



*Research article*

## **An explorative study of current strategies to reduce sedentary behaviour in hospital wards**

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**Abstract:** Prolonged sitting (or sedentary behaviour—SB) has profound detrimental effects on health and is associated with increased risk of chronic disease, hospitalisation and premature death. However, while in hospital, a person will spend the vast majority of the day sitting or lying down. A number of strategies have started to be implemented to counteract this phenomenon and get patients up and moving. This is the first explorative study that used device-based measurements of the postural physical activity of older hospitalised adults taking part in such initiatives. A total of 43 patients, mean age 83.8y (SD 8.3), wore a waterproofed activity monitor (activPAL3) for 4 days (including overnight); physical activity was analysed for waking hours. Interventions designed to get patients up and moving were introduced sequentially. Participants were grouped based on the highest level of intervention they received. There were 4 groups: “control” (n = 12), “education” (advice on SB reduction via infographics on the ward noticeboards, n = 12), “#endpjaralysis” (up and dressed by the nurses before 11: 30 am, n = 9), “personalised activity passports” (agreed by Occupational Therapists and other members of the multidisciplinary team with patients, on SB reduction, n = 10). ANOVA revealed the absence of any differences between the 4 groups for total sitting time (p = 0.989), time spent upright (standing and walking) (p = 0.700), number of sitting events (i.e. sit to stand transitions) (p = 0.418) and longest upright period (p = 0.915). This small explorative study of sequential initiatives within a ward setting to reduce SB found they were not successful. The cross-sectional service-improvement nature of the study limited the ability to assess change in individuals as interventions were introduced. Further work is warranted to untangle the determinants of SB in hospital settings and implement interventions of sustainable SB change in this setting.

**Keywords:** older adults; sedentary behaviour; physical inactivity; hospitalisation; personalised activity passports

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## 1. Introduction

Sedentary behaviour (SB) is defined as “any waking behaviour characterized by energy expenditure  $\leq 1.5$  metabolic equivalents (METs) while in a sitting or reclining posture” [1]. Prolonged SB is an independent risk factor for cardiovascular disease and diabetes, cancer and all-cause mortality, which is generally independent of the amount of physical activity carried out [2]. Adults may meet the daily physical activity guidelines, but still be at risk for developing ill health due to high levels of SB throughout the rest of the day [2]. Older adults are the most sedentary and inactive subgroup of the population, self-reporting SB between 5.3 to 7.5h/d [3,4]. The level of SB increases even more whilst in hospital, where patients spend the vast majority of the day (80–98% of the day) sitting or lying and, mostly alone [5–7]. Prolonged sitting has been observed in orthopaedic, geriatric, neurology, rehabilitation, and medical wards in hospitals [5,8–10]. A number of barriers to mobility have been identified including patient centred reasons (e.g. due to illness, experiencing weakness, pain and fatigue, or having an intravenous line or urinary catheter), but also whole ward behaviours (such as lack of staff to assist with out of bed activities) [11].

There is mounting evidence that people who spend time in hospital tend to adopt a much more sedentary lifestyle while in hospital and this perseveres after discharge [6,7,9,12], even if they have recovered to full functional capacity and are medically stable [12]. Yet, we know that for every 10 days of bed-rest, the equivalent of 10 years of muscle ageing occurs in people over 80-years old [13]. One week of bedrest equates to a 10% loss in strength [14], and for an older person who is at threshold strength for climbing the stairs at home, or getting out of bed standing up, such loss of strength may make the difference between dependence and independence [15].

The importance of moving more and reducing SB in hospital was the basis of the 2016 social media campaign #endpjaralysis (<http://www.endpjaralysis.com>). The campaign was a call to action for NHS staff to consider ways they could support patients to maintain some normality in their routine and get up, out of their pyjamas or dressing gowns and get dressed; the idea behind it was that if people were up and dressed, they would get moving, which in turn would prevent complications associated with prolonged immobility. The social media campaign #endpjaralysis has been very successful, with 23 million Twitter impressions across many countries. Most of the people engaged in this campaign are staff working in acute hospital provision, with nurses, allied health professionals and medics considering how they can encourage their in-patients to be more active in hospital. To date though, no one has evaluated whether this or other similar initiatives are successful in getting patients moving more while in hospital. Thus, the aim of this project was to assess, in a pragmatic setting and via means of device-based measurement of physical activity and SB, whether getting up and dressed or even having a personalised “mobility plan” while in hospital, reduces SB and increases movement in ward-based patients.

## 2. Methods and materials

### 2.1. Participants

The participants for this study were recruited from a Scottish Hospital situated in a rural location, Kello Hospital (NHS Lanarkshire), which provides care for acute medical patients, rehabilitation and palliative care. Patients are admitted to Kello Hospital either from home via their General Practitioner or are transferred from a regional Acute Hospital for a period of rehabilitation. Reasons for admission include reduced mobility/frailty, falls, post-operative care (e.g. hip/knee replacement), stroke, infection (e.g. chest infection/urinary tract infection), exacerbation of a long-term condition such as Parkinson's disease or COPD, and symptom management of disease. The hospital has 17 beds and normally 2–3 beds are occupied by people from the local community with palliative care needs. Medical cover for the hospital is provided by the local General Practitioners.

Upon admission to the hospital, ward-based patients were considered for this study if they were mobile (we excluded those who required substantial external assistance with mobility) and medically stable (i.e. they were not on palliative care or confined to bed due to an acute period of illness, and therefore not fit to participate in activity). The study volunteers were recruited to the study by the Hospital's Occupational Therapist (OT), data were collected by the OT between April and November 2017. The study followed a quality improvement design and thus a formal ethics approval was not required as per the HQIP quality improvement ethics guidance [16], which is in line with the NHS National Research Ethics Service (NRES) guidance and was confirmed in writing by the NHS Lanarkshire Research and Development Manager.

Routinely collected data such as age, sex, length of hospital stay and the Scottish Index of Multiple Deprivation (SIMD) based on postcode classification [17] were collected for each patient. The SIMD is an official tool for identifying areas of multiple deprivation in Scotland that combines seven different domains of deprivation: income, employment, education, health access to services, crime and housing. A patient's postcode can be used to determine whether he or she lives in an area that is deemed most deprived (SIMD 1) or least deprived (SIMD 5) [17]. The researchers carrying out the analysis of the data did not have access to the patients' medical notes.

### 2.2. Physical activity monitor

The activPAL3 (PAL Technologies Ltd, Glasgow, UK) is a small, single unit, tri-axial accelerometer-based system that measures activity for up to 14 days. It is worn on the front of the thigh, under clothing; it is worn continuously (including overnight) and is waterproof and thus does not need to be removed during water based activities or bathing. For the purposes of this study, the OT waterproofed the monitor (heat-sealed in lay flat tubing) and secured the monitor onto each participant's thigh (PALstickie adhesive pad, covered by Opsite waterproof dressing) [18]. The OT placed the accelerometer on any new patients who were eligible for the study every Tuesday morning, and removed it and downloaded the data every Friday leading to four days of data for analysis. This approach was based on pragmatic considerations, balancing convenience in ward routine with minimising participant burden.

The activPAL uses thigh inclination to distinguish postural sitting (from standing), and proprietary software classifies posture as sitting/lying (sedentary behaviour), standing or walking

(upright movement). The activPAL is > 98% accurate in defining sitting and standing against observation in adults [19,20] and older adults [21] and has been used in large studies to monitor and define SB [22,23].

### 2.3. Interventions

Interventions designed to get patients up and moving were introduced sequentially in an additional manner (following a quality improvement methodology [24]). Participants were grouped based on the highest level of intervention they received during the time they were assessed, which depended on the date they were admitted to hospital. There were four groups: “control” (no intervention), “education” (advice on SB reduction via infographics on the ward noticeboards), “#endpjaralysis” (patients were up and dressed by the nurses before 11:30 am), “personalised activity passports” (agreed by Occupational Therapists (OT) and other members of a multidisciplinary team with patients on SB reduction).

In brief, data for the control group were collected during the month of April 2017; in May 2017 “#ThinkActivity Board” was introduced in the ward, this included information/infographics on the importance of keeping active during a hospital stay, and data for the “education” group were collected until July 2017. The “#ThinkActivity Board” was created by one of the authors (LMcI) based on improvement science and evidence around providing information to staff and patients.

The board was visible at the front door of the hospital, with information on the project and the importance of improving activity on the ward. It was updated on a monthly basis to include feedback comments from patients and staff about why activity mattered to them and the challenges associated with changing physical activity levels and reducing SB. A list of all the ward-based physical activity initiatives was also posted on the board, detailing all the formal activities on offer each day at the ward (such as chair based exercise classes, bingo etc.).

By August 2017, all nurses and staff had been trained in the importance of reducing SB and were delivering the “#endPjaralysis” intervention. This intervention based on the 2016 social media campaign #endpjaralysis (<http://www.endpjaralysis.com>) aimed to have all patients on the ward up and dressed by 11:30 am at the latest, this was refined to 10:30 am as part of the “plan, do, study, act” cycles of the quality improvement methodology [25].

By September 2017, the final intervention was delivered, where patients had “personalised activity passports” [26] which involved custom-made advice agreed by OTs and other members of the multidisciplinary team with patients on SB reduction. The “personalised activity passports” were designed in collaboration with the OT and physiotherapist on the ward and with input from patients. They consist of a booklet that contains information about each patient’s normal sleeping and waking routines (including activities that each patient enjoys or dislikes, and whether they prefer a group setting or individual activities). Based on that information and discussion with the patient, the OT or the physiotherapist helped each patient to devise an individualised plan of action aiming to reduce SB and increase physical activity based on personal preferences. This included a pledge to break SB and stand up regularly at an agreed frequency (e.g. every hour). The patients then had to implement the agreed “personalised activity passport” for a week and record their daily activity and exercise using visual analogue clocks incorporated in their booklets.

## 2.4. Data analysis

Data from the activPAL were downloaded and categorised using proprietary software (PALtechnologies version 7.2.32). The activity profile for every individual over the 4 days of monitoring was inspected, and all abnormal periods of activity that appeared out of character for the individual were identified. Examples of these included protracted periods of standing during the night or prolonged uninterrupted sedentary spells during daytime in an individual who, on other days, changed position regularly. The raw accelerations signals for the abnormal periods were inspected in detail, and cross-checked against the notes that the OT kept for each participant while in the study, and if the acceleration signal remained constant throughout, the monitor was considered to have been attached incorrectly and the data was excluded from the analysis.

In this study, the time period between 6am and 11pm was classified as “waking hours” based on ward routines and visual inspection of activity patterns in the baseline data. Outcome measures were calculated from the activPAL monitor using a custom Excel macro as per Dall et al (2017) [27]. An event is defined as a single continuous period of a single posture or activity [28]. For each participant, the following outcomes were calculated for the waking day: total upright time (standing and walking), total sitting time, the number of sitting events (i.e. the number of sit-to-stand transitions), and the duration of the longest upright period. ANOVA with post hoc test was employed to assess differences between the 4 groups. Significance was set at  $p < 0.05$  for all testing procedures. All analyses were performed using SPSS Statistics version 23.

The waking hours activity was examined further. The length of each upright and sedentary event during the waking day was determined for all participants in each group and was assigned to a time category (< 5 mins, 5–10 mins, 10–30 mins, 30–60 mins and > 60 mins). Events crossing the start (6 am) and end (11 pm) of the waking day were cut at that point. For each group, the total time spent upright in each category of event was calculated as a percentage of the total time upright. This procedure was repeated for sedentary time.

## 3. Results

In total, 43 patients took part in the study. The demographic details of the participants in each successive intervention group are presented in Table 1. Data from six patients were excluded from the analysis upon inspection of the abnormal acceleration signals that indicated that the monitor had not been attached correctly or had been removed early.

**Table 1.** Participant characteristics according to group.

	ALL (n = 43)	Control (n = 12)	Education (n = 12)	#endpjjparalysis (n = 9)	Personalised activity passport (n = 10)
Male/female (n)	17/26	5/7	5/7	4/5	3/7
[% female]	[60]	[58]	[58]	[55]	[70]
Age (years) mean (SD)	83.8 (8.3)	81.6 (5.2)	85.7 (6.6)	87.7 (9.5)	80.5 (10.6)
SIMD <sup>1</sup> (%) categories 1 to 5	9, 23, 16, 40, 12	0, 33, 25, 12, 25	17, 17, 8, 58, 0	0, 22, 11, 56, 11	20, 20, 20, 30, 10
Total length of stay (days) mean (SD)	57.9 (33.5)	73.8 (39.9)	48 (32.1)	52.3 (32.7)	54.3 (10.3)

<sup>1</sup> SIMD: Scottish Index of Multiple Deprivation (1: most deprived, 5: least deprived).

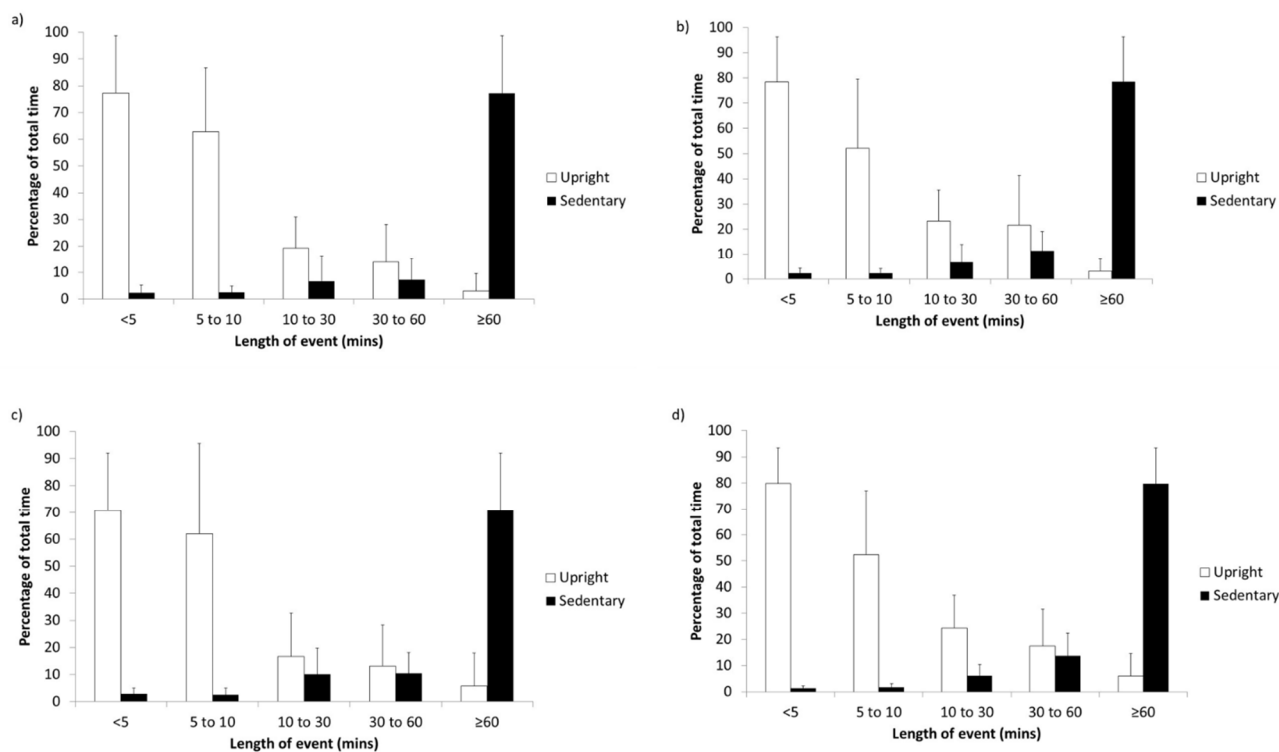
The daily upright (standing and walking) time for each group is presented in Table 2. Ward patients spent just over an hour upright during waking hours, and there were no differences between the 4 intervention groups for upright and sedentary time.

**Table 2.** Average daily upright and sedentary time (min) according to group—mean (SD).

	Upright time (min)	Longest upright period (min)	Sedentary time (min)	Number of sitting events <sup>1</sup>
	Mean (SD) [min–max]	Mean (SD) [min–max]	Mean (SD) [min–max]	Mean (SD) [min–max]
Control (n = 12)	72 (72) [24–252]	23 (18) [7–65]	852 (90) [672–942]	22 (16) [7–65]
Education (n = 12)	78 (60) [12–228]	21 (14) [5–48]	834 (54) [714–918]	22 (12) [9–51]
#endpjjparalysis (n = 9)	96 (96) [12–282]	24 (27) [4–88]	846 (108) [648–990]	28 (15) [9–55]
Personalised activity care plan (n = 10)	60 (42) [18–174]	27 (19) [5–57]	846 (78) [756–894]	18 (7) [8–32]
ANOVA p	0.700	0.915	0.989	0.418

<sup>1</sup> Number of sitting events is equivalent to number of sit-to-stand transitions ( $\pm 1$ ).

There were no notable differences in length of sedentary and upright events throughout the day (6 am to 11 pm) between the different 4 groups (Figure 1).



**Figure 1.** (a) Control, (b) education, (c) #endpparalysis, and (d) personalised activity care plan upright and sedentary time represented by event length (mean (SD)).

It appears that regardless of intervention groups, 70–80% of total upright time was accrued in short standing or walking events of less than 5 mins duration. Upright events lasting more than 1h were responsible for only 3–6% of total upright time. SB reveals an inverse pattern, in which most sitting or lying time (70–80%) was accumulated in sedentary periods longer than an hour. Shorter sitting events were responsible for only a small amount of the total sedentary time. Neither the number of sitting events (i.e. sit to stand transitions), nor the longest upright period were different between the 4 intervention groups (ANOVA  $p = 0.418$  and  $0.915$  respectively, Table 2).

#### 4. Discussion

This small explorative study of hospital based patients identified that current initiatives did not decrease SB or increase time spent upright (standing and walking). The cross-sectional nature of the study limited the ability to assess change in individuals as interventions were introduced. These initiatives, introduced sequentially, aimed to change behaviour in both staff and patients. They included changes to knowledge of hospital staff (through infographic posters on the ward), changes to whole-ward behaviour (using the #endpparalysis movement, getting patients dressed earlier in the day), and individualised plans to reduce and break-up SB.

The amount of the SB of the hospital-based patients in this study (83% to 88% of waking hours across the groups) was similar to that found in other studies in which SB was measured using devices (80–98%) [5–7], in a range of healthcare settings in developed countries. The number of sitting events (effectively equivalent to the number of sit to stand transitions) in this study (mean of 18 to 28 across

17 hours) was broadly similar to other hospital-based patients in Scotland (mean 36 across 24 hours) [29], if the difference in hours measured is taken into consideration. Additionally, the distribution of duration of SB events (generally long) and upright events (generally short) was similar to that of other hospital-based patients in Scotland [5].

There was wide variability of SB within each of the groups, which may have masked individual change in response to the initiatives (although this could not be assessed in our cross-sectional design). Although the minimal detectable change for individual SB using device-based measurement may be large (~2 hours/day) for community-dwelling older adults [30], such differences may actually be commonplace on transitioning to a hospital situation. For example, a case-study of an older adult admitted to hospital following upper limb injury, showed an extra 8 hours/day of SB (measured objectively) while she was in hospital compared to her pre-admission SB levels [10]. It is possible that, for this frail population, the number of sit-to-stand transitions in a day would be a more appropriate outcome measure. In a small (n = 23) pilot intervention to reduce SB in frail older adults (mean age  $79 \pm 8$  years) living in sheltered housing, an increase in number of sit-to-stand transitions was associated with an increase in function (timed up and go 4 s faster, 2 more sit-to-stands in 30 s) [31]. However, in the current study, there was no difference in number of sitting events (effectively equivalent to number of sit-to-stand transitions) between groups. Future research should consider involving the family and carers as awareness and support among family members of the benefits of reducing prolonged sedentary time could translate into greater behaviour change and greater intervention fidelity.

The strengths of this study were the use of a device-based measure of postural sitting, allowing for a relatively unbiased assessment of the difference between SB and upright behaviour, and a clear timeline for the introduction of successive initiatives. Another strength of this study, is that the interventions were co-created by all parties involved. The process involved staff and patients' input all the way, from the initial interviews which aimed to understand the current system and assess what mattered to patients and staff about participation in activity on the ward. This process allowed identification of current knowledge, awareness and barriers to implementation. It highlighted that patients wanted to move more, participate in structured exercise programmes and engage in a wider activity programme during their stay. Staff acknowledged the importance of encouraging people to be active, however, staff absence and limited time to spend individually with patients were highlighted as barriers to supporting patient participation in activity. For example, staff often used mechanical equipment to assist a patient to move rather than providing assistance to walk as it was less time consuming. Another barrier to initial implementation was staff awareness of the extent to which patients were sitting throughout the day. Presenting staff with the findings from the device-based measurement of the amount of sedentary time patients spent on the ward, allowed them to understand the issue, and engage more fully with the program during the sequential Plan, Do, Study Act (PDSA) cycles. The activity passport was well received by patients and provided them with a visual tool to see their progress over time; this has now been adopted as common practice and currently all 17 patients in Kello Hospital have an activity passport and there is now an activity programme 7 days per week.

The main limitations of the study were the inability of the cross-sectional service-methodology design to assess individual response to the initiatives, and the absence of controlling for length of stay and reason for hospitalisation. This may have masked potential effects of the initiative within the wide range of behaviour across the groups. However, this design was necessary because of the use of improvement methodology, i.e. introducing initiatives sequentially, combined with initiatives which



impacted ward routine for all patients (meaning the individual baseline was “current ward practice” and not “initial ward practice”). The study was introduced in a single ward, which meant only a small number of participants were included in each group. In addition, as this was a quality improvement study, its results cannot be generalizable to other locations, however our findings might be useful to others who may be thinking of implementing this kind of intervention in their own settings (and especially for people who may be thinking of measuring change). Finally, an arbitrary value was used for waking hours (based on ward routine and inspection of baseline data), therefore if people were awake outside of these hours, or asleep within these hours, data may not reflect individual sleep times and thus may misclassify SB as sleep or vice versa. Using diaries to record waking times may have allowed a more accurate record of waking times, however, routines of waking and sleeping may not have been simple, and patients may have needed help in completing the diaries, potentially leading to bias in reporting.

## 5. Conclusion

In line with other studies, hospital-based patients in Scotland were sedentary for 80 to 90% of the waking day. The potential loss of muscle strength during a hospital stay could result in readmission or loss of independence on discharge, which means that this is an important area to tackle. The service-methodology used sequential introduced initiatives in line with current practice, but did not show any meaningful changes to SB in this small sample and in this setting. The trajectory of deconditioning/recovery and its relationship with engagement with physical activity/reducing SB is of interest and needs exploring. Further work is warranted to untangle the determinants of SB in hospital settings and implement successful interventions of sustainable SB change in this setting.

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## Conflict of interest

D. Skelton is a Director of a not for profit training company, Later Life Training, which provides training to health and leisure professionals to deliver strength and balance training. The rest of the authors have nothing to disclose. The authors have no conflicts of interest.

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