset itself during data collection from two participants, resulting in data being lost. One participant was discharged home prior to completion of data collection.

Eighty-three age- and gender-matched healthy participants living in the community were screened for eligibility. Of the 13 community participants excluded from the study, four developed health problems after initially expressing an interest in the study and four were found to have an allergy to adhesive dressings. Of the remaining 70, 28 community participants commenced data collection once matched with an inpatient participant. Three were withdrawn from the study, with two developing skin irritation along the edge of the Tegaderm® dressing. One participant requested that the activity logger be removed so that she could have a bath. Only data from the 25 participants remaining in each group were used for analysis.

Participant characteristics are listed in Table 1. For the inpatient group, only the principal reason for admission for each patient was documented. Only two inpatient participants received physiotherapy on a weekend day during data collection. Data collection commenced a mean 3.8 days (SD 2.3, range 1–10) after admission.

Physical activity in the inpatient group before admission, based on Adjusted Activity Scores of the Human Activity Profile, was significantly lower than that of the community group ($p = 0.005$) (Table 1). When well, prior to admission, 44% of the inpatient group required a walking aid compared to 12% of the community group. The inpatient group also had a lower level of mobility than the community group. All community participants achieved near-maximum scores on the Functional Ambulation Classification, indicating complete or modified independence for ambulation. Only one inpatient participant was unable to complete the 10 m Walk Test. The remaining 24 inpatients walked significantly slower ($p < 0.001$) with shorter steps ($p < 0.001$) than the community group.

Uptime by group

Physical activity, as measured by uptime, is reported in Table 2. Median daily uptime (average total uptime over three days) for the inpatient group was significantly less than for the community group ($p < 0.001$).

Weekday versus weekend uptime by group

There was no significant difference in median uptime in community participants on weekdays compared to weekends ($p = 0.05$). In contrast, the inpatient group had significantly reduced uptime on weekends compared to weekdays ($p < 0.001$). Since two inpatient participants received physiotherapy on a weekend day, the analysis was repeated with these participants excluded and the significant difference in activity levels persisted ($p < 0.001$). Median weekday uptime was significantly less for the inpatient group than for the community group ($p < 0.001$). Similarly, median weekend day uptime was significantly less for the inpatient group than for the community group ($p < 0.001$).

Time of day uptime by group

Median uptime was significantly less for the inpatient group than the community group for all three time periods ($p < 0.001$). Four inpatients (16%) had at least one period during which no uptime at all was registered. Community participants recorded uptime in all periods.

Time of day over weekday versus weekend uptime by group

In the community group, uptime did not differ between the weekend and weekday for any of the three time periods. In the inpatient group, uptime did not differ between the weekend and weekday for the early and late time period. However, there was significantly less uptime on the weekend day compared with the weekday during the 09:00 to 17:00 period ($p < 0.001$).

Discussion

This study demonstrated that older adults undergoing rehabilitation have very low levels of physical activity compared to their community-dwelling peers. The inpatient group achieved less than 1.5 hours of uptime per 24 hours, which was less than 25% of the median daily uptime achieved
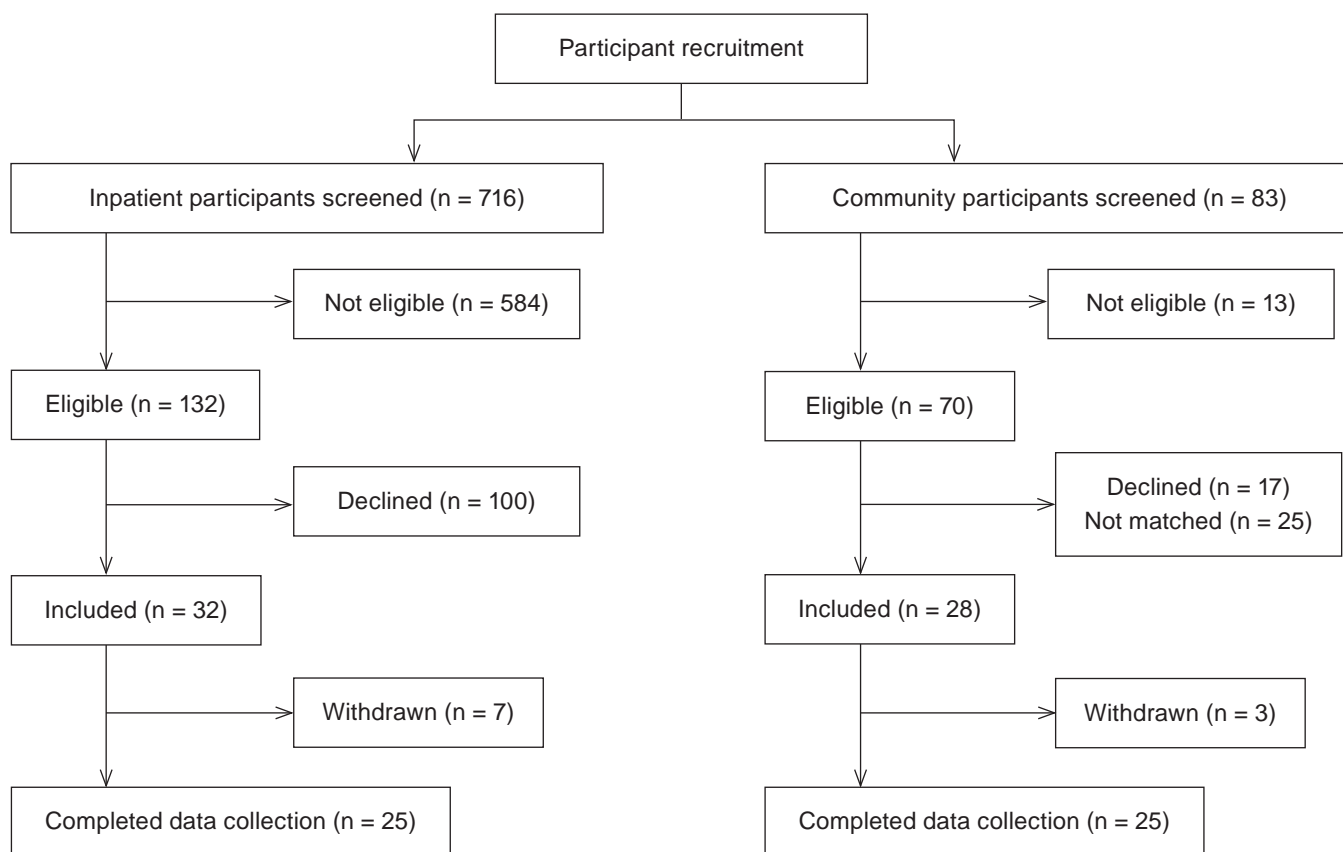
Figure 1. Flow of participants through the study.

by the community group. Inpatients spent most of the day sitting or lying, activities that may contribute little to their rehabilitation. Physical activity by the inpatients ranged from 2 minutes to almost 4 hours, suggesting that some inpatients might benefit more than others from programs aimed at increasing their physical activity levels. However, no inpatient exceeded the minimum amount of physical activity of the community group. Four inpatients recorded no uptime for at least one eight-hour period during the three-day data collection period; community participants, in contrast, recorded uptime in all periods. Currently there are no recommended guidelines for physical activity levels for inpatients undergoing rehabilitation, which makes it difficult to evaluate whether the levels of activity achieved by the inpatient group are acceptable, but we would argue that the inpatient group levels of activity are sub-optimal. The lack of activity observed in the inpatient group was similar to results from other studies of patients undergoing rehabilitation (Bernhardt et al 2005, Esmonde et al 1997).

Inpatients were inactive after 17:00, with a median of 11 minutes spent in walking or standing activities. This level of activity is modest, and for some would represent two walks to the toilet. Community participants achieved almost seven times the inpatients' median uptime after 17:00. Before 09:00, inpatients were only a little more active than after 17:00, achieving a median uptime of only 15 minutes. Community participants achieved five times the inpatients' median uptime before 09:00. Initiatives to increase levels of physical activity for inpatients should particularly target these two periods.

To our knowledge, this is the first study to demonstrate that physical activity for inpatients was significantly less on

weekend, days than on weekdays. On the weekend, when therapists were not available, inpatients achieved only two-thirds of their weekday uptime. In contrast, community participants achieved 82% of their weekday uptime, consistent with findings from other studies on elderly community-dwelling people (Kochersberger et al 1996, Matthews et al 2002). The difference in activity observed in the inpatients on weekends appears to be due to a reduction in activity during the 09:00 to 17:00 period, when therapy would usually occur during the week. This finding raises the question of whether it is cost effective to offer therapy to inpatients on weekend days, as this has the potential to increase total activity which may in turn hasten recovery thereby reducing hospital length of stay. Future studies could investigate the benefits of twilight activities and/or weekend therapy.

Strategies need to be developed that empower patients to be active. Rehabilitation services ought to be designed to entice patients to be active within and outside their rooms. There should be no confusion as to whose responsibility it is to mobilise patients (Markey and Brown 2002). All members of the multidisciplinary team and, when appropriate, family, friends and volunteers should be involved in increasing patients' physical activity levels.

Differences between the inpatient and community groups' physical activity may be partly explained by premorbid mobility, since the inpatient group was more disabled than the community group. Before admission to hospital, 24% of the inpatient group required a walking frame. While both groups were well matched for gender and age, the ability to match participants for all characteristics, including mobility, was beyond the scope of this study.

Furthermore, the participants in this study may not be typical of the service, as a significant number (82%) of inpatients screened were excluded from the study. We elected to have conservative inclusion criteria to minimise the risk to participants' skin integrity. In addition, male inpatients were over-represented in the study, comprising 60% of the inpatient group compared to a normal rate of 39% of admissions to this service. The average length of stay of the inpatient group (19 days) was slightly less than that for all inpatients in this service (23 days), suggesting the inpatient group was more active than the average inpatient (perhaps because frailer and cognitively impaired participants were excluded). Nevertheless we demonstrated that activity levels are low in this possibly fitter inpatient sample. Despite these differences in premorbid mobility, the possible overestimation of inpatient physical activity and the small sample size, the findings of this study remain important as they offer insights into a population in which clinical research is difficult. Our findings can contribute to and guide further research and interventions designed to improve inpatients' physical activity levels and outcomes.

The fact that the majority of suitable patients declined to consent for this study and a significant number of patients were excluded did however raise questions regarding the suitability of the activity logger in its current format for further studies of elderly inpatients. A device that is more attractive to wear and easier to attach, would enable recruitment of a more representative sample of patients in future studies.

In conclusion, elderly patients undergoing rehabilitation spend a large part of the day inactive and significantly more so than their community-dwelling peers. Further research is required to investigate whether increasing patients' physical activity levels improves patient outcomes and to develop innovative strategies to do so.

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