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BRIEF REPORT

MEASURING ACTIVITY PERFORMANCE OF CONTINUING CARE RESIDENTS USING THE ACTIVPAL: AN EXPLORATORY STUDY

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Abstract: Few studies have measured the activity patterns of continuing care residents using objective, uniaxial, accelerometers such as the activPAL. This exploratory study described the activity performance of continuing care residents and explored the correlation of activity performance with grip strength, falls and mobility. Data were gathered from 24 continuing care residents. Participants (82.3 ± 5.8 years of age), wore the activPAL an average of 12.60 hours per day (SD = 0.96) and were stepping for a median of 0.47 hours (25th and 75th percentiles = 0.31, 0.81) with a median step count of 1906 steps (25th and 75th percentiles = 1216, 3420). Participants were inactive (sitting/lying/standing) for a mean 11.99 hours (SD = 1.03). No statistically significant correlations were identified between activity performance (active time, inactive time or step count) and grip strength, falls or mobility. Ambulatory older adults in continuing care centres were more sedentary compared to community-dwelling older adults or older adults with cancer.

Key words: Continuing care residents, activPAL, physical activity.

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Introduction

Physical activity in older adults can protect against frailty and sarcopenia (1, 2). Measurement of physical activity in older adults has been evaluated with performance-based mobility tests (3) or self-report questionnaires (4). Rather than providing a full picture, performance-based tests reflect the individual's ability at the time of assessment (3), while self-reports exclude activity within activities of daily living and are prone to recall bias (4). Technologies that measure activity, however, potentially provide a more comprehensive picture over time (3, 5).

One such technology is the activPAL, an accelerometer that classifies activity as sitting/lying, standing or stepping (3). The activPAL has been validated and used in multiple studies with community-dwelling older adults (3) and individuals with stroke (6). Little evidence has reported activity performance in the continuing care population using the activPAL (7). This small but growing population has poor mobility and is at high risk of falls (8). Studies involving older adults have explored the relationship between general physical activity and grip strength (9), falls (10), and mobility (11); but to our knowledge, no studies have used the activPAL to quantify activity performance and examine the relationship between these variables.

The aims of this brief report are to describe the activity performance of older adults from 13 Canadian continuing care centers using the activPAL and to examine the correlation of activity performance with grip strength, reported falls and mobility.

Methods

Study Design

This cross-sectional study was a secondary analysis of data collected from 34 continuing care residents participating in the MOVE and START studies (8, 12). One resident was removed from the study as the activPAL was dislodged on all three days of data collection.

Ethical approvals for both studies were received from the University of Alberta Health Research Ethics Board. All participants signed an informed consent form.

Activity Performance

Resident activity was captured by the activPAL, a lightweight, uni-axial accelerometer affixed to the mid-thigh that records periods of sitting/lying, standing, stepping, sit-to-stand transitions, and step count. The activPAL detects activity in relation to time and uses algorithms to interpret movement and posture (3). A research assistant secured the activPAL on the residents' thighs in the morning, for three consecutive days, before they started their day. Data were collected for the period that the residents were awake and ambulating. A research assistant removed the activPAL after residents were in bed each evening, approximately 12-14 hours later. Removal of the activPAL at night prevented residents from lying on the activPAL, thus avoiding the possibility of skin breakdown in this frail elderly population. For ease of use, the activPAL was not turned off over the course of the three days. The research assistant recorded the precise times that the device was applied and removed. Activity of residents who sat in an elevated chair with a knee angle > 90-100 degrees was incorrectly

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Table 1
Comparison of Residents' Settings and Wheelchair Use

Variable of Interest	Supportive Living Residents Mean (SD) n= 20	Long-term Care Residents Mean (SD) n= 13	p-value
Age (years)	79.55 (6.07)	86.31 (5.86)	0.003
Grip Strength (PSI)	39.82 (21.75)	37.16 (22.53)	0.81
Major Falls (count)	0.05 (0.22)	0.08 (0.28)	0.76
Minor Falls (count)	0.05 (0.22)	0.69 (1.03)	0.046
Falls (count)	0.55 (0.83)	0.46 (0.97)	0.78
Time-to-First Sit-to Stand (seconds)	4.26 (2.37)	5.09 (2.90)	0.38
Sit-to-Stand 30 second (count)	7.05 (2.68)	6.00 (3.11)	0.31
Variable of Interest	**Ambulating Residents Mean (SD) n=24**	**Wheelchair-Dependent Residents Mean (SD) n=9**	**p-value**
Age (years)	82.3 (5.8)	81.9 (9.3)	0.87
Grip Strength (PSI)	34.0 (16.6)	45.1 (27.0)	0.31
Major Falls (count)	0.0417 (0.20)	0.111 (0.33)	0.47
Minor Falls (count)	0.08 (0.28)	0.89 (1.2)	0.07
Falls (count)	0.42 (0.71)	0.78 (1.2)	0.42
Time-to-First Sit-to Stand (seconds)	4.3 (2.6)	5.2 (2.5)	0.38
Sit-to-Stand 30 second (count)	7.0 (2.9)	5.7 (2.7)	0.24

Note: SD = standard deviation, PSI = pounds per square inch

classified as standing; therefore, activity performance data were dichotomized into active time (stepping time) and inactive time (standing and sitting/lying time). Active and inactive time equaled total hours worn.

Grip Strength

Grip strength was measured in pounds per square inch (PSI) using a Jamar Hand Dynamometer (Lafayette Instrument Company, USA) on three occasions, alternately for each hand. The hand with the higher average grip strength was used in the analysis. Only a subset of participants in the START study had grip strength data available.

Falls

Monthly falls data were collected from facility logs for the three months prior to activPAL use and categorized into major falls (resulting in hospitalization or assessment by emergency personnel), minor falls (resulting in no injury) and falls (when the individual was found on the floor regardless if they fell or not).

Mobility

Mobility was measured using the 30 Second Sit-to Stand test (8) and the Time to First Sit-to-Stand test (8). The 30 Second Sit-to-Stand test is the number of sit-to-stand-to-sit transitions completed within 30 seconds (8). The Time to First Sit-to-Stand test is the number of seconds taken to complete a single sit-to-stand transition (8).

Statistical Analysis

A t-test was used to compare long-term care and supportive living residents to determine if we could examine them as one group. Grip strength, falls, mobility and activity levels were compared. Moreover, grip strength, falls and mobility in wheelchair-dependent and ambulatory residents were compared to determine if there was any difference between the two groups using a t-test. A p-value < 0.05 was statistically significant. Pearson correlations (r) were used to assess the correlation of activPAL data (active time, inactive time and step count) with grip strength, falls, mobility, age and sex. 95% confidence intervals are reported.

Results

Residential settings

Of the remaining 33 residents, 20 (61%) lived in supportive living and 13 (39%) in long-term care facilities. No significant differences were noted in grip strength or mobility (Table 1). Grip strength was added as an outcome after the START study began so only 18 residents had grip strength data. Long-term care residents were older (p=0.003) and experienced more minor falls compared with supportive living residents (p=0.046). No significant differences were seen between the two groups of residents in the time spent inactive (p =0.47) or

Table 2
Activity Performance Outcomes of Ambulating Residents Over Three Days

ActivPAL Outcome	Daily Mean	Standard Deviation	Minimum	Maximum
Wear Time (hours)	12.60	0.96	10.09	14.18
Inactive Time (hours)	11.99	1.03	8.90	14.17
ActivPAL Outcome	**Daily Median***	**Interquartile range***	**Minimum**	**Maximum**
Active Time (hours)	0.47	0.31, 0.81	0.01†	2.51
Step Count (steps)	1906	1416, 3420	38	12636

* Median and 25th and 75th percentiles are reported when distribution was skewed; † 48 seconds

active (p =0.21); therefore these data were analyzed together.

Activity Performance

During the three days of data collection, residents who did not use wheelchairs wore the activPAL a mean (SD) of 12.60 (0.96) hours per day. They were inactive a mean of 11.99 (SD 1.03) hours and active a median of 0.47 (25th and 75th percentiles = 0.31, 0.81) hours per day. Their median daily step count was 1906 (25th and 75th percentiles = 1416, 3420) steps (range: 38 - 12636) (Table 2). There was little variation in activity pattern across hours of the day, days of the week or month.

Resident Functional Mobility

Table 1 displays the mean of each activity variable stratified by functional mobility (ambulatory vs. wheelchair-dependent). No significant difference was found in mean grip strength between ambulatory (34.0; SD 16.6) and wheelchair-dependent residents (45.1; SD 27.0; p=0.31). Likewise, no significant differences were found with falls or in the mean (SD) time residents completed the Time to First Sit-to-Stand 4.3 (2.6) compared to wheelchair-dependent residents (5.2; SD 2.5; p=0.38).

Correlation of activPAL with grip strength, falls, mobility, age and sex

The 30 Second Sit-to-Stand and grip strength had a moderate correlation with inactive time (r=-0.261 [95% confidence intervals: -874.1, 210.1], r=0.213 [95% confidence intervals: -63.1, 109.0]), respectively. Step count and time spent active or inactive were not associated with the number of falls (r=-0.192 [95% confidence intervals: -2768.8, 1071.6], r=0.140 [95% confidence intervals: -2197.6, 4266.1], r=-0.143 [95% confidence intervals: -1998.4, 1013.7]), respectively.

Discussion

The findings from this cross-sectional study highlight the extensive sedentary time of older adults in continuing care centres, even with residents who do not use the wheelchair as their primary mode of mobility. Active time in this sample was similar to that found in an Australian continuing care sample, also measured with the activPAL, with a median (interquartile range) of 0.36 (0.40) hours spent stepping (7). This Canadian sample of continuing care residents had the lowest active time and step count when compared to other activPAL studies of community-dwelling older adults and older adult with lung or gastrointestinal cancer. This sample had ~¼ the mean (SD) active time and ~1/8 the mean (SD) step count of community-dwelling older adults [hours active = 1.96 (0.64), step count = 8493 (2291)]. The residents had ~½ the mean (SD) active time and ~1/4 the mean (SD) step count of older adults with cancer [hours active = 1.0 (0.7), step count = 4244 (2939)] (14). It is unknown whether low active time was due to pre-existing immobility upon admittance to the continuing care centre. However, each study participant was assessed as sufficiently mobile to be eligible for the primary study, which examined the preservation of mobility (8). Although wheelchair-dependent resident activity levels were not examined in this study, a lack of a statistically significant difference in Time-to-First-Sit-to-Stand or Sit-to-Stand-30 Second test scores between ambulating residents and wheelchair-dependent residents may indicate the potential for wheelchair-dependent residents to stand. Residents may have been placed in wheelchairs for staff convenience or as a short-term measure thus their potential ability to stand should not be ignored. Standing is an important functional pre-requisite for ambulating, transfers, dressing and toileting. Exclusion of long-term care residents based on the use of a wheelchair may overlook residents' actual or potential activity. The sample revealed no increased likelihood of having had a fall associated with their degree of mobility.

Grip strength in this study was not associated with activity performance although it is known to be a marker of mobility limitations (9). Although step count and active time spent was not associated with falls, others have shown that sedentary time increases with age (15) and fear of falling has shown to lead to greater inactivity (10). Although physical activity has been shown to be positively associated with mobility (2); activity performance was not correlated with the mobility measures in this sample of residents whose mobility was extremely limited.

Limitations of the activPAL have been reported in community-dwelling and continuing care residents as the

slow or hesitant walking pace of these individuals have been misclassified as standing (3, 7). Although the activPAL has been validated for use with older adults (3, 6), the activPal should be further validated in the continuing care population by comparing recorded mobility using accelerometry with human observation.

Findings from this study contribute more evidence that older adults in continuing care centres spend the least time active compared to older adults that were community-dwelling (13) or had cancer (14). Future research should explore factors influencing activity and examine sedentary activity in relation to functional activity performed throughout the day.

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