Article in press. *Archives of Physical Medicine and Rehabilitation.*

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Measures of Physical Ability Are Unrelated to Objectively Measured Physical Activity Behavior in Older Adults Residing in Continuing Care Retirement Communities

Kathryn R. Zalewski, PhD, PT, J. Carson Smith, PhD, Jake Malzahn, BS, Mark VanHart, DPT, Derek O'Connell, BS

From the University of Wisconsin-Milwaukee, Department of Human Movement Sciences, Milwaukee, WI (Zalewski, Smith, Malzahn, O'Connell), HealthReach, Physical Therapy Department, Brookfield, WI (VanHart)

Supported in part by the College of Health Sciences, University of Wisconsin-Milwaukee (grant no. XXX).

No commercial party having a direct financial interest in the results of the research supporting this article has or will confer a benefit on the authors or on any organization with which the authors are associated.

Correspondence to Kathryn Zalewski, University of Wisconsin-Milwaukee, PO Box 413 – Pavilion Rm 36, Milwaukee, WI 53201, e-mail: *zalewski@uwm.edu*. Reprints are not available from the author.

ABSTRACT.

Objective: The purpose of this study is to explore the relationship between measures of physical performance, physical activity, and self-reported physical activity.

Design: Cross-sectional analysis.

Setting: Continuing care retirement communities in the greater Milwaukee area.

Participants: Older adults from independent or assisted living apartments (n=59).

Interventions: Not applicable.

Main Outcome Measures: Physical performance was measured with comfortable and fast gait speeds and the 6-minute walk test. Physical activity was measured using an ankle mounted accelerometer to observe daily steps and stepping rate averaged over a 7-day wear time. Self-reported physical activity was measured using the Physical Activity Scale for the Elderly (PASE).

Results: Participants reported walking more steps per day than older adults who are not living in continuing care retirement communities (CCRCs). There was no relationship between physical abilities and total steps walked (r=.087-.213, $p > .05$). No relationship was observed between measures of physical performance or total steps and PASE scores (r=-.034-.177, p=*ns*). The relative contributions of physical activity categories to total PASE score were different than published reports for older adults not living in CCRCs.

Conclusions: Common measures of physical performance often used by clinicians in making decisions on rehabilitation outcomes do not appear to be related to actual function of older adults residing in senior communities. The nature of the environment customized to the needs of the older adult may facilitate increased physical activity participation independent of physical abilities.

Key Words: Aged; Rehabilitation; Residence characteristics.

List of Abbreviations

CV	coefficient of variation
CCRC	continuing care retirement community
MMSE	Mini-Mental State Examination
6MWT	6-minute walk test
PASE	Physical Activity Scale for the Elderly
RPE	rating of perceived exertion
SAM	Step Watch Activity Monitor

Clinicians use measures of physical performance collected in the clinic environment to inform predictive judgments of physical performance in the natural environment, to make decisions on discharge criteria and to inform continued need for therapy intervention. The comfortable gait speed, fast gait speed and the 6MWT are common outcome measures tracked in rehabilitation environments, and have published normative values for age and gender[1]. These tests have been found to be sensitive to change in healthy older adults[2] and in adults with specific medical diagnoses[3, 4] . Although gait speeds have been shown to be predictive of discharge placement[4] and functional ambulation for people with stroke[5], the broader relationship of walking ability measured in the clinic to ability witnessed in the community is not known.

The few studies that do explore the relationship between measures of physical performance in clinic and field environments report a lack of reliable association between the two. Moseley and colleges reported poor agreement between clinic measures of gait speed and

endurance and covert field measures including walking in a parking lot and shopping center in persons with traumatic brain injury ($ICC_{1,1}$ ranges between .06 and .29 for comfortable gait speed, fast gait speed and 6MWT)[6]. Field studies exploring physical activity in the older adult using activity monitors generally find that the older adult walks fewer steps per day and engages in more sedentary behavior (i.e., fewer bouts of activity) than their younger counterparts[7-9].

To determine whether activity monitor data is consistent with subjective report of activity behavior of older adults, Washbourn and Flicker examined healthy older adults who wore the activity monitor for 3 days and then completed the PASE. The PASE is a survey designed to describe and categorize various daily activity behaviors (e.g., light housekeeping versus yard work), which are weighted to reflect energy expenditure. The findings suggested statistically significant but only moderate relationships (r = .49 - .64 depending on age) between measured steps per day and total PASE scores scores[10]. The PASE was found to be moderately correlated to physical abilities as measured by the 6-minute walk test (r =.35) in a group of older adults with knee pain due to osteoarthritis [11].

There is a paucity of information on the physical performance and daily activity of adults living in CCRCs. Continuing care retirement communities are designed to allow older adults to age in a community of other older adults. Typically, these environments differ from other retirement communities as they offer people a range of living support from independent apartments, to assisted living, and skilled nursing care. The level of care chosen by a resident is often specified in the initial contract and may be re-negotiated as the needs of the person change. A CCRC has the advantage of allowing people to age in a community even if the level of care needed changes. As these CCRCs develop, they may become powerful mediators in moderating the health behaviors of their residents.

The purposes of this study are two-fold. First, we aim to describe the physical activity characteristics of older adults residing in CCRCs. Second, we explore the relationships between 3 measures of physical performance, a field measure of physical activity, and subjective report of physical activity in older adults residing in CCRCs.

METHODS

This paper reports data collected as part of a larger study[12] exploring physical activity, physical abilities, and psychosocial factors in older adults. Approval for the study was obtained from the Institutional Review Board of the University of Wisconsin-Milwaukee. The study was conducted in a set of 5 CCRCs, providing services to adults age 55 and older. The CCRCs included in the request to participate in the study included 10 facilities known to the principal investigator. Five of the facilities contacted agreed to participate in the research. These facilities represent 3 private non-profit religious affiliated institutions, and 2 private for-profit facilities. All of the facilities were within a 60-mile radius of the University of Wisconsin-Milwaukee. This study included only those individuals who resided in independent or assisted living apartments in the participating CCRCs. Eligible participants were required to self-report walking as their primary means of mobility inside the facility, but were allowed to use an assistive device. Participants were excluded in this analysis if their MMSE[13] score was below a 21/30. Participants were recruited through informational sessions (total attendance 81 residents), fliers distributed to the residents' mailboxes (approximate distribution 400 fliers), and through word of mouth. The 5 facilities participating in the study represent approximately 400 apartments (some apartments had more than 1 resident). Sixty participants were recruited from these 5 facilities.

Participants completed 1 session of data collection. Once completing informed consent, participants completed a battery of tests. The tests were administered in the following order: MMSE[13], PASE[14], comfortable gait speed, fast gait speed, and the 6MWT. Gait speeds and the 6MWT were completed following the protocol as outlined in Steffen, et al[1]. Participants completed 2 trials of walking over a 10-meter distance; the middle 8 meters were collected and analyzed for gait speeds. The 6MWT was completed on an inside path within the resident facility. Although paths were constrained by the environment, they all had a minimal distance of at least 40 meters and were oval or round. Participants were encouraged at minute 3 and minute 5 with reports of remaining time and 'good work' feedback. Heart rate and blood pressure were collected prior to and after the 6MWT; a RPE was collected only after the 6MWT using the 6-20 Borg RPE scale[15]. Immediately after the walk, participants were asked to rate their fatigue on a 0-10 scale with zero described as 'no fatigue at all – like sitting in a chair' and ten described as 'the most fatigue you have ever experienced'.

At the end of the session, each participant was fitted with a SAM[a] which is worn on the ankle and attached with a small Velcro strap. The SAM is a dual-axis accelerometer designed to count steps in individuals with atypical gait characteristics, including those with abnormal or slow gaits, and can be specifically configured based on individual gait characteristics. For the current study, all participants used the same settings: the quick stepping option was set to *no*, walking speed and leg motion were set to *normal,* and range of speeds was set to *uses a moderate range of speeds.* Height settings were customized to each participant. Participants wore the SAM for 7 consecutive days and were instructed to apply the SAM upon waking and to only remove the SAM if it became uncomfortable or interfered with sleep. As the SAM is waterproof, participants were encouraged to wear the SAM during water-based physical activity

(e.g., water aerobics). Data collected from the 7-day wear period included total steps, highest mean step rate for 60 continuous minutes, and highest mean step rate for 20 continuous minutes. The latter 2 estimates represent the best continuous minutes of activity during the respective time window.

The PASE questionnaire is comprised of activities typically engaged in by people who reside in their own homes. Participants reported their current level of participation in sitting, walking, light recreation, moderate recreation, strenuous recreation, and strength training activities ('never', 'seldom' [1-2 d/wk], 'sometimes' [3-4 d/wk], or 'often' [5-7 d/wk]), and how many hours per day on average were spent engaged in these activities. Participants also reported household and work/volunteer related activity (yes or no). The total PASE score was computed by multiplying the amount of time spent in each activity by item weights[14, 16].

Statistics

Means and standard deviations were calculated on all variables. Relationships between comfortable and fast gait speeds, 6MWT, total PASE score and total steps were explored using Pearson's Product Moment Correlation. Differences within individuals in comfortable and fast gait speeds, and stepping rates over short (20 minute) and longer (60 minute) performances were evaluated using paired t-tests.

RESULTS

Among those recruited, 59 individuals participated (mean age 83.8y, 45 women). Four of the participants were recruited from assisted living apartments; the remainder of the participants resided in independent apartments. Additional demographic data are provided in table 1.

Although no participants were ineligible due to low MMSE scores, not all participants completed the entire test battery. (The entire test battery required 2 hours to administer.) If participants were unable to contribute that amount of time they were allowed to withdraw from the study; these participants allowed their collected data to be used for analysis. One participant withdrew from the study early in the data collection process stating the data collection was 'too cumbersome', and refused to allow any data to be used for analysis. Performance on tests of physical performance and PASE scores are presented in table 2. Physical abilities of study participants were below published age-related normative values[1]. Participants in this study had higher reported average total steps per day than reported in other literature[7]. In attempt to evaluate variability in daily walking behavior within the day, mean stepping rate for the best continuous 60 minutes and best continuous 20 minutes of activity during the 7-day testing window are reported, as are comfortable and fast gait speeds. Although there was a difference between comfortable and fast gait speeds ($t[57] = -9.126$, $p<.05$), there was no difference in step rate measured during a longer (60 min) compared to a shorter (20 min) walking duration ($t[52] = .229$, $p=.82$).

There was no relationship between tests of physical ability, physical activity, and total PASE scores (table 3).

Total PASE score distribution is presented in table 4. For this sample, 64.5% of the total PASE score was due to exercise activity, whereas 5.1% was from work or volunteer activities, and 30.4% was due to daily household related activity. These relative contributions are considerably different than reported in the literature [14, 16].

DISCUSSION

This study failed to find a relationship between measures of physical performance, physical activity and PASE scores. One explanation for this finding may be that older adults residing in CCRCs do not engage in behaviors that contribute to the total PASE score in the same proportion as do other independently living adults. Specifically, light housework, heavy housework, outdoor gardening, home repair, lawn and yard care, which contributed 60% of the total PASE score in a study of independent older adults living in their homes[14], contributed only 30.4% of the total PASE score of older adults in CCRCs. Typically, much of the more strenuous home care is provided by the CCRC and thus would not be reported as physical activity behavior by the PASE. This explanation is supported with an analysis of the relationship between the best continuous minutes of activity and PASE subscale scores. The best continuous 60 minutes of physical activity was correlated with the sub-component of walking (Pearson's $r=.314$, $p<.05$), and moderate activity (Pearson's $r=.281$, $p<.05$); however, the best 20 minutes of physical activity failed to correlate significantly with any of the PASE subscale measures.

Measures of daily physical activity suggest that people living in CCRCs may actually be more active than independently living seniors not residing in senior designed environments. Considering the participants in this study appeared more physically limited, based on measures of physical performance, compared to independently living older adults, the high daily step count in the current sample suggests the residential environment may be encouraging behaviors that minimize the impact of physical limitations on daily physical activity. Noting that measures of physical performance were not related to daily steps further supports the suggestion that aspects of the residential environment may minimize physical limitations. However, this finding must be interpreted with caution. The SAM may over count actual activity by approximately 3% of total steps[17], leading to an overestimation of actual activity. Although the older adults in this study

appeared very similar to other published reports using the SAM as a measurement tool[7], there is the possibility that these step counts are artificially high.

Another explanation may be that participants in this sample have over-reported moderate and strenuous activity in the PASE. It is possible that the participants in this study found the rating of activity intensity to be ambiguous, perhaps reflecting a difficulty separating the construct of 'difficulty' of a behavior from 'aerobic intensity' of a behavior. Although this hypothesis is not directly tested in this study, it is suggested by comparing the coefficient of variation of the 6-minute walk distance (28%) against the CV of the 6-mintue-walk test perceived exertion (82%). The perception of effort was highly variable in this sample, despite a fairly consistent walking distance. Individual differences in cardiovascular fitness may also explain the high variability in perceived exertion. Although fitness was not directly assessed in this study, the CV for heart rate after the 6MWT was also low (29%). Finally, it is possible that the PASE is not valid in this population.

The lack of relationship with between physical performance and steps walked per day is more difficult to explain. It may be that people engage in many short bouts of walking that sum to high daily activity scores, and are less constrained by walking speed or endurance in CCRC environments. Most facilities are designed to facilitate this type of walking behavior, encouraging short walks to dinner, to get mail, and to most central congregation areas. This possibility is further supported by the lack of difference between stepping rates for the best continuous 60 minutes and best continuous 20 minutes of walking. Participants in this sample were consistent in their daily activity behaviors.

Results of this study should be interpreted cautiously. It is possible that only the healthiest and most active individuals from the CCRCs volunteered for the study, introducing a

source of potential bias. Additionally, most of the participants were from 2 of the 5 CCRCs. These 2 facilities represent large facilities in the greater Milwaukee area. It is possible that each facility has a set of cohort characteristics that may not be reflective of residents of CCRCs in general.

As therapists often have used measures of physical performance, particularly comfortable gait speeds, to make clinical decisions regarding a patient's abilities outside of the rehabilitation environment, the lack of relationship between gait speeds and 6MWT and measures of physical activity is important to consider. This study suggests therapists should be cautious in predicting participation in routine daily physical activity based on common clinical measures, and consider the residential living environment when interpreting test scores. The SAM provides an easy method for objective and accurate measurement daily physical activity in a home environment and should be considered as a complementary tool to assess outcomes.

CONCLUSIONS

The 6-mintue walk test, and comfortable and fast gait speeds as measures of physical performance are not good predictors of objectively measured daily physical activity behavior among residents of continuing care rehabilitation communities.

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Suppliers

a. StepWatch Activity Monitor (SAM), OrthoCare Innovations, LLC, Mount Lake Terrace, WA.

Table 1: Demographic Data for Study Participants

Item (Number Reporting)	Sub-category	Frequency
Resident facility (59)	1	40%
	2	50%
	3	7%
	4	0%*
	5	2%
Marital status (56)	Married	28%
	Widowed	33%
	Divorced	11%
	Single	8%
Highest achieved education (59)	Elementary	0%
	High school	52%
	College	32%
	Graduate	15%
Number of physician visits annually (59)	0	2%
	1	20%
	2	33%
	3 or more	44%
Number of prescription medications taken daily (59)	0	17%
	1-2	27%
	3-4	30%
	5 or more	24%

Self-reported co-morbidities percent reporting ‘yes’ (59)	Cardiovascular	71%
	Psychiatric	8%
	Medical/metabolic	70%
	Orthopedic	64%

Note. Percentages have been rounded to the nearest whole number.

* The 1 participant who withdrew from the study resided in Facility 4.

Table 2: Performance on Tests of Physical Ability and Daily Ambulatory Activity

	Participant Mean (SD)	CV* (%)	Normative Values (SD)†
6MWT (m)[1] (n=53)	332.10 (92.45)	28%	392 (85)
Fatigue rating after 6MWT (0-10 scale) (n=45)	5.96 (4.90)	82%	n/a
Heart rate after 6MWT (beats/min) (n=53)	86.60 (25.09)	29%	n/a
Comfortable gait speed (m/s)[1] (n=57)	1.07 (.25)	23%	1.15 (.21)
Fast gait speed (m/s)[1] (n=57)	1.32 (.32)	24%	1.59 (.28)
Total steps per day[7] (n=53)	8,130 (2861)	35%	7,681 (844)
Stepping rate for best continuous 60 minutes (steps/min) (n=53)	21.45 (9.8)	46%	n/a
Stepping rate for best continuous 20 minutes (steps/min) (n=50)	21.83 (10.8)	49%	n/a
(PASE) (n=57)	136.56 (105.00)	77%	n/a

* Coefficient of Variation ([SD/mean]*100)

† For Steffen, et al (2002), normative data for women age 80-89 are reported in this table.

Table 3: Relationships Between Physical Abilities, Physical Activity and Energy Expenditure

Variable	6MWT	CGS	FGS	TSPD	PASE
TSPD					.073
					(N=47)
FGS				.087	.177
				(N=51)	(N=48)
CGS			.812*	.123	.173
			(N=57)	(N=51)	(N=48)
6MWT		.649*	.639*	.213	-.034
		(N=53)	(N=53)	(N=47)	(N=44)

Note. Pearson's Product Moment Correlation (N=47-56).

Abbreviations: 6MWT, 6 Minute Walk Test (meters); CGS, Comfortable Gait Speed (meters/second); FGS, Fast Gait Speed (meters/second); TSPD, Total Steps Per Day (steps); PASE, Physical Activity Scale for the Elderly.

* $p < .01$

Table 4: Contribution to Total PASE Score by PASE Component

PASE Component (n=44)	Sample Means	Weight[13, 14]	Contribution to Total PASE Score
Walking (h/day)	1.75	20	35.00
Light recreation/sport (h/d)	.64	21	13.47
Moderate recreation/sport (h/d)	.33	23	7.67
Strenuous recreation/sport (h/d)	.25	23	5.75
Muscular strength/endurance (h/d)	.87	30	26.18
Job-standing or walking (h/d)	.33	21	7.00
Light housework (% reporting 'yes')	74.6	25	20.00
Heavy housework (% reporting 'yes')	30.5	25	8.18
Home repair (% reporting 'yes')	5.1	30	1.67
Lawn work/yard care (% reporting 'yes')	10.2	36	3.92