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A Snapshot on the Daily Sedentary Behavior of Community Dwelling Older African American Women

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Abstract

Long periods of sedentary behavior (SB) is detrimental for health. This study investigated SB in older African American women (OAAW) and further compared it between participants of different physical activity status. Twenty OAAW had their sedentary time measured by accelerometers for seven consecutive days. Actigraph 6 processed accelerometer data and SPSS was used for statistical analysis with significance set at $p < .05$. Our sample spent approximately 9 hours in SB with an average of 27 breaks of sedentary time per day. The inactive group had higher amounts of time ($p < .01$) on the average length of sedentary bout and the average number of sedentary bouts longer than 30 minutes compared with the active group. OAAW spend large amounts of their awaking hours in sedentary activities. The findings suggest that the inactive women may be at increased health risk based on the low levels of physical activity and the prolonged sedentary bouts.

Keywords

elderly, sedentary lifestyle, African Americans, physical activity

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There is solid evidence of the benefits of regular physical activity (PA[1]) for older adults (Chodzko-Zajko et al., 2009). However, emerging evidence suggests that large amounts of sedentary time are associated with a large array of chronic conditions and premature mortality, independently of achieving current PA recommendations (i.e., 150 minutes per week of moderate to vigorous PA [MVPA[2]]; de Grøntved & Hu, 2011; de Rezende, Rodrigues Lopes, Rey-López, Matsudo, & Luiz, 2014; Proper, Singh, van Mechelen, & Chinapaw, 2011; Thorp, Owen, Neuhaus, & Dunstan, 2011). For instance, a recent study conducted with nearly 5,000 adults with an average age of 57 observed that those spending 10 hours per day in sedentary activities, objectively measured through accelerometer, had 29% greater risk of death compared with less sedentary adults (Matthews et al., 2016). In the older adult population, high levels of sedentary time have been linked to decreased functional fitness (Santos et al., 2012); increased risk of breast cancer (George et al., 2010); increased metabolic risk, overweight, and obesity; increased mortality rates (Gardiner et al., 2011; Inoue et al., 2012; van der Ploeg, Chey, Korda, Banks, & Bauman, 2012); and shorter leukocite telomere length (Shadyab et al., 2017). Sedentary behavior (SB) is commonly defined as "any waking behavior characterized by an energy expenditure ≤ 1.5 METS while in a sitting or reclining posture" (Tremblay, 2012, p. 540). These behaviors are generally considered distinct from inactivity, which refers to a lack of MVPA, which requires a metabolic equivalent of ≥3 (Pate, O'Neill, & Lobelo, 2008).

As with PA, SB is a major concern in the older adult population, but especially in older African American women (OAAW) who tend to have low rates of PA participation, high amounts of SB (Evenson, Buchner, & Morland, 2012; Troiano et al., 2008), and high rates of chronic conditions. A 2016 study conducted with U.S. adults over the age of 45 observed that older age (i.e., 65 and over), body mass index (BMI), winter season, and low amounts of MVPA were associated with prolonged SB (Diaz et al., 2016). Of note, roughly 30% of the participants in that study were Black. Additional factors reported in the literature influencing SB include, but are not limited to, physical health, aging attitudes, lack of companionship, marital status, and gender (Chastin et al., 2015; Tam-Seto, Weir, & Dogra, 2016). Furthermore, there is evidence suggesting that leisure is the most frequent purpose for SB among older adults, accounting for roughly 50% of sedentary time (Leask, Harvey, Skelton, & Chastin, 2015). Studies examining SB and focused on older African Americans have mostly looked into volume (i.e., total amount spent during awaking hours) and not addressing other potential meaningful variables (e.g., breaks in sedentary time, number of longer sedentary bouts). This is important as it may provide valuable information about patterns of SB in this population that can devise future interventions. For instance, researchers examined PA and SB patterns among low-income African Americans and Whites living in the United States (Cohen et al., 2013). In this study, SB was reported as the total amount of time and patterns were described in terms of type (i.e., TV viewing). Importantly, the authors employed a self-report measurement of the variables, which is known to be susceptible to recall bias. Very little is known about SB in this population using objective measurements (e.g., accelerometers). Evenson et al. advanced the knowledge base by describing sedentary time in a representative sample of U.S. adults aged 60 years and older from different racial groups, including African Americans (Evenson et al., 2012). Despite using objective measures of SB, the previous did not include a more in-depth/detailed analysis of SB (i.e., bouts or breaks). The study was limited to reported volume of sedentary time per day. Furthermore, previous studies did not attempt to examine potential differences in SB between active and inactive participants. This is important as there is evidence that prolonged sedentary time is detrimental for health, independent of achieving PA guidelines.

Advancing previous studies on SB in older African Americans, this exploratory study examined metrics of SB (i.e., volume, breaks in sedentary time, maximum length of sedentary bout, average length of sedentary bout, sedentary bout length >30 minutes) in a sample of community dwelling OAAW (i.e., OAAW living independently in the community as opposed to those living in assistive living facilities). We further explored and compared the data according to participants' PA status (i.e., active vs. inactive; based on accelerometer-derived MVPA) to enhance our understanding on how those metrics differ depending on whether the participant was active or inactive. It was hypothesized that active women would present with better metrics of SB compared with those who were inactive.

Method

Study Design

This cross-sectional study employed the objective measurement of SB through accelerometry. Accelerometry is a technique employed to quantify body acceleration normally using a small and light monitor called accelerometer. Acceleration is defined as the rate of change in velocity over a given time; therefore, the frequency, intensity (i.e., sedentary, light, moderate, and vigorous), and duration of PA can be assessed as a function of body movement. Prior to the commencement of the study, the research study protocol was approved by the University of Illinois Institutional Review Board and a signed informed consent was obtained from all participants before data collection.

Participants

Twenty OAAW living in a Midwestern university town community area were invited to take part in this study. Participants were recruited from a local senior center and posting flyers in different places (e.g., health care, food stores). A snowball sampling technique was also employed. The investigator visited the senior center during their monthly meeting that congregates most of the senior members, and briefly explained the study and asked for their participation. Participants who demonstrated interest were asked to report to the investigator following the end of the meeting to provide their contact information and clarify any additional questions. A total of 13 out of 20 participants were recruited from the local senior center, and four were invited by their peers (e.g., neighbors, church friends) and three replied after seeing the flyer. None of the participants dropped out of the study. To be included, participants had to be able to walk independently and answer questions without help from others. Participants using any assistive device (e.g., walkers and canes) to walk or unable to wear the accelerometer for at least 4 days (including a weekend day) were excluded from the study. Participants were cash compensated for their participation.

Measures

Accelerometer-derived sedentary time. SB was objectively measured using Actigraph GT3X+ accelerometers (Penscola, FL). All accelerometers were previously tested/calibrated prior to use by laboratory staff members. The calibration procedure consisted of having laboratory members walking (slowly and rapidly) and running on a treadmill (4.8 kilometer per hour, 5.6 kilometer per hour, and 8 kilometer per hour at 0% inclination for 12 minutes total) while wearing four accelerometers on a belt around the waist. Accuracy was established by >10% difference in average counts per minute across the 12-minute period among the set of accelerometers worn simultaneously. The ActiGraph accelerometer is a technically reliable instrument, able to detect different levels of intensity (Esliger & Tremblay, 2006; McClain, Sisson, & Tudor-Locke, 2007), and has been proven to be reliable to use in older adults from different race groups, including African Americans (Evenson et al., 2012; Harris et al., 2009). Previous large epidemiological study conducted with older adults (i.e., 60 years and over) including African Americans supports the use of this approach in the present study (Evenson et al., 2012). In the previous study, the authors adopted accelerometry to measure PA and SB using similar protocol than the one applied in the present study. Of note, of 2,630 persons aged 60 years and above participating in the study, more than 600 were Blacks/African

Americans (Evenson et al., 2012). A potential challenge of the use of accelerometer in this population is related to compliance. As participants are asked to remove the accelerometer to sleep and during aquatic activities (e.g., shower), they may forget to replace it. Furthermore, accelerometers are attached to the hip/waist through an elastic belt and, therefore, may shift through the day, which can contribute to measurement error (Schrack et al., 2016). Furthermore, disadvantages of this approach are related to the fact that accelerometers are still relatively costly (i.e., device and software for data analysis price), unable to measure water-based activities, and may pose a burden to participants (i.e., as it is normally used for seven consecutive days), and that there is no consensus regarding cut points to determine PA intensity in the older adult population (Strath, Pfeiffer, & Whitt-Glover, 2012). Despite of the aforementioned study, the advantages far outweigh the disadvantages. Accelerometer is regarded as the "gold standard" measure for field assessment PA. This device has enabled both PA and SB to be measured with great levels of accuracy and precision compared with other indirect and subjective measures (e.g., self-report questionnaires—overestimates PA and subestimates SB). For instance, researchers have demonstrated in a comparative validity study that objective monitors more appropriately rank PA energy expenditure compared with subjective measures (i.e., questionnaires) in older adults (Colbert, Matthews, Havighurst, Kim, & Schoeller, 2011). In fact, there is strong evidence suggesting age is not an important factor in using objective monitoring (i.e., accelerometer) in older adults to evaluate accelerometer outputs (Strath et al., 2012) as done in the present study. Accelerometer has the additional advantage of being small in size and lightweight, and able to record data continuously over an extended period (e.g., days or weeks). These features make it suitable to be used in older adults who oppose to some cumbersome devices and methods. The lack of immediate visual feedback is also an advantage as the possibility of tampering is reduced compared with other objective measures, for example, pedometers.

Volumes of sedentary time and MVPA. ActiLife 6 software was used to process accelerometer data from each individual separately. The output was then transferred into a Microsoft Excel file representing wear time, time spent being sedentary, and MVPA (Table 1) based on activity count cut points developed for adult individuals (Freedson, Melanson, & Sirard, 1998) and in accordance with recent work (Van Cauwenberg, Van Holle, De Bourdeaudhuij, Owen, & Deforche, 2015).

Metrics of sedentary time. Metrics of sedentary time were determined from the excel files and constituted the number of daily breaks in sedentary time,

Table 1. Description of Sedentary Behavior and Physical Activity Terms With Cut Points.

Term	Definition	Accelerometer cut point
Volume		
Sedentary time	Time in activities (sitting or lying) that do not increase energy expenditure substantially above the resting level (1.0-1.5 METs)	Total minutes < 100 counts/min*
MVPA intensity activity	Activities that involve energy expenditure above 3.0 METs	≥1,952 counts/min*
Pattern		
Break in sedentary time	A defined point in time where there is a change from sedentary to a nonsedentary activity or an interruption in sedentary time	Activity count change from <100 to ≥100 counts. A break only occurs if the change in counts is sustained for more than 2 minutes
Sedentary bout length	Consecutive minutes when count values fall into the sedentary range (<100 counts/min). In this study, drop time was 2 minutes	Consecutive minutes with recorded counts of <100/min (if sustained for more than 2 minutes)
Maximum length of sedentary bouts	The length of the longest sedentary bout	NA
Average length of sedentary bouts	Average of the sedentary bouts—minimum of 10 minutes uninterrupted	NA
Sedentary bout length >30 minutes	Number of sedentary bouts larger than 30 minutes uninterrupted	NA

Note. MET = metabolic equivalent; MVPA = moderate-to-vigorous physical activity.
*based on activity count cut points developed by Freedson, Melanson, and Sirard, 1998

maximum lengths of sedentary bouts (minutes), average length of sedentary bouts (minutes), and number of long sedentary bouts (i.e., >30 minutes). The definitions and cut points used for the analysis are displayed in Table 1. Briefly, breaks in sedentary time refers to interruption in sedentary activity where participants change from sedentary to a nonsedentary activity. Sedentary bout length refers to the amount of consecutive time participants remained in sedentary activity. Accelerometer wear time data were checked using the log file output, and only valid days (set as ≥10 hours of wear time without periods of continuous zeros exceeding 60 minutes indicative of compliance) were included in the analysis. Consistent with previous research conducted in the field (Baranowski, Mâsse, Ragan, & Welk, 2008; Matthews, Hagströmer, Pober, & Bowles, 2012; Trost, Mciver, & Pate, 2005), our analysis included only participants with a minimum of 4 valid days, including at least one weekend day, which has been shown to provide a reliable estimate of habitual activity behavior. This was important, as we aimed to examine potential differences in metrics of SB between active and inactive participants.

PA status. PA status was determined based on the participant's amount of MVPA and using the current national PA recommendations as the criterion measure (Physical Activity Guidelines Advisory Committee, 2008). This recommendation states that adults and older adults should accumulate at least 150 minutes per week of MVPA for health benefits. Of the 20 participants, nine performed 150 minutes per week or more of MVPA and were allocated into the active group; and 11 performed less than the recommended amount and were allocated into the inactive group.

Demographics and anthropometrics. Along with the objective assessment of SB, participants provided demographic and anthropometric information that was used for sample characterization. Demographic and anthropometric information including age, marital status, annual income, years of education, height and weight (to calculate participants' BMI), number of medications, and number of chronic conditions were collected.

Procedure

Participants who were eligible to participate in the study were contacted to schedule a meeting with the investigator to sign the informed consent, complete the sociodemographic and health questionnaire, and receive the accelerometer. At this meeting, participants were asked to wear the accelerometer at the hip for seven consecutive days for at least 10 hours per day. The device was set up to register data in 60-second epoch with standard drop time of 2 minutes. Participants were instructed to put on the device after they wake up in the morning and get ready for the day and to take it off when going to bed at night. Nonwear periods were defined as times during which no movement was detected for 60 consecutive minutes (Troiano et al., 2008). Participants were further instructed to not use the device during aquatic activities (i.e., bathing, showering, or swimming) and to maintain their usual levels of activity during the 1-week period. The investigator instructed participants on how to properly use the device (i.e., position at the nondominant hip and proper side of the device) and also provided participants with written and graphic instructions on how to wear the device. Moreover, participants were directed to promptly contact the investigator if they identified any malfunctioning with the device (e.g., a blinking flashing light after data collection started). After completion of the 1-week period, accelerometers were retrieved by research staff for data processing.

Data Analysis

SPSS version 22 (IBM Corp., SPSS Inc., Armonk, NY) was used for data analysis with significance set as $p < .05$. General characteristics of the participants (age, years of education, marital status, annual income, BMI, number of diagnosed diseases, number of medication taken) were reported overall and by PA status (i.e., active vs. inactive). Furthermore, *t* test and Mann–Whitney *U* test depending on the variable being analyzed were used to determine possible differences in accelerometer-derived SB metrics between groups of different PA status. Effect sizes using Cohen's *d* based on a difference in mean scores between PA status groups of pertinent variables were further calculated and interpreted (i.e., $d = 0.2$ is a small effect, $d = 0.5$ is a moderate effect, and $d = 0.8$ or higher is a large effect).

Results

Sociodemographic and biomedical characteristics of the overall sample and separated by PA status (i.e., active vs. inactive) are given in Table 2. Briefly, groups were found to be similar regarding age ($p = .15$) with overall mean age of the sample being approximately 68 years. All participants reported having at least a high school degree with most of them being married or divorced/separated. The presence of disease and use of medication was common among the participants, which presented with an average BMI of about 30 kilogram per meter squared.

Volume and Metrics of SB

The findings on volume and metrics of SB for the overall sample and separated by PA status are given in Table 3. Briefly, OAAW participants in this study engage in sedentary activity on an average of approximately 81% of the day (i.e., ~9.4 hours). The average length of sedentary bouts and the average number of sedentary bouts longer than 30 minutes were significantly greater in the inactive group ($p < .01$), and the difference was in large magnitude

Table 2. General Characteristics of the Participants.

		Physical Activity Status	
	Total (n = 20)	Active (≥150 min/week of MVPA) (n = 9)	Inactive (<150 min/week of MVPA) (n = 11)
Age (*M*, *SD*)	68.3 (6.1)	66.11 (6.4)	70.09 (5.6)
Education (*n*, %)			
High school	5 (25)	2 (22.2)	3 (27.2)
Some college	8 (40)	5 (55.5)	3 (27.2)
College or more	7 (35)	2 (22.2)	5 (45.4)
Years living in town (*M*, *SD*)	48.15 (20.9)	43.33 (22.7)	52.09 (16.6)
Marital status (*n*, %)			
Single	1 (5)	1 (11.1)	—
Married	7 (35)	3 (33.3)	4 (36.4)
Divorced/separated	7 (35)	4 (44.4)	3 (27.3)
Widowed	5 (25)	1 (11.1)	4 (36.3)
Living status (*n*, %)			
Alone	3 (15)	3 (33.3)	—
With someone	17 (85)	6 (66.6)	11 (100)
Income (*n*, %)			
US$5,000-US$9,999	1 (5)	1 (11.1)	—
US$15,000-US$19,999	3 (15)	3 (33.3)	—
US$20,000-US$29,999	7 (35)	—	7 (63.6)
US$30,000-US$39,999	3 (15)	2 (22.2)	1 (9.1)
US$40,000-US$49,999	1 (5)	—	1 (9.09)
US$50,000 and over	5 (25)	3 (33.3)	2 (18.2)
Self-reported health (*n*, %)			
Good	9 (45)	5 (55.5)	7 (63.6)
Very good	11 (55)	4 (44.4)	4 (36.3)
Chronic disease (*n*, %)			
0	4 (20)	3 (33.3)	1 (9.1)
1-2	11 (55)	5 (55.5)	6 (54.5)
≥3	5 (25)	1 (11.1)	4 (36.3)
Medication (*n*, %)			
0	5 (25)	4 (44.4)	1 (9.1)
1-2	9 (45)	3 (33.3)	6 (54.5)
≥3	6 (30)	2 (22.2)	4 (36.3)
Health insurance (*n*, %)			
Yes	19 (95)	8	11 (100)
BMI (kg/m^2; *M*, *SD*)	30.6 (3.94)	29.2 (4.1)	31.8 (3.5)
Fall in the past 12 months (*n*, %)			
Yes	5 (25)	2 (22.2)	3 (27.2)

Note. MVPA = Moderate to vigorous physical activity; BMI = body mass index—calculated by the weight divided by the height squared.

Table 3. Accelerometry Results for the Entire Sample and by Physical Activity Status.

Variables	Total n = 20 M (SD)	Physical Activity Status: Active (n = 9) M (SD)	Physical Activity Status: Inactive (n = 11) M (SD)	p	d
Accelerometer variables					
Valid days[a]	5.7 (1.1)	5.8 (1.3)	5.5 (0.8)	0.58	0.27
Wear time, min/day[b]	699.3 (64.4)	722.4 (78.4)	680.3 (45.7)	0.15	0.65
Volume					
Sedentary time, min/day[b]	566.3 (63.3)	558.1 (76.8)	573.1 (52.6)	0.60	−0.22
MVPA intensity, min/day[b]	28.9 (16.8)	42.9 (5.3)	17.4 (2.8)	<0.01	6.01
Pattern					
Breaks in sedentary time, n per day[b]	27.5 (6.7)	25.6 (7.1)	29.2 (6.2)	0.90	−0.54
Maximum length of sedentary bouts, min[a]	114.7 (87.1)	76.3 (29.6)	146.1 (106.3)	0.07	−0.89
Average length of sedentary bouts, min[b]	21.05 (5.3)	17.1 (2.4)	24.3 (1.4)	<0.01	−3.66
Sedentary bout length >30 minutes, n per day[a]	5.9 (2.7)	3.5 (1.5)	7.95 (1.4)	<0.01	−3.06

Note. MVPA = Moderate to vigorous physical activity; *d* = Cohen's *d* effect size.
[a]The *t* test for independent sample.
[b]Mann–Whitney *U* test.

based on the effect size observed. A marginal difference between active and inactive groups was observed for maximum length of sedentary bouts (p = .07), but the other variables did not differ between groups (p > .05).

Discussion

This study examined metrics of SB (i.e., volume, breaks in sedentary time, maximum length of sedentary bout, average length of sedentary bout, sedentary bout length >30 minutes) in a sample of community dwelling OAAW, and further compared these metrics between groups of different PA status (i.e., active vs. inactive). The major findings of this study are (a) OAAW spent large amounts of their daily awaking hours in sedentary activities with very few number of sedentary breaks regardless of PA status, without a significant difference between groups of PA status, and (b) women classified as inactive had significantly higher average length of sedentary bout and accumulated significantly more sedentary bouts of greater than 30 minutes than their active counterparts. Subsequent analysis demonstrated that the difference between groups was large in magnitude based on the effect sizes observed. It was further observed that there was a marginal difference on maximum length of sedentary bout between groups. Collectively, these findings partially support our hypothesis and underscore the need for interventions focusing on reducing SB in this population, especially for those struggling to meet current PA guidelines (i.e., inactive group). In addition, due to the strong association between SB and adverse health outcomes, our results (coupled with findings from previous investigations on SB in the older adult population) may further help in the development of and/or to enhance future strategies and interventions aiming to improve health among OAAW.

In the present study, OAAW regardless of PA status (i.e., active or inactive) spent over 9 hours per day in sedentary activity. These findings corroborate those of previous studies conducted in a similar population (Cohen et al., 2013; Evenson et al., 2012). For instance, Cohen et al. reported a total sitting time (a proxy of SB) of 9.5 hours for their African American participants aged 60 to 69 years old and 9.4 hours for those aged 70 to 79 years (Cohen et al., 2013). The last is similar to those objectively assessed 9.2 hours reported by Shadyab et al. (2017) in older adults (African Americans and Whites) aged 64 to 79 years, but slightly higher than the 8 hours demonstrated by investigators using accelerometry to assess SB in older African Americans (Evenson et al., 2012). By contrast, our findings are higher than the 7.5 hours per day of SB observed in a study with older Japanese adults (Chen et al., 2015) and the 7 hours per day in studies addressing SB conducted in U.S. adults (C. E. Matthews et al., 2016). There is further evidence that engagement in SB constitutes a great part of the day in the general population (50%-80%; Bauman et al., 2011; Dunstan & Owen, 2012). Collectively, the different studies suggest that OAAW are prone to large amounts of SB during their awaking hours, reinforcing older adults as the most sedentary age group (Healy, Clark, et al., 2011; Rhodes, Mark, & Temmel, 2012). It should be a concern, especially among OAAW, as this group also presents with one of the lowest levels of PA participation compared with other racial groups (Troiano et al., 2008). This is further important because, for example, there is evidence of the association between high amounts of sedentary time measured by accelerometer and shorter leukocyte telomere length among less physically active women. This suggests that prolonged sedentary time and limited engagement in PA may act synergistically to shorten leukocyte telomere length among older women. Shortened leukocyte telomere length has been associated with a large array of conditions including cardiovascular disease, type 2 diabetes, and some cancers (Shadyab et al., 2017). These conditions are known to be highly prevalent in the African American population (Chow, Foster, Gonzalez, & Mclver, 2012; Desantis et al., 2016). Thereby, avoiding a sedentary lifestyle may provide health benefits at the cellular level (Shadyba et al., 2017).

Although the number of daily breaks in sedentary time did not differ by PA status, the overall average daily number of breaks for the sample (27.5), and in both active (25.6) and inactive (29.2) groups, was extremely lower compared with a previous study adopting, on average, a lower age group (Healy et al., 2008; Schlaff, Baruth, Boggs, & Hutto, 2017). For instance, investigators reported an average of nearly 93 daily breaks in sedentary time in healthy adults aged 20 years and over (Healy et al., 2008) and 73 in persons aged 55 years and over (Schlaff et al., 2017). This suggests that OAAW (active and inactive) engage in more prolonged sedentary activities compared with other groups. The average length of sedentary bouts and the number of long sedentary bouts (i.e., ≥30 minutes) were significantly higher in those in the inactive group. Overall, participants in this study reported six long sedentary bouts per day, with the subsample of active women reporting around four, and the inactive subsample reporting nearly eight. These numbers are somehow similar (i.e., 5.5 on average) to those reported in a large study involving U.S. adults (i.e., ≥45 years old; Diaz et al., 2016). However, a recent study conducted in 67 inactive older adults reported an average of 3.7 long sedentary time bouts (i.e., ≥30 minutes; Schlaff et al., 2017). This number is similar to the four bouts observed for the active group of women participating in this study but nearly half of the average number reported by the inactive group. A partial explanation could be related to race/cultural differences and age. The previous recruited persons aged 55 years and above (i.e., one decade younger than ours). Furthermore, out of the 67 participants, only nine were African Americans. Prolonged uninterrupted periods of SB have been described to be particularly detrimental for health. For instance, there is evidence linking prolonged uninterrupted periods of sedentary time with negative cardiometabolic markers (Healy, Matthews, Dunstan, Winkler, & Owen, 2011; for example, High-density lipoprotein (HDL) cholesterol, C-reactive protein, insulin sensitivity) and metabolic syndrome (Gardiner et al., 2011). In the previous study, the authors examined the association between SB assessed through TV viewing and overall sitting time and concluded that for older adults, high levels of

SB were associated with greater prevalence of metabolic syndrome. On the contrary, transitions from sedentary to nonsedentary activities (e.g., light-intensity activities) have been associated with improvements in similar cardio-metabolic markers (Healy, Matthews, et al., 2011). From the perspective of energy expenditure, a previous study with young adults (18-39 years old) indicates that standing up and walking for 1 minute within a sedentary bout of 30 minutes may result in a net energy expenditure of 3.0 kcal, and if sustained for 1 week will accrue nearly 40 times more (~120 kcal; Swartz, Squires, & Strath, 2011). To this end, frequently interrupting sedentary time with light-intensity activity with a particular emphasis on long sedentary bouts deserves special attention as it may help individuals improve their health. This is reinforced by a recent study suggesting that increasing light-intensity activity and reducing sedentary time are particularly important for inactive adults. In this study, researchers observed that compared with those who performed less light activity (i.e., 3 hours per day), those performing 5 hours per day of light activity presented with a 23% reduction in the risk of premature death (Matthews et al., 2016). There is preliminary evidence suggesting that interventions focusing on reducing sedentary time in older adults may be effective. Researchers reported a reduction of 24 minutes per day on time spent sitting/lying in older Scottish adults following an intervention using individualized consultation and activPAL accelerometer feedback (Fitzsimons et al., 2013).

To the best of our knowledge, this is the first study to provide preliminary novel findings on metrics of SB (i.e., breaks in sedentary time, sedentary bout length, maximum length of sedentary bouts, sedentary bout length over 30 minutes) not addressed in previous studies in this population. The study of different metrics of SB are important because it may potentially provide new insights into SB that can be useful to devise strategies and interventions focusing on reducing this health risk. Along with the objective measurement of SB in an underresearched population (i.e., OAAW) and the fact that we analyze the data also separated by PA status, these could be regarded as strengths of the study. The objective measurement of SB was important to minimize the bias inherent in self-report. Furthermore, despite no systematic data were collected in this matter, participants of this study had no complaints about the use of the device (i.e., accelerometer) or the time they were asked to wear it. Importantly, during instructions on how to use the device, participants were explained that the device was not featured with any type of camera or global positioning system (i.e., GPS), and that the device was able to record only the amount of activity they perform during the awaking hours. Despite the importance, this study has some limitations. The relatively small sample size and recruitment procedures are limitations of this study. Involving African Americans in research has proved to be a challenging task for researchers. Mistrust of doctors, scientists, and the government have been reported (Corbie-Smith, Thomas, Williams, & Moody-Ayers, 1999). In our study, we invited over 40 participants, and only 20 agreed to participate in the study. All 20 participants enrolled completed the study. Because of our small sample and convenience sampling strategy, caution is warranted when interpreting our findings and generalizing them to the broader community of OAAW. Although objectively measuring SB minimizes bias, it does not provide information about the domain/type of the SB (e.g., TV viewing, computer, transportation). Such information would complement the findings of this study. Another limitation lies in the fact that the Actigraph accelerometers may not be the best approach to measure SB. There is evidence suggesting that ActivPAL accelerometers are more accurate than the Actigraph GT3X accelerometer in assessing SB (Kim, Barry, & Kang, 2015). Despite its limitations, this study provided preliminary novel evidence on meaningful metrics of SB of OAAW not previously reported. However, future studies should replicate this protocol in a larger sample size for a better comprehension of such behavior in this population, and may attempt to examine SB using ActivPAL accelerometer and complementing the data collection with self-report information on where the SB occurs (i.e., domains— leisure, household, transportation, work). A better understanding of SB in active and inactive OAAW is particularly important to promote and optimize health interventions focusing on SB in this population.

Conclusion

In summary, our findings demonstrate that OAAW regardless of PA status (i.e., active or inactive) spend high amounts of their daily waking hours in SB with very low numbers of sedentary breaks. In addition, inactive women have higher average length of sedentary bout and accumulate more number of long sedentary bouts compared with their active counterparts. Collectively, it suggests that despite the fact that some women are achieving the PA recommendation, they continue to be at high risk for negative health outcomes due to the long time spent in SB. Furthermore, the inactive women in this study may be at increased risk due to the long period of time spent in SB as well as their inability to accumulate enough PA for health benefits (i.e., 150 minutes per week of MVPA). The findings of this study compliment and build upon the results of previous work on SB among African Americans and constitute important information for public health practice. Our study is one of the relatively few on this topic and the findings underscore the importance of, and may serve as starting point for, developing strategies and interventions to reduce sedentary time and to increase PA in this population. Furthermore, studies of this nature are important because older minority groups—like African Americans—are growing exponentially in the United States and they present one of the lowest level of PA participation at recommended levels and higher levels of SB. This is timely as prolonged sedentary time has been linked to a large array of negative health outcomes in adults and older adults.

Authors' Note

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Notes

1. Any bodily movement produced by the skeletal muscles that results in energy expenditure above resting level (Bouchard, Shephard, & Stephens, 1994).
2. Moderate-intensity activities require a moderate amount of effort a noticeably accelerates the heart rate. In other words, activities requiring 3 to 6 times more energy per minute compared to a sitting quietly position (resting level). Vigorous-intensity activities require a large amount of effort and causes rapid breathing and a substantial increase in heart rate. In other words, activities requiring over 6 times more energy per minute compared to a sitting quietly position (resting level; Physical Activity Guidelines Advisory Committee, 2008).

References

Baranowski, T., Mâsse, L. C., Ragan, B., & Welk, G. (2008). How many days was that? We're still not sure, but we're asking the question better! *Medicine & Science in Sports & Exercise*, *40*, 544-549. doi:10.1249/MSS.0b013e31817c6651

Bauman, A., Ainsworth, B. E., Sallis, J. F., Hagströmer, M., Craig, C. L., Bull, F. C., . . .Sjöström, M. (2011). The descriptive epidemiology of sitting: A 20-country comparison using the International Physical Activity Questionnaire

(IPAQ). *American Journal of Preventive Medicine*, *41*, 228-235. doi:10.1016/j.amepre.2011.05.003

Bouchard, C., Shephard, R. J., & Stephens, T. (1994). Physical activity, fitness, and health: International proceedings and consensus statement. In C. Bouchard, R. J. Shephard, & T. Stephens (Eds.), *Physical activity, fitness, and health: International proceedings and consensus statement*. Champaign, IL: Human Kinetics. Retrieved from http://ovidsp.ovid.com/ovidweb.cgi?T=JS&CSC=Y&NEWS=N&PAGE=fulltext&D=psyc3&AN=1994-97580-000%5Cnhttp://sfx.scholarsportal.info/uhn?sid=OVID:psycdb&id=pmid:&id=doi:&issn=&isbn=0873225228&volume=&issue=&spage=&pages=&date=1994&title=Physical+activity%2C+fitne

Chastin, S. F. M., Buck, C., Freiberger, E., Murphy, M., Brug, J., Cardon, G., . . . Oppert, J.-M. (2015). Systematic literature review of determinants of sedentary behaviour in older adults: A DEDIPAC study. *The International Journal of Behavioral Nutrition and Physical Activity*, *12*(1), Article 127. doi:10.1186/s12966-015-0292-3

Chen, T., Narazaki, K., Honda, T., Chen, S., Haeuchi, Y., Nofuji, Y., . . .Kumagai, S. (2015). Tri-axial accelerometer-determined daily physical activity and sedentary behavior of Suburban community-dwelling older Japanese adults. *Journal of Sports Science & Medicine*, *14*, 507-514. Available from http://www.jssm.org

Chodzko-Zajko, W. J., Proctor, D. N., Fiatarone Singh, M. A., Minson, C. T., Nigg, C. R., Salem, G. J., & Skinner, J. S. (2009). American college of sports medicine position stand. Exercise and physical activity for older adults. *Medicine & Science in Sports & Exercise*, *41*, 1510-1530. doi:10.1249/MSS.0b013e3181a0c95c

Chow, E., Foster, H., Gonzalez, V., & Mclver, L. (2012). The disparate impact of diabetes on racial / ethnic minority populations. *Clinical Diabetes*, *30*, 130-133. doi:10.2337/diaclin.30.3.130

Cohen, S. S., Matthews, C. E., Signorello, L. B., Schlundt, D. G., Blot, W. J., & Buchowski, M. S. (2013). Sedentary and physically active behavior patterns among low-income African-American and white adults living in the southeastern United States. *PLoS ONE*, *8*(4), e59975. doi:10.1371/journal.pone.0059975

Colbert, L. H., Matthews, C. E., Havighurst, T. C., Kim, K., & Schoeller, D. A. (2011). Comparative validity of physical activity measures in older adults. *Medicine & Science in Sports & Exercise*, *43*, 867-876. doi:10.1249/MSS.0b013e3181fc7162

Corbie-Smith, G., Thomas, S. B., Williams, M. V., & Moody-Ayers, S. (1999). Attitudes and beliefs of African Americans toward participation in medical research. *Journal of General Internal Medicine*, *14*, 537-546. doi:10.1046/j.1525-1497.1999.07048.x

de Rezende, L. F. M., Rodrigues Lopes, M., Rey-López, J. P., Matsudo, V. K. R., & Luiz, O. do. C. (2014). Sedentary behavior and health outcomes: An overview of systematic reviews. *PLoS ONE*, *9*(8), e105620. doi:10.1371/journal.pone.0105620

Desantis, C. E., Siegel, R. L., Sauer, A. G., Miller, K. D., Fedewa, S. A., Alcaraz, K. I., & Jemal, A. (2016). Cancer statistics for African Americans, 2016: Progress and opportunities in reducing racial disparities. *CA: A Cancer Journal for Clinicians*, *66*, 290-308. doi:10.3322/caac.21340

Diaz, K. M., Howard, V. J., Hutto, B., Colabianchi, N., Vena, J. E., Blair, S. N., & Hooker, S. P. (2016). Patterns of sedentary behavior in US middle-age and older adults: The REGARDS study. *Medicine & Science in Sports & Exercise*, *48*, 430-438. doi:10.1249/MSS.0000000000000792

Dunstan, D. W., & Owen, N. (2012). New exercise prescription: Don't just sit there: Stand up and move more, more often: Comment on "sitting time and all-cause mortality risk in 222 497 Australian adults." *Archives of Internal Medicine*, *172*, 500-501. doi:10.1001/archinternmed.2012.209

Esliger, D. W., & Tremblay, M. S. (2006). Technical reliability assessment of three accelerometer models in a mechanical setup. *Medicine & Science in Sports & Exercise*, *38*, 2173-2181. doi:10.1249/01.mss.0000239394.55461.08

Evenson, K. R., Buchner, D. M., & Morland, K. B. (2012). Objective measurement of physical activity and sedentary behavior among US adults aged 60 years or older. *Preventing Chronic Disease*, *9*(2), E26. doi:10.5888/pcd9.110109

Fitzsimons, C. F., Kirk, A., Baker, G., Michie, F., Kane, C., & Mutrie, N. (2013). Using an individualised consultation and activPAL™ feedback to reduce sedentary time in older Scottish adults: Results of a feasibility and pilot study. *Preventive Medicine*, *57*, 718-720. doi:10.1016/j.ypmed.2013.07.017

Freedson, P. S., Melanson, E., & Sirard, J. (1998). Calibration of the computer science and applications, Inc. accelerometer. *Medicine & Science in Sports & Exercise*, *30*, 777-781. doi:10.1097/00005768-199805000-00021

Gardiner, P. A., Healy, G. N., Eakin, E. G., Clark, B. K., Dunstan, D. W., Shaw, J. E., . . .Owen, N. (2011). Associations between television viewing time and overall sitting time with the metabolic syndrome in older men and women: The Australian diabetes obesity and lifestyle study. *Journal of the American Geriatrics Society*, *59*, 788-796. doi:10.1111/j.1532-5415.2011.03390.x

George, S. M., Irwin, M. L., Matthews, C. E., Mayne, S. T., Gail, M. H., Moore, S. C., . . .Leitzmann, M. F. (2010). Beyond recreational physical activity: Examining occupational and household activity, transportation activity, and sedentary behavior in relation to postmenopausal breast cancer risk. *American Journal of Public Health*, *100*, 2288-2295. doi:10.2105/AJPH.2009.180828

Grøntved, A., & Hu, F. B. (2011). Television viewing and risk of type 2 diabetes, cardiovascular disease, and all-cause mortality: A meta-analysis. *The Journal of the American Medical Association*, *305*, 2448-2455. doi:10.1001/jama.2011.812

Harris, T. J., Owen, C. G., Victor, C. R., Adams, R., Ekelund, U., & Cook, D. G. (2009). A comparison of Questionnaire, accelerometer, and pedometer: Measures in older people. *Medicine & Science in Sports & Exercise*, *41*, 1392-1402. doi:10.1249/MSS.0b013e31819b3533

Healy, G. N., Clark, B. K., Winkler, E. A. H., Gardiner, P. A., Brown, W. J., & Matthews, C. E. (2011). Measurement of adults' sedentary time in population-based studies. *American Journal of Preventive Medicine*, *41*, 216-227. doi:10.1016/j.amepre.2011.05.005

Healy, G. N., Dunstan, D. W., Salmon, J., Cerin, E., Shaw, J. E., Zimmet, P. Z., & Owen, N. (2008). Breaks in sedentary time: Beneficial associations with metabolic risk. *Diabetes Care*, *31*, 661-666. doi:10.2337/dc07-2046

Healy, G. N., Matthews, C. E., Dunstan, D. W., Winkler, E. A. H., & Owen, N. (2011). Sedentary time and cardio-metabolic biomarkers in US adults: NHANES 2003–06. *European Heart Journal*, *32*, 590-597. doi:10.1093/eurheartj/ehq451

Inoue, S., Sugiyama, T., Takamiya, T., Oka, K., Owen, N., & Shimomitsu, T. (2012). Television viewing time is associated with overweight/obesity among older adults, independent of meeting physical activity and health guidelines. *Journal of Epidemiology/Japan Epidemiological Association*, *22*, 50-56. doi:10.2188/jea.JE20110054

Kim, Y., Barry, V. W., & Kang, M. (2015). Validation of the actiGraph GT3X and activPAL accelerometers for the assessment of sedentary behavior. *Measurement in Physical Education and Exercise Science*, *19*, 125-137. doi:10.1080/1091367X.2015.1054390

Leask, C. F., Harvey, J. A., Skelton, D. A., & Chastin, S. F. (2015). Exploring the context of sedentary behaviour in older adults (what, where, why, when and with whom). *European Review of Aging and Physical Activity*, *12*(1), Article 4. doi:10.1186/s11556-015-0146-7

Matthews, C. E., Hagströmer, M., Pober, D. M., & Bowles, H. R. (2012). Best practices for using physical activity monitors in population-based research. *Medicine & Science in Sports & Exercise*, *44*(Suppl. 1), S68-S76. doi:10.1249/MSS.0b013e3182399e5b

Matthews, C. E., Keadle, S. K., Troiano, R. P., Kahle, L., Koster, A., Brychta, R., . . .Berrigan, D. (2016). Accelerometer-measured dose-response for physical activity, sedentary time, and mortality in US adults. *American Journal of Clinical Nutrition*, *104*, 1424-1432. doi:10.3945/ajcn.116.135129

McClain, J. J., Sisson, S. B., & Tudor-Locke, C. (2007). Actigraph accelerometer interinstrument reliability during free-living in adults. *Medicine & Science in Sports & Exercise*, *39*, 1509-1514. doi:10.1249/mss.0b013e3180dc9954

Pate, R. R., O'Neill, J. R., & Lobelo, F. (2008). The evolving definition of "sedentary." *Exercise and Sport Sciences Reviews*, *36*, 173-178. doi:10.1097/JES.0b013e3181877d1a

Physical Activity Guidelines Advisory Committee. (2008). *Physical activity guidelines advisory committee report*. Washington, DC: U.S. Department of Health and Human Services.

Proper, K. I., Singh, A. S., van Mechelen, W., & Chinapaw, M. J. (2011). Sedentary behaviors and health outcomes among adults: A systematic review of prospective studies. *American Journal of Preventive Medicine*, *40*, 174-182. doi:10.1016/j.amepre.2010.10.015

Rhodes, R. E., Mark, R. S., & Temmel, C. P. (2012). Adult sedentary behavior: A systematic review. *American Journal of Preventive Medicine*, *42*, e3-e28. doi:10.1016/j.amepre.2011.10.020

Santos, D., Silva, A. M., Baptista, F., Santos, R., Vale, S., Mota, J., & Sardinha, L. B. (2012). Sedentary behavior and physical activity are independently related to functional fitness in older adults. *Experimental Gerontology*, *47*, 908-912. doi:10.1016/j.exger.2012.07.011

Schlaff, R. A., Baruth, M., Boggs, A., & Hutto, B. (2017). Patterns of sedentary behavior in older adults. *American Journal of Health Behavior*, *41*, 411-418. doi:10.5993/AJHB.41.4.5

Schrack, J. A., Cooper, R., Koster, A., Shiroma, E. J., Murabito, J. M., Rejeski, W. J., . . .Harris, T. B. (2016). Assessing daily physical activity in older adults: Unraveling the complexity of monitors, measures, and methods. *Journals of Gerontology Series A: Biological Sciences & Medical Sciences*, *71*, 1039-1048. doi:10.1093/gerona/glw026

Shadyab, A. H., Macera, C. A., Shaffer, R. A., Jain, S., Gallo, L. C., Lamonte, M. J., . . .Lacroix, A. Z. (2017). Associations of accelerometer-measured and self-reported sedentary time with leukocyte telomere length in older women. *American Journal of Epidemiology*, *185*, 172-184. doi:10.1093/aje/kww196

Strath, S. J., Pfeiffer, K. A., & Whitt-Glover, M. C. (2012). Accelerometer use with children, older adults, and adults with functional limitations. *Medicine & Science in Sports & Exercise*, *44*(S1), S77-S85. doi:10.1249/MSS.0b013e3182399eb1

Swartz, A. M., Squires, L., & Strath, S. J. (2011). Energy expenditure of interruptions to sedentary behavior. *The International Journal of Behavioral Nutrition and Physical Activity*, *8*, Article 69. doi:10.1186/1479-5868-8-69

Tam-Seto, L., Weir, P., & Dogra, S. (2016). Factors influencing sedentary behaviour in older adults: An ecological approach. *AIMS Public Health*, *3*, 555-572. doi:10.3934/publichealth.2016.3.555

Thorp, A. A., Owen, N., Neuhaus, M., & Dunstan, D. W. (2011). Sedentary behaviors and subsequent health outcomes in adults: A systematic review of longitudinal studies, 1996–2011. *American Journal of Preventive Medicine*, *41*, 207-215. doi:10.1016/j.amepre.2011.05.004

Tremblay, M. (2012). Letter to the editor: Standardized use of the terms "sedentary" and "sedentary behaviours." *Applied Physiology, Nutrition, and Metabolism*, *37*, 540-542.

Troiano, R. P., Berrigan, D., Dodd, K. W., Mâsse, L. C., Tilert, T., & Mcdowell, M. (2008). Physical activity in the United States measured by accelerometer. *Medicine & Science in Sports & Exercise*, *40*, 181-188. doi:10.1249/mss.0b013e31815a51b3

Trost, S. G., Mciver, K. L., & Pate, R. R. (2005). Conducting accelerometer-based activity assessments in field-based research. *Medicine & Science in Sports & Exercise*, *37*, 531-543. doi:10.1249/01.mss.0000185657.86065.98

Van Cauwenberg, J., Van Holle, V., De Bourdeaudhuij, I., Owen, N., & Deforche, B. (2015). Diurnal patterns and correlates of older adults' sedentary behavior. *PLoS ONE*, *10*(8), e0133175. doi:10.1371/journal.pone.0133175 van der Ploeg, H. P., Chey, T., Korda, R. J., Banks, E., & Bauman, A. (2012). Sitting time and all-cause mortality risk in 222 497 Australian adults. *Archives of Internal Medicine*, *172*, 494-500. doi:10.1001/archinternmed.2011.2174

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