

RESEARCH

MEASURING PHYSICAL ACTIVITY USING ACCELEROMETRY IN A COMMUNITY SAMPLE WITH DEMENTIA

To the Editor: Physical activity (PA) reduces the risk of dementia¹ and extends the lifespan.² Although most prospective studies assess PA according to self-report, these measures are limited in scope and susceptible to social desirability biases. Despite the prospect that PA may alleviate cognitive impairment, few studies have objectively assessed PA in cognitively impaired individuals. Herein the feasibility of objectively measuring PA and adherence to wearing an activity-monitoring device in a cognitively impaired sample was assessed.

Participants were recruited from the Pittsburgh Alzheimer's Disease Research Center (ADRC). Details of clinical adjudication have been described.^{3,4} Participants and caregivers signed an informed consent/assent approved by the University of Pittsburgh institutional review board and were remunerated \$50. A control group of 28 cognitively normal adults, age matched to the impaired group, were also enrolled.

Information on the number of subjects recruited, consented, and returning the device was documented. Participants were given a PA monitoring device (BodyMedia, SenseWear, Pittsburgh, PA), an accelerometer designed to be worn on the arm, at the time of their ADRC visit and were asked to return the device in a prepaid envelope after 7 days of data collection. Caregivers were required to be present at the ADRC visit, so results are reported only from subjects with caregivers. Caregivers were important in maintaining adherence and were provided information and instructions on the device. The device collected information on number of steps, estimates of metabolic equivalent of

tasks (METs), and active energy expenditure (EE) and has been extensively validated.⁵ Minutes of moderate and intense PA were estimated from standard criteria based on METs.

Fifty-two cognitively impaired individuals were approached, and 47 (90.4%) were recruited. At least 3 days of accelerometry are necessary for assessing PA.⁶ Of the 39 participants (83%) completing the study with at least 3 days of data, 26 were diagnosed with Alzheimer's disease (AD) and 13 with mild cognitive impairment (MCI). Nine lived alone (4 AD, 5 MCI) and 30 with a caregiver. The AD group was less educated than the MCI or control group ($P = .005$) and slightly older than the MCI group ($P = .05$) (Table 1).

Of the eight cognitively impaired individuals not completing the study, four were diagnosed with AD, three with MCI, and one with impairment without subjective memory complaints. Those not completing the study (mean age 78.2 ± 9.5) were older but statistically equivalent to those finishing the study (mean age 74.2 ± 10.3 ; $P = .70$). The reasons for not finishing the study were that the monitoring device was lost or not returned ($n = 2$), was returned without data ($n = 2$), was returned but was worn for fewer than 3 days ($n = 3$), and was returned prematurely for unknown reasons ($n = 1$).

The cognitively normal adults ($n = 28$) had a 100% adherence rate for wearing the device for at least 3 days. The daily percentage of time wearing the device did not differ between the cognitively normal and impaired groups ($t(1,65) = 0.89$; $P = .40$), nor did it differ between the diagnostic subgroups ($t(1,37) = 0.81$; $P = .42$).

This study demonstrates that it is feasible to use PA monitoring devices in individuals with cognitive impairment. There was interest in and a commitment to wearing the device for at least 3 days, and most wore the device for 7 days (Table 1). Demonstrating feasibility of PA monitoring devices in a cognitively impaired population is fundamental

Table 1. Physical Activity and Demographic Information According to Group

Factor	Alzheimer's Disease Group	Mild Cognitive Impairment Group	Control Group
Completing the study, n	26	13	28
Not completing the study, n	4	3	0
Age, mean \pm SD	76.8 \pm 9.3	70.5 \pm 12.6	75.0 \pm 7.5
Female, %	30.8	61.5	53.6
Years of education	14.2 \pm 2.3	17.1 \pm 2.2	16.7 \pm 3.4
Caucasian, %	88.5	76.9	92.8
Body mass index, kg/m ² , mean \pm SD	26.4 \pm 5.3	28.1 \pm 4.1	27.3 \pm 4.6
Days wearing the device, mean \pm SD	6.6 \pm 1.0	6.2 \pm 1.3	7.2 \pm 1.3
Percentage of time wearing the device, mean \pm SD	95.6 \pm 7.1	97.4 \pm 4.2	96.9 \pm 3.3
Total steps per day, mean \pm SD	2,658.8 \pm 2,207.0	5,889.7 \pm 2,867.4	6,470.2 \pm 4,715.8
Metabolic equivalents per hour, mean \pm SD	1.1 \pm 0.2	1.1 \pm 0.2	1.2 \pm 0.3
Active energy expenditure, J, mean \pm SD	198.2 \pm 238.8	213.6 \pm 189.22	632.2 \pm 1,008.7
Minutes of moderate physical activity per day, mean \pm SD	40.7 \pm 43.4	41.6 \pm 30.9	86.2 \pm 118.5

SD = standard deviation.

for designing randomized trials of PA, but despite the high level of interest in participating, adherence was lower in the cognitively impaired population (83%) than in the cognitively normal adults (100%). These numbers should be considered when designing future trials and power analyses to assess adherence and sample sizes.

PA monitoring devices have been validated in samples across the lifespan⁷ and are used to assess risk of falls,⁸ quality of life,⁹ and sleep¹⁰ in elderly adults. The current study demonstrated the feasibility of objectively assessing PA in a community sample of individuals with dementia. Given the cross-sectional nature of the study, the small sample size, and the limited information on comorbidities, it will be necessary for future studies to systematically and comprehensively assess and control for potential confounders between groups. Nonetheless, this study demonstrates that there is interest in using this type of technology to monitor activity and lifestyle in cognitively impaired individuals. Future studies could use this technology for monitoring activity, sleep, and physical exertion in elderly adults with the aim of developing non-pharmacological interventions to enhance cognition or prevent further cognitive decline.

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REFERENCES

- Podewils LJ, Guallar E, Kuller LH et al. Physical activity, APOE genotype, and dementia risk: Findings from the Cardiovascular Health Cognition Study. *Am J Epidemiol* 2005;161:639–651.
- Blair SN, Kohl HW III, Paffenbarger RS Jr, et al. Physical fitness and all-cause mortality. A prospective study of healthy men and women. *JAMA* 1989;262:2395–2401.
- Lopez OL, Becker JT, Klunk W et al. Research evaluation and diagnosis of possible Alzheimer's disease over the last two decades: II. *Neurology* 2000;55:1863–1869.
- Lopez OL, Becker JT, Klunk W et al. Research evaluation and diagnosis of probable Alzheimer's disease over the last two decades: I. *Neurology* 2000;55:1854–1862.
- Jakicic JM, Marcus M, Gallagher KI et al. Evaluation of the SenseWear Pro Armband to assess energy expenditure during exercise. *Med Sci Sports Exerc* 2004;36:897–904.
- Hart TL, Swartz AM, Cashin SE et al. How many days of monitoring predict physical activity and sedentary behaviour in older adults? *Int J Behav Nutr Phys Act* 2011;8:62–68.
- Lopes VP, Magalhaes P, Bragada J et al. Actigraph calibration in obese/overweight and type 2 diabetes mellitus middle-aged to old adult patients. *J Phys Act Health* 2009;6(Suppl 1):S133–S140.
- Stone KL, Ancoli-Israel S, Blackwell T et al. Actigraphy-measured sleep characteristics and risk of falls in older women. *Arch Intern Med* 2008;168:1768–1775.
- Voukelatos A, Merom D, Rissel C et al. The effect of walking on falls in older people: The 'Easy Steps to Health' randomized controlled trial study protocol. *BMC Public Health* 2011;11:888.
- Naismith SL, Rogers NL, Hickie IB et al. Sleep well, think well: Sleep-wake disturbance in mild cognitive impairment. *J Geriatr Psychiatry Neurol* 2010;23:123–130.