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SHORT COMMUNICATION

Acceptability of physical activity monitoring in older adults undergoing inpatient rehabilitation

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Abstract

Background There is little research into interventions to increase activity levels of hospitalised older adults.
Aims To assess the feasibility of using a physical activity monitor (PAL2) in hospitalized older adults and the effect of group exercise on activity levels.
Methods Participants were hospitalized, ambulant adults ≥ 65 years randomized to individual physical therapy alone or combined with a high intensity exercise group and wore the PAL2 for five consecutive days.
Results Only 33% of eligible participants agreed to participate with 19/30 (63%) complete data sets obtained; physical activity levels were low regardless of intervention.
Conclusion Acceptability of physical activity monitoring in hospitalized older adults was low and physical activity levels of those monitored was low across groups. To improve monitor compliance, future studies may consider excluding patients with specific comorbidities that impact on wear time, or selection of an alternative monitor.

Keywords Physical activity levels · Exercise · Hospitalization

Introduction

Physical activity (PA) is low in hospitalized older adults [1–3]; however, increasing PA levels through exercise may minimise or reverse potential deleterious effects of hospitalization [4]. The aims of this study were to investigate in hospitalized older adults: (1) the feasibility of wearing an activity monitor and (2) PA levels between high intensity functional exercise (HIFE) group participants versus individual Physical Therapy (PT) participants.

Method

Study design

This project was part of a larger trial investigating clinical outcomes of hospitalized older adults participating in a HIFE group program compared with individual PT during their admission [5]. Activity monitors were placed on a subset of participants.

Participants

Older adults admitted to a metropolitan rehabilitation hospital geriatric evaluation and management (GEM) ward were included in this study. Participants were ≥ 65 years and were physically and cognitively able and willing to engage in the HIFE group program. Participants were excluded from wearing the activity monitor if they had a wound or reduced sensation around the site of attachment, lower limb oedema, concern regarding lower limb circulation, or cognitive

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impairment that would limit their reporting of discomfort of the device.

Intervention

Participants randomly allocated to 'control' received daily individual PT for approximately 20 min per session. Participants randomised to 'HIFE' attended exercise classes three times per week (approximately 30 min duration), details described elsewhere [5].

Procedure

Ethics approval was sought from hospital and university ethics committees. Informed consent was obtained from all participants included in the study; those with Mini-Mental State Examination (MMSE) scores of ≤ 24 had their person responsible contacted for written third party acknowledgement.

Equipment

The Positional Activity Logger version 2 (PAL2, Gorman ProMed, Melbourne, Australia) has previously been validated in hospitalized older adults [6] and was used to measure PA.

Measurement of physical activity levels

The PAL2 was worn around the lower thigh and upper calf. Monitors were removed for showering/hygiene and participants were informed it could be removed if uncomfortable or with change of mind. Physical activity levels were recorded over five consecutive days during admission, overlapping a weekend.

Data and statistical analysis

Data were analysed using SPSS for Windows (IBM Corporation, Version 23) and visually and statistically inspected for normality. Independent *t* tests were used for between group analysis for parametric data (reported as mean and standard deviation—SD) and Mann–Whitney *U* test were used for non-parametric data (median and interquartile range—IQR) for time spent in upright, lying and sitting positions, as well as transitions (e.g. sit-to-stand). Data were analysed in 24 h periods from 0000 hours to 2400 hours as well as from 0100 hours to 0900 hours, 0900–1700 ('daytime') and 1700 hours to 0100 hours. Data were analysed separately for weekdays and weekend days.

Outcome measures

The following demographic measures were recorded to describe the sample characteristics: MMSE, Charlson Comorbidity Index and preadmission living arrangements. Physical outcome measures taken included Elderly Mobility Scale, Berg Balance Scale and gait speed (m/s).

Feasibility data included the number of people invited to wear the PAL2 and those who accepted, the number of complete data sets, the number of participants who removed the PAL2 prior to completion of recording, and reasons contributing to early removal.

The time spent in the positions of lying, sitting and standing were recorded. Standing ('upright') time was separated into 'moving' and 'stationary'. Activity counts recorded during walking at comfortable and fast gait speeds during calibration were used to define the intensity of movement: activity counts recorded with fast gait speed was deemed moderate to high intensity, less than this was deemed low intensity. Transitions between positions (lie-sit, sit-stand) were also recorded. Prolonged sedentary periods were also recorded (inactive in non-upright positions for 3 h or more) from 9 am to 5 pm.

Results

One hundred and fifty-six participants who were enrolled in the parent trial were asked if they would wear the PAL2. Primary reasons for declining ($n = 104$) were not wanting to be monitored and a lack of interest. Fifty-two participants consented (33%); however, three changed their mind and 19 had a planned discharge date that would preclude them from wearing the monitor for three weekdays and two weekend days. Thirty participants (19%) wore the PAL2. Out of these, 19 complete data sets (63%) were obtained: seven participants (23%) removed the PAL2 prior to the final day [discomfort ($n = 2$), anxiety ($n = 2$) and interference with toileting/indwelling catheter ($n = 3$)], the electrical cable broke on one (3%) and three data sets (10%) were lost due to faulty recording. Mean age of participants was 83.6 years (6.9), Berg Balance Scale mean was 33.3 (11.3), Elderly Mobility Scale mean was 12.3 (4.4), and Charlson Co-morbidity Index median was 2 (IQR 1–4). Mean gait speed was 0.58 m/s and nearly all participants (97%) were living at home prior to admission.

On weekdays, control participants spent a median of 16.56 (IQR 12.87–19.04) hours per day lying compared with 14.40 (IQR 12.81–14.93) hours for HIFE participants, ($p = 0.288$). Control participants sat for nearly 2 h less on weekdays [median 6.14 (IQR 4.40–8.71) versus

Table 1 Median daily time spent in each position by time of day (hours)

	Lying hours (IQR)			Sitting hours (IQR)			Standing hours (IQR)		
	Control ($n=10$)	HIFE ($n=9$)	*p* value	Control	HIFE	*p* value	Control	HIFE	*p* value
Weekday (h)									
01:00–09:00	7.13 (6.62–7.52)	7.10 (3.50–7.75)	0.245	0.73 (0.18–0.93)	0.30 (0.12–3.93)	0.341	0.18(0.08–0.48)	0.26 (0.4–0.71)	0.300
09:00–17:00	3.48 (1.64–4.84)	2.61 (1.30–5.97)	0.229	3.57 (2.85–4.40)	3.16 (1.56–5.86)	0.213	0.62 (0.26–1.35)	0.64 (0.44–2.09)	0.483
17:00–01:00	5.92 (4.43–7.04)	5.76 (3.79–7.03)	0.245	1.84 (0.64–2.70)	1.61 (0.67–3.06)	0.300	0.31 (0.13–0.75)	0.18 (0.11–0.82)	0.213
Weekend (h)									
01:00–09:00	6.99 (6.71–7.22)	7.26 (5.41–7.70)	0.509	0.73 (0.32–1.18)	0.36 (0.12–2.11)	0.133	0.24 (0.12–0.51)	0.21 (0.06–0.51)	0.123
09:00–17:00	3.44 (1.76–6.61)	4.02 (1.28–4.92)	0.198	3.24 (0.96–4.94)	3.17 (1.61–5.01)	0.300	0.54 (0.14–1.88)	0.92 (0.18–2.0)	0.457
17:00–01:00	5.48 (2.75–6.99)	6.41 (5.21–6.95)	0.408	1.61 (0.64–3.68)	1.17 (0.95–1.93)	0.213	0.42 (0.16–0.99)	0.24 (0.11–0.68)	0.086

Figures reported are median (interquartile range)

HIFE high intensity functional exercise

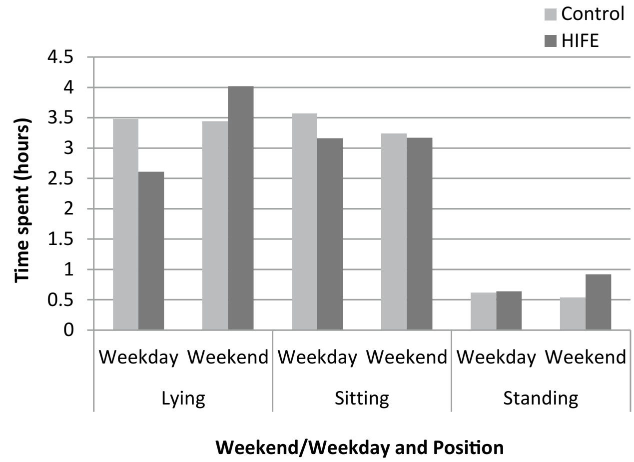

Fig. 1 Median time spent in each position during 09:00–17:00 h comparing weekday and weekend for lying, sitting and standing position. *HIFE* high intensity functional exercise

Table 2 Time spent upright and moving (hours)

	Upright moving time, h (IQR)		
	Control ($n=10$)	HIFE ($n=9$)	*p* value
Weekday			
01:00–09:00	0.04 (0.02–0.16)	0.09 (0.02–0.57)	0.432
09:00–17:00	0.21 (0.17–0.65)	0.50 (0.27–1.39)	0.563
17:00–01:00	0.18 (0.06–0.41)	0.15 (0.06–0.59)	0.263
Weekend			
01:00–09:00	0.15 (0.07–0.21)	0.10 (0.02–0.25)	0.170
09:00–17:00	0.37 (0.05–0.50)	0.19 (0.10–0.61)	0.509
17:00–01:00	0.30 (0.09–0.40)	0.10 (0.04–0.21)	0.059

Data in this table are presented as median and interquartile range

HIFE high intensity functional exercise

8.07 (IQR 4.90–9.91), respectively ($p=0.462$)]. There was no difference in time spent standing [control median 1.18 (IQR 0.52–2.54) and HIFE 1.00 (IQR 0.76–4.62), $p=0.624$] on weekdays. Time spent in standing was similar over the weekend (p range 0.842–0.968).

There was no significant difference between groups for time spent in any position, or for weekdays versus weekends (Table 1). Figure 1 shows participants spending less than an hour during 09:00–17:00 h in an upright position and nearly 50% of the day was spent in lying.

At least one prolonged sedentary period (≥ 3 h) was experienced by 38% of HIFE participants and 30% of control participants from 9 am to 5 pm during a weekday. On at least one weekend day, 88% of HIFE and 50% of control participants experienced at least one prolonged sedentary period.

During daytime hours, HIFE participants spent more upright time moving than stationary (Tables 1, 2). Control

Table 3 Median number of transitions by time of day

	Lie–sit/sit–lie			Sit–stand/stand–sit			Lie–stand/stand–lie		
	Control ($n = 10$)	HIFE ($n = 9$)	*p* value	Control	HIFE	*p* value	Control	HIFE	*p* value
Weekday									
01:00–09:00	4.33 (2.50–6.33)	2.50 (0.75–5.67)	0.065	8.50 (5.83–12.17)	19.50 (4.67–45.00)	0.460	2.00 (0.58–3.33)	0.17 (0.00–1.92)	0.027
09:00–17:00	7.00 (3.88–10.88)	4.25 (1.63–5.88)	0.043	31.25 (13.63–42.00)	48.25 (36.00–87.50)	0.083	1.75 (1.00–3.13)	0.75 (0.50–2.38)	0.203
17:00–01:00	70.8 (4.92–8.00)	4.33 (2.00–6.75)	0.173	15.00 (9.50–18.50)	9.42 (6.75–14.63)	0.146	1.42 (0.00–2.50)	0.42 (0.00–1.13)	0.274
Weekend									
01:00–09:00	7.00 (3.75–8.38)	4.25 (1.50–7.63)	0.237	8.00 (5.75–16.13)	11.00 (8.38–16.25)	0.515	1.00 (0.00–1.75)	0.75 (0.50–1.38)	1.00
09:00–17:00	5.5 (2.00–8.13)	2.00 (0.50–4.00)	0.083	17.75 (7.38–31.25)	16.25 (10.75–23.38)	0.965	1.25 (0.00–2.13)	0.75 (0.13–1.50)	0.696
17:00–01:00	6.50 (4.75–9.63)	3.00 (0.63–5.13)	0.009	24.25 (9.63–30.50)	6.25 (4.63–10.88)	0.012	0.25 (0.00–1.75)	1.25 (0.50–2.38)	0.237

Data in this table are presented as median and interquartile range

HIFE high intensity functional exercise

participants spent a median of 12.6 min/day moving compared with a median of 30 min/day for HIFE participants ($p = 0.563$). Participants spent the majority of their moving time in low intensity PA. When multiplied across five weekdays, this equates to 21 min/week of moderate to high intensity PA for control and 30 min/week for HIFE participants.

The total number of transitions was greater during daytime weekday hours than other periods, and was lower in control than HIFE participants, although not statistically significant: median 43.00 (IQR 27.38–54.63) and 50.50 (IQR 44.50–93.13) respectively, $p = 0.173$ (Table 3). This was mainly due to increased frequency of sit-to-stand.

Discussion

The aims of this pilot study were to report on the feasibility of hospitalized older adults wearing the PAL2 and investigate the effects of a group exercise program on PA levels in this same population. At only 19%, the acceptance rate for PA monitoring with the PAL2 was very low and nearly a quarter of those who agreed removed the PAL2 prior to completion. Preliminary results suggest that the type of therapy and day of the week did not influence PA levels in hospitalized older adults. Many participants were sedentary for prolonged periods of time, with at least half experiencing sedentary periods of 3 h or more on the weekends. Sit-to-stand transitions were higher in HIFE participants than control participants, approaching statistical significance.

Only a third of participants approached to wear the PAL2 accepted the invitation and many of these were discharged prior to wearing it for the predetermined period. Barriers to obtaining complete data sets in those who wore it arose in participants with anxiety and continence issues (i.e. increased frequency and the presence of indwelling catheters). Although previous studies have also found that pedometers are not useful in elderly [7], researchers could also consider using an alternative monitor where these issues are less likely to occur: e.g. a monitor on the arm/wrist may be less likely to interfere with toileting.

Results from this pilot study concur with other studies demonstrating that hospitalized older adults spend a significant amount of their day in bed and inactive [1, 2, 8, 9]; hospitalization is not conducive to older adults being physically active. It is reported that up to 30% of older adults experience deconditioning and functional decline while in hospital [10, 11], which may not necessarily be entirely caused by the acute illness itself [12]. Further investigation into factors contributing to low levels of PA during hospitalization and means to improve this is warranted.

The mobility scores of participants suggest dependence with ambulation and transfers. This risk and dependence on staff for mobilising limits incidental and patient initiated mobility; however, uptime during daytime hours was lower than reported elsewhere in potentially fitter older inpatients [1]. As inactivity may increase the risk of morbidity and mortality and reduce the ability to live independently [13, 14], strategies to increase PA activity are required. In addition to structured exercise, incidental activity such as that required to attend meals and socialise with others may be considered. There is potential for greater involvement of family, volunteers and other staff to assist with increasing PA of older adults, as well as the implementation of targeted therapy groups. Investigation into the effects of increasing PA in hospitalized older adults on mobility, morbidity, mortality, length of stay, and discharge outcomes are required.

The median number of sit-to-stands performed during daytime hours by both groups was more than described in community-dwelling older adults [15]. There was a trend towards statistical significance in the median number of transitions (HIFE more than control participants), with HIFE achieving more than the cut off of 45 transitions as suggested for adults to prevent deficits [16]. Increasing the number of intentional sit-to-stands has been shown to have additional benefits in adults after stroke [17, 18] and in community dwelling older adults [19]. Long periods of time spent inactive can lead to multiple negative effects on health which can be difficult to reverse even with exercise [20]. Participants in this study spent the majority of daytime hours inactive, with a greater number experiencing prolonged sedentary periods over the weekend. There is potential for further research into older adults and into minimising these long periods by disrupting them with regular and/or intermittent bouts of PA [21]. HIFE participants spent over 15 min more per day moving than control participants, and although this was not statistically significant, it may have clinical significance, given that it has been suggested that 15 min of even low level PA per day may reduce risk of mortality [22].

Study limitations

This study was not powered to examine the effect of HIFE on activity levels in hospitalized older adults and as such, the PA findings from this study should be interpreted with caution. This small sample size also limits generalisability of the findings, although similarly low levels of PA have been reported elsewhere [1]. The limited acceptance of wearing the PAL2, in addition to the high proportion of participants who removed it early, further limited the conclusions that can be drawn regarding PA levels. Alternate devices that increase acceptability of PA monitoring in hospitalised older adults are required. It is possible that the slow movements of some hospitalized older adults (recorded as low intensity) may not reflect the potential effort required for activities such as walking. This highlights the need for future research to examine the energy expenditure of functional activities in hospitalized older adults.

Conclusion

The acceptability of PA monitoring in hospitalized older adults was low. Pilot data suggest that more participants experienced prolonged sedentary periods on weekends compared with weekdays and therapy type did not influence activity levels, which were very low. To improve acceptability of PA monitoring, future studies may consider excluding specific comorbidities that may interfere with wearing the PAL2, or selection of an alternative monitor worn elsewhere on the body. In addition, further research into factors contributing to low levels of PA and strategies to address this is required.

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Compliance with ethical standards

Conflict of interest All authors declare that there is no conflict of interest.

Research involving human and animal participants All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent Informed consent was obtained from all participants included in the study.

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