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The Role of the Environment on Sedentary Behavior in Community-Dwelling Older Adults

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Abstract

Objectives.—To compare amounts of sedentary behavior and physical activity in adults residing in planned group residential settings to those residing in private homes.

Methods.—Thirty-one older adults who resided in planned group residential settings (n=13) and in private homes (n=18) participated. Daily activities were measured using the Sensewear Armband for 7 days. Estimates of the duration of daily activities performed across sedentary, light, and moderate-to-vigorous intensities were captured.

Results.—Participants in planned group residential settings were older (age 85.9±3.5 vs 78.3±7.2; p=0.001) and spent more time in sedentary behaviors (12.7±1.5 vs 11.3±1.6; p=0.02) than participants in private homes. The difference was attenuated slightly after controlling for age and wear time (adjusted difference 1.2±0.6 hours, p=0.06).

Discussion.—Adults residing in planned group residential settings, which provide supportive services, were more sedentary than adults residing in private homes. The environment in which older adults live may contribute to sedentary behavior.

Keywords

sedentary; environment; planned group residential settings

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INTRODUCTION

Despite the fact that physical activity is an essential part of healthy aging, older adults are the least active group of Americans, with only about one fifth achieving physical activity recommendations.(Statistics, 2013) Compounding this issue are growing concerns about prolonged sitting, or sedentary behavior. Sedentary behavior is defined as waking activity expending <1.5 metabolic equivalents (METs) while in a seated or reclined posture.(Gibbs, Hergenroeder, Katzmarzyk, Lee, & Jakicic, 2015) Emerging evidence has shown that, independent of physical activity, high levels of sedentary behavior are linked to adverse outcomes such as cardiovascular disease, diabetes, and mortality.(A. Biswas & Alter, 2015; A Biswas, Oh, & Faulkner, 2015; Wilmot et al., 2012) In older adults, greater sedentary behavior is especially concerning given further associations with worse physical function/ disability(Gennuso, Gangnon, Matthews, Thraen-Borowski, & Colbert, 2013; Rosenberg et al., 2016; Santos et al., 2012; Seguin et al., 2014) and less successful aging.(Dogra & Stathokostas, 2012)

Sedentary behavior is highly prevalent across all age groups in the United States. Data from the 2003–2004 National Health and Nutrition Examination Survey in people 6 years of age and older showed that individuals spent on average 7.7 hours/day in sedentary behaviors. (Matthews et al., 2008) Time spent in sedentary behavior increases with age, with adults over the age of 60 one of the most sedentary age groups. One systematic review found that, whether measured by questionnaire or by activity monitors, the majority of older adults were highly sedentary. In fact, when measured by an accelerometer, older adults spend an average of 8.5–9.8 hours/day engaged in sedentary behaviors.(Harvey, Chastin, & Skelton, 2015; Seguin et al., 2014; Semanik et al., 2015)

Many factors such as characteristics of the individual, the social environment, the physical environment, and policies may contribute to sedentary behavior.(Sallis et al., 2006) Though community-dwelling older adults all live in the “community”, they are a diverse group residing in very different types of living environments which may influence their sedentary behavior. Often as older adults age and develop functional limitations, they relocate from private homes to more disability-friendly residences such as planned group residential settings (i.e. independent living facilities). In planned group residential settings, the private space often shrinks, many services such as meals, housekeeping, planned social activities and transportation are provided, and there is an (arguably over-)emphasis on resident safety. (Kane & Cutler, 2015) Though supportive and protective, these characteristics of the physical and social environment may actually discourage activity and promote sedentary behavior in older adults. Understanding the association between the living environment and sedentary behavior is important to the development of multifactorial interventions focused on minimizing sedentary behaviors in older adults.

Therefore, the purpose of the present study was to compare the amount of sedentary behavior and physical activity in community-dwelling older adults residing in a planned group residential setting (i.e. independent living facilities) to those residing in private homes/ apartments. We hypothesized the sedentary behavior would be greater in older adults

residing in planned group residential settings compared to those in private homes/apartments.

METHODS

Study Overview

This study involved secondary data analysis of the On the Move study (clinicaltrials.gov NCT01986647). (Brach et al., 2016) Briefly, the parent study was a cluster randomized, single-blind intervention trial to compare the effects of a group-based exercise program that includes timing and coordination exercises that focus on improving walking (On the Move) and a standard strength and endurance group exercise program in community-dwelling older adults. Outcomes were assessed before and immediately following the 12-week exercise intervention. In a convenience sub-sample of participants, physical activity was assessed post-intervention (physical activity ancillary study) and is the focus of this investigation. The study was approved by the University of Pittsburgh Institutional Review Board, and signed informed consent was obtained from all participants.

Subjects

For the parent trial, participants were recruited between April 2014 and January 2016, from those individuals residing in a group residential setting, senior apartment buildings, and private residences in the greater Pittsburgh, Pennsylvania area. The group residential settings included private apartment or townhome living often in a single building or within a larger campus with convenient access to dining, medical care, entertainment and more. Hospitality services, such as housekeeping, meals, and laundry are typically included in these settings.

Inclusion criteria were age ≥ 65 , a resident/member of the participating facility, and ability to ambulate independently (with or without a straight cane) with a gait speed ≥ 0.60 m/s. Those who were non-English speaking; were unable to follow a 2-step command or understand the informed consent process; planned to leave the area for an extended period of time; had a progressive neuromuscular disorder; had any medical condition or illness that was not stable; or had a post 6-minute walk test heart rate ≥ 120 beats per minute, systolic blood pressure ≥ 220 or a drop in systolic blood pressure >10 mmHg or diastolic blood pressure ≥ 110 mm Hg were excluded. Participants (N=31) in the present study were a sample of convenience selected based on the availability of physical activity monitors to be used for testing.

Assessments

All testing was conducted by trained research staff. Demographics, fear of falling, fall history, height and weight were self-reported. Chronic condition burden was assessed with a self-reported comorbidity index indicating 18 common conditions. (Rigler, Studenski, Wallace, Reker, & Duncan, 2002) Eight domains (cardiovascular, respiratory, musculoskeletal, neurological, general, cancer, diabetes, and visual) were derived and summed. Gait speed was assessed on an instrumented walkway (Zeno Walkway, Zenometrics, Peekskill, NY). Participants completed 6 passes at their usual, self-selected

speed which were then averaged. Gait speed has excellent test-retest reliability (0.98). (Brach, Perera, Studenski, & Newman, 2008)

Physical Activity

Daily physical activity and sedentary behavior were measured using the Sensewear Armband (SWA; BodyMedia Inc., Pittsburgh, PA). The SWA Pro3 is a small multi-sensor wireless monitor that combines information on heat flux, skin temperature, galvanic signal, and biaxial accelerometry that enable data collection on activities that do not require ambulation. Subjects were instructed to wear the SWA on the back of their right arm (over the triceps muscle) for 7 consecutive days and to remove it only for showering/water exercises and sleeping. The SWA turns on/off automatically when on/off the arm. After the 7-day period, subjects returned the SWA to the research facility where data was downloaded.

Data were integrated and processed by the SenseWear Professional software v8.1 (BodyMedia Inc., Pittsburgh, PA) using proprietary algorithms that utilizes the subject's demographic characteristics (gender, age, height, and weight). The software generates estimates of wear time, duration of physical activity performed across several intensities, i.e., sedentary (<1.5 metabolic equivalents [METs]), light (1.5–2.9 METs) and moderate-to-vigorous (≥3 METs). Subjects were excluded from analyses if they had less than 4 days with at least 10 hours of daily activities data. (Troiano et al., 2008) The SWA is a reliable and valid tool to measure daily activities in older adults. (Almeida, Irrgang, Fitzgerald, Jakicic, & Piva, 2016; Almeida, Wert, Brower, & Piva, 2015; Colbert, Matthews, Havighurst, Kim, & Schoeller, 2011)

Data Analysis

We used independent samples *t*- and Fisher's exact tests to compare participant characteristics between settings (i.e. planned group residential settings and private homes/apartments). We used an analysis of covariance (ANCOVA) type linear models to compare physical activity measures between the two settings, with and without adjusting for covariates. With a sample size of 31, we could only accommodate two additional covariates at a time. We adjusted for wear time as it is a requirement in such measures, (Cain & Geremia, 2011) and age and completed intervention which were significantly different between living settings. Upon observing an unadjusted difference in sedentary time, we further explored it by controlling for comorbidities, completed intervention and gait speed which are likely to affect physical activity through alternative pathways other than living environment, based on simple plausibility. SAS® version 9.3 (SAS Institute, Inc., Cary, North Carolina) was used for analysis.

RESULTS

Of the thirty-one participants included in the analyses, 13 resided in a planned group residential setting and 18 resided in private homes/apartments. Older adults residing in a planned group residential setting were older and more likely to have a college education compared to older adults residing in private homes/apartments. Though not statistically

significant, individuals in a planned group residential setting appeared to have more disease burden and walked slower than those residing in private homes (Table 1).

The participants had on average 6.4 ± 1.0 days of valid wear and the number of days of valid wear did not differ between the groups (6.3 ± 0.9 for planned group residential settings and 6.5 ± 1.0 for private homes; $p=0.603$). Participants wore the monitors for 13.9 ± 1.2 hours per day and the amount of wear time did not differ between groups (planned group residential settings = 14.1 ± 1.2 hours and private homes = 13.8 ± 1.3 hours; $p=0.586$). Older adults residing in planned group residential settings spent 1.4 ± 0.6 greater hours in sedentary behaviors per day than those in private homes/apartments. After adjusting for age and wear time, the difference in sedentary time between groups was attenuated slightly but was still greater than one hour per day (Table 2). Adjusting for gait speed and wear time or comorbidities and wear time slightly attenuated the difference in sedentary time between groups, but the difference was still 1 hour per day (Table 3).

DISCUSSION

The participants in this study were an extremely inactive group of older adults, spending between 11.3 hours and 12.7 hours per day in sedentary behaviors. This level is approximately 1–3 hours more time in sedentary behavior than what is reported in the literature for community-dwelling older adults. (Harvey et al., 2015; Lee et al., 2015; Seguin et al., 2014; Semanik et al., 2015) Sedentary behavior increases with age (Matthews et al., 2008) and the participants in this study are likely older than those previously studied (mean age early 80's – most other research reports on those >65). Individuals residing in planned group residential settings were more sedentary compared to those residing in private residences, spending an average of 1 additional hour in sedentary behaviors per day. These differences in sedentary time were only partially explained by personal factors (age, function, and comorbidities). Thus, it is likely that some of the difference in sedentary time may be attributed to the living environment.

Planned group residential settings provide many amenities for the older adult. Services often include anywhere from one to three meals per day, housekeeping on a daily or weekly basis, and even laundry services. Many recreational activities such as book clubs, bingo, arts and crafts, and exercise classes are provided onsite. Though these provided services are very convenient for the older adult, they may in fact limit or minimize the amount of movement or activity the older adult must do. For example, if meals are provided, the need for leaving the facility to shop for groceries and the need to prepare meals is minimized. In addition to the provided services, the environment is designed to facilitate or promote safety. Elevators are the norm and residents are encouraged to use the elevators instead of taking the stairs to minimize fall risk and promote safety.

One may question if the convenient and protective environment of the planned group residence is a positive or negative characteristic for successful aging. Though the older adults residing in the planned group residences were older and walked slower than those in private homes/apartments they were also less likely to report a fall in the past year (15 vs 22% respectively – though not statistically different). One explanation for the lower fall rate

may be the fact that the older adults in the planned group residences are more sedentary (i.e. moving less) and have less exposure or chance to fall. This lower fall rate may seem like a benefit of sedentary behavior; however, when considering this potential benefit, potential negative health consequences of sedentary behavior must be taken into consideration. Moving forward, researchers will need to consider strategies that are able to safely increase movement and decrease sedentary behaviors in this at-risk group of older adults. Given the potential influence of the physical and social environment on sedentary behavior, interventions should not only target personal level factors but should also address environmental factors to be most successful. A next research step could be a qualitative study involving focus groups and interviews of residents and staff of the planned group residences. By interviewing residents and staff we can begin to identify specific factors that may influence sedentary behavior. Using the social ecological model as a guide, factors under consideration should include individual, interpersonal, organizational, community, and public policy level factors. Once these factors are identified, multi-factorial interventions can be designed to target the various influencing factors.

When interpreting our results, several limitations should be taken into consideration. The study included a relatively small convenience sample of older adults residing in the different environments. Given the small sample, we encourage the reader to focus more on the magnitude of the effects than the statistical significance of the findings. Also, the small sample limits the number of covariates that can be included in the models. Separate models were constructed to examine the influence of the individual covariates, but we were unable to consider all potential covariates simultaneously. Finally, most participants from private homes/apartments had completed the study intervention while those from group residential setting had not. We did perform analyses adjusting for intervention, but cannot ensure our findings are devoid of confounding. While the objective recording of activity data is a strength, the armband used specifically measures intensity and not posture (e.g. seated vs standing), which could have resulted in measurement error when quantifying the sedentary behavior. Another strength is the well characterized sample of much older adults (mean age >80 years of age) who are usually not included in studies of sedentary behavior.

CONCLUSION

Though both groups of older adults were quite sedentary, older adults residing in planned group residential settings, which provide supportive and protective services, had on average an hour more of sedentary time per day than those residing in private homes/apartments. In community-dwelling older adults, the environment in which they live appears to contribute to sedentary behavior.

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Table 1 Demographics: mean $\pm$ standard deviation or n (%)

	Planned Group Residential Setting n=13	Private Homes/ Apartments n=18
Age [†]	85.9 $\pm$ 3.5	78.3 $\pm$ 7.2
Female gender	11 (84.6)	17 (94.4)
White race	13 (100.0)	17 (94.4)
Married	5 (38.5)	2 (11.1)
College education [†]	9 (69.2)	2 (11.1)
Comorbidities		
Cardiovascular	4 (30.8)	3 (16.7)
Neurological	0 (0.0)	1 (5.6)
Musculoskeletal	12 (92.3)	17 (94.4)
General	6 (46.2)	7 (38.9)
Visual/hearing	12 (92.3)	14 (77.8)
Diabetes	2 (15.4)	5 (27.8)
Cancer	5 (38.5)	3 (16.7)
Lung	2 (15.4)	3 (16.7)
Duke comorbidity index (0–8)	3.3 $\pm$ 1.4	2.9 $\pm$ 1.1
Fear of falling	6 (46.2)	8 (44.4)
Fall prior year	2 (15.4)	4 (22.2)
Excellent/very good mobility [†]	9 (75.0)	14 (77.8)
Excellent/very good health [†]	7 (58.3)	11 (61.1)
Excellent/very good balance [†]	4 (33.3)	6 (33.3)
Height (m)	1.6 $\pm$ 0.1	1.6 $\pm$ 0.1
Weight (kg)	65.4 $\pm$ 12.3	74.1 $\pm$ 34.4
Body mass index (kg/m ²)	24.1 $\pm$ 3.3	28.5 $\pm$ 12.1
Gait speed ^{††}	0.85 $\pm$ 0.19	1.06 $\pm$ 0.18
Completed <i>On The Move</i> Intervention [†]	1 (7.7)	17 (94.4)

[†]Collected at the same time as physical activity data^{††} $p < 0.05$ using independent samples t- or Fisher's exact test

Table 2

Sedentary behavior and physical activity by living environment

Measure	Planned Group Residential Setting N=13 mean± standard deviation	Private Homes/ Apartments N=18 mean± standard deviation	Unadjusted difference ± standard error	p-value	* Adjusted estimate± standard error	p-value
Sedentary time, hours/day	12.7±1.5	11.3±1.6	1.4±0.6	0.020	1.2±0.6	0.055
Light intensity activity, minutes/day	96.0±53.7	129.6±78.7	-33.6±25.3	0.195	-47.2±30.3	0.131
Moderate-to-vigorous intensity activity, minutes/ day	6.9±8.8	11.7±13.7	-4.8±4.4	0.280	-1.5±5.0	0.773
Steps per day	2637±1499	2576±1469	60.7±539.3	0.911	295.0±641.1	0.649

*
adjusted for age and wear time

Table 3.

Differences in time (hours) spent in sedentary behavior between living environments adjusting for wear time and other covariates

Model	Adjusted Difference	Standard error	p-value
Unadjusted	1.4	0.6	0.020
Wear time	1.2	0.5	0.016
Age + wear time	1.2	0.6	0.055
Gait speed+ wear time	1.0	0.6	0.088
Comorbidities + wear time	1.1	0.5	0.027
Intervention + wear time	1.4	1.0	0.177