Published in final edited form as:

Appl Nurs Res. 2019 August ; 48: 1–7. doi:10.1016/j.apnr.2019.05.012.

Physical activity and postural balance in rural community dwelling older adults

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Abstract

Aim—The purpose of this study was two-fold: 1) identify the types of physical activity being done among rural community dwelling older adults; and 2) determine the relationship between amount of physical activity and postural balance in that population.

Background—Balance impairment coupled with other fall risk factors pose a formidable challenge for aging adults. This study identified types of physical activity rural-community dwelling older adults do and explored the relationship between amount (in minutes) of physical activity and balance.

Methods—A cross sectional, correlational design was used to recruit rural community-dwelling older adults. Data were collected using the Jackson Heart Study Physical Activity Survey, Berg Balance Scale, and Timed Up and Go Test; ActiGraph accelerometers were worn to objectively measure physical activity.

Results—One hundred and one participants enrolled. Most were female (78%), White (74%), and between 65 and 91 years old. Berg Balance Scale scores positively correlated with average minutes of light ($r = 0.262$) and moderate ($r = 0.276$) physical activity; and the Jackson Heart Study Physical Activity Survey active living index ($r = 0.320$) and home and garden index ($r = 0.324$). In regression models, age and sex were the strongest predictors of Berg Balance Scale (adjusted $r = 0.313$, $F(6, 89) = 8.203$, $P \leq 0.001$). Physical activity was not associated.

Conclusions—Minutes of light or moderate physical activity were not associated with balance. However, investigating factors such as physical activity that influence health functional status and balance deserve continuous attention.

Keywords

Physical activity; Postural balance; Rural dwelling; Older adults; Accelerometers

1. Introduction

Falls are the leading cause of unintentional injuries in older adults and can lead to devastating consequences and changes in lifestyle. Fear of falls among those with or without

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a history of a previous fall affect between 3%–85% (Scheffer, Schuurmans, van Dijk, van der Hooft, & de Rooij, 2008), and often lead to decreased mobility and increased risk of falling (Auais et al., 2017). Falls among adults age 65 years and older can result in increased morbidity and mortality, decreased quality of life, loss of independence, injuries, disability, and increased economic costs. Despite efforts to reduce falls, national incidence rates continue to rise. In a single decade, the crude rate for unintentional fall deaths among U.S. adults 65 years and older grew from 41.50 per 1000 in 2004 to 58.58 per 1000 in 2014 (Centers for Disease Control and Prevention, 2015).

Multiple factors including balance impairment contribute to fall risk (American Geriatrics Society and British Geriatrics Society, 2016). Postural balance provides the foundation for mobility and functional independence throughout the life span (2016). Physical activity is known to have multiple benefits and is recommended for fall risk reduction (Guirguis-Blake, Perdue, Coppola, Beil, & Thompson, 2018). However, few adults meet national physical activity recommendations, with levels lower among rural adults (Durazo et al., 2011; Rural Health Reform Policy Research Center, 2014).

Approximately 60 million people within the United States live in rural areas (Rural Health Reform Policy Research Center, 2014; United States Census Bureau, 2015). Rural residents are disproportionately affected by health disparities (Mississippi Office of Rural Health, 2017). There is little information about the amounts and types of physical activity that rural older adults currently do to stay healthy. Further-more, the relationship between the amount of time and intensity of physical activity or the effect of physical activity on postural balance in rural community-dwelling older adults remains unclear.

Few studies have examined the relationship between amounts of physical activity and postural balance, or assessed differences in amounts of physical activity categorized by intensity utilizing accelerometers. Among the studies conducted, increased physical activity was associated with better lower extremity performance (Osuka et al., 2015); lower fear of falling (Jefferis et al., 2014); faster 400-meter walk time, shorter time to complete chair stands (Rosenburg et al., 2015), and lower risk of disability (Ortlieb et al., 2014) at levels from light to moderate-vigorous intensity. However, higher activity levels were associated with increased fall risk in participants with no disability in a study conducted by Jefferis et al. (2015).

The potential to address the growing problem of falls among older adults lies in understanding the relationship. Knowledge about the types and amounts of physical activity necessary to reduce falls informs future development of interventions for health and independence of rural community-dwelling older adults. The purpose of this study was two-fold: 1) to describe the types of physical activity among rural community-dwelling adults age 65 years and older; and 2) to determine the relationship between the amount of physical activity in minutes and by intensity and postural balance. Our hypothesis was that higher amounts of physical activity are positively related to greater postural balance.

2. Methods

2.1. Study design, sample, and setting

A cross sectional, prospective, descriptive, correlational design guided the study of rural community-dwelling elders. Mississippi (MS) is primarily a rural state with 83% of rural counties, and > 53% of the state's population live in rural areas (Rural Health Reform Policy Research Center, 2014). The research team identified 14 rural counties in South MS as the sampling area using 2016 estimated resident population (United States Census Bureau, 2017). Eligible participants were adults age 65 and older, English-speaking, independently ambulatory, and residing in a rural community. Exclusion criteria included long-term care or assisted living residence, current home health services requiring homebound status, cognitive impairment or dementia, use of cane or other mobility device, and visual impairment not corrected with reading glasses. Purposive, convenience sampling was used for recruitment. Three recruitment and data collection sites were used: two senior centers that served the 14 target counties, and a local community college in the area convenient to residents. Approval for the study was obtained from the University of MS Medical Center Institutional Review Board before beginning the study.

2.2. Measures

2.2.1. Demographics and health information—Information on sex, age, self-identified race, body mass index (BMI), history of fall, chronic medical conditions, and medications was obtained. Medications such as psychotropics, antidepressants, Type 1a antiarrhythmics, sedatives, neuroleptics, benzodiazepines, Digoxin, nitrates, and antihypertensives and chronic conditions of urinary incontinence, dementia, neuropathy, degenerative neurological conditions, degenerative arthritis, osteoporosis, and vitamin D deficiency were assessed because of their associations with increased fall risk (Beegan & Messinger-Rapport, 2015; de Jong, Van der Elst, & Hartholt, 2013).

2.2.2. Physical activity—Subjective physical activity was measured using the Jackson Heart Study Physical Activity Survey. The Jackson Heart Study Physical Activity Survey measures physical activity and identifies the domains and types of activities. It is a 40-item questionnaire that assesses physical activity over the previous 12 months, and captures 4 domains of physical activity: exercise and sports; home and garden; transportation or active living; and occupation. Scores for each subscale as well as a total physical activity score were calculated. The test-retest reliability is excellent, with intra-correlation coefficients at 0.99 for the total combined scores and exceeding 0.80 in each subscale (Smitherman et al., 2009). Scores can range from 1 (none) to 4.75 (highest) for active living, 1(none) to 5 for each subscale.

GT3X ActiLife accelerometers were used. Accelerometers were worn on the right hip (Swartz et al., 2000) for seven days while awake and removed when bathing or swimming. Minimum wear time for analysis was set as 4 days of ≥10 h per day based on other studies (Gorman et al., 2014; Ortlieb et al., 2014; Osuka et al., 2015). Minutes in light, moderate, and vigorous intensity were obtained and moderate to vigorous intensities were also combined to create the variable, MVPA, or moderate to vigorous physical activity as is frequently used in other studies (Jefferis et al., 2014; Jefferis et al., 2015; Rosenburg et al., 2015). Freedson cut points were used to determine categorical levels of physical activity (Freedson, Melanson, & Sirard, 1998). The validity and reliability of the accelerometers have been established in previous studies (Aadland & Ylvisaker, 2015; Kelly et al., 2013; Santos-Lozano, Marin, Torres-Luque, & Garatachea, 2012).

2.2.3. Postural balance—The Berg Balance Scale was used to measure postural balance. The Berg Balance Scale is the clinical criterion standard used to measure balance in the geriatric community (Berg, Maki, Williams, Holliday, & Wood-Dauphinee, 1992; Park & Lee, 2017). The 14-item instrument incorporates a rating of 0 (poor balance) to 4 (better balance) and yields a perfect score of 56. The instrument has good intra- and inter-rater reliability (ICC = 0.98 & 0.97, respectively), internal consistency (Cronbach's alpha of 0.8), and adequate sensitivity (0.72) and specificity (0.73) with the accuracy curve area of 0.84 in meta-analysis of 21 studies that included data from 1690 participants (Park & Lee, 2017). A score of < 45 on the Berg Balance Scale indicates individuals may be at a greater risk of falling (Berg, Wood-Dauphinee, Williams, & Maki, 1992).

The Timed Up and Go Test was used as a second measure of postural balance. It is a short and simple evaluation commonly used in functional assessment of older adults in clinical practice and research (Shumway-Cook, Brauer, & Woolacott, 2000). It contains balance and gait maneuvers used in everyday life. The Timed Up and Go measures the time it takes for an individual to stand up from a standard chair, walk 10 m, turn, walk back to the chair, and sit. To accurately complete this test, a minimum of 14 unobstructed feet are required. The score is reported in seconds with a lower score representing better (faster) performance. A cut off score of 12 s for the Timed Up and Go test is the screening threshold value for increased fall risk (Podsiadlo & Richardson, 1999). The Timed Up and Go has been shown to be a good predictor for fall risk in the elderly (Shumway-Cook et al., 2000), and excellent test-retest reliability (ICC = 0. 99) (Podsiadlo & Richardson, 1999).

2.3. Procedure

Following informed consent, paper questionnaires were administered, Timed Up and Go and Berg Balance Scale assessments were conducted, and participants were instructed on accelerometers use. The first author completed all the measurement instruments to ensure consistent rating. The Timed Up and Go was not administered at the first senior center due to limited space for measurement. Weather conditions and safety concerns did not allow for the assessment to be completed outside. Following other assessments, the research team placed accelerometers on the participants and provided instruction about wear time. After seven days, the participants returned the accelerometers to the respective research site at times that were convenient for them. Participants received a $10 gift card for their time.

2.4. Data analysis

Descriptive statistics of mean, standard deviation (SD), and range were used to evaluate demographics, health information frequencies, and types of physical activity. Baseline comparisons of balance scores and subject characteristics were measured using independent *t*-tests and one-way analysis of variance. Pearson correlation coefficients were computed among the variables. Linear regression models were conducted to examine the effects of physical activity (minutes in light, moderate, & vigorous), age, race, sex, history of falls, medication use, and medical conditions on balance (Berg Balance Scale scores and Timed Up and Go scores), separately. We examined model significance and variance in predictability of Berg Balance Scale and Timed Up and Go, by entering variables in a series of hierarchical blocks. At step one, age, sex, and race were entered into the model with Berg Balance Scale and Timed Up and Go as the dependent variable, respectively. In a stepwise manner, BMI, comorbid conditions, history of falls, and medications were added to the second model. Average minutes in light and moderate physical activity were added to the third model. Comorbid conditions, history of falls, and medications were not significant in any models and were removed with better model fit. IBM SPSS (IBM Corporation, 2016) was used for all statistical analysis. ActiLife 6 software (Actigraph, 2019) was used for accelerometer data.

3. Results

3.1. Demographics and health information

We enrolled 46 participants (45.5%) at the first recruitment site (Park & Lee, 2017), 26 (25.7%) at the second, and 29 (28.7%) at the third for a total of 101 participants. Descriptive statistics for each demographic and health information variable are presented in Table 1. The participants in the study resided in 7 rural South MS counties. The ages of participants ranged from 65 to 91 years old, with a mean (SD) age of 74 (6.47). For the purpose of descriptive frequencies only, age groups were subdivided into young old (65–69), middle old (70–79), and oldest old (80 and over) according to the United States Census Bureau (2016).

Overall activity from the accelerometer data showed that only 18 (17.8%) of the participants met the American College of Sports Medicine (2011) and Centers for Disease Control (2015) recommendations that older adults should engage in 150 min of at least moderate intensity activity per week. Most activity was of light intensity [mean minutes = 114 (55.91)]. The cumulative Jackson Heart Study Physical Activity Survey score, a sum of each subscale, ranged from 2.24 to 10.57 [mean = 6.41 (1.64)]. Physical activity and Jackson Heart Study Physical Activity Survey score frequencies are presented in Table 2.

Comparisons of Berg Balance Scale scores and participant characteristics revealed higher balance scores among males ($p \leq 0.001$); White participants ($p = .041$); and participants taking medications ($p \leq 0.001$). No significant differences existed between those reporting a fall and no falls ($p = .616$) or those who reported a chronic condition compared to none ($p = .070$). There was a significant difference in Berg Balance Scale scores ($p = .026$) between normal weight group and the obese group, but not between the normal weight group compared to the overweight group ($p = .08$). Although we had TUG scores on 53 participants, comparisons of Timed Up and Go scores and sex, race, and reported medications, chronic conditions, and falls, indicated no significant differences among the group means (data not shown).

Using the Jackson Heart Study Physical Activity Survey, on the sport and exercise subscale, 39 (38.61%) participants did not report participation in a sport or exercise activity. Among the 62 participants who did report participation, 39 (62.90%) engaged in only one sport or exercise activity, 15 (24.19%) participated in two sports or exercise activities, and 8 (12.90%) participated in three activities. Participants reported 19 different activities. Line dancing ($n = 28$) was most frequent, followed by non-vigorous walking ($n = 19$) and chair exercises ($n = 10$) (data not shown).

3.2. Determine the relationship between the amount of PA and postural balance

Correlation coefficients among the variables are summarized in Table 3. Eleven of the 17 correlations with Berg Balance Scale scores were statistically significant and 6 of the 17 correlations with the Timed Up and Go scores were statistically significant. Among the 99 participants with valid wear times, Berg Balance Scale scores positively correlated with average minutes of light physical activity ($r = 0.262$), moderate physical activity ($r = 0.276$), MVPA ($r = 0.270$), Jackson Heart Study Physical Activity Survey active living index scores ($r = 0.320$), and Jackson Heart Study Physical Activity Survey home and garden index scores ($r = 0.324$). Timed Up and Go scores and amounts of physical activity were inversely correlated with average minutes of light physical activity ($r = - 0.404$), moderate physical activity ($r = - 0.363$), moderate to vigorous physical activity ($r = - 0.337$), Jackson Heart Study Physical Activity Survey cumulative index scores ($r = - 0.353$), and Jackson Heart Study Physical Activity Survey home and garden index scores ($r = - 0.357$).

In the multiple regression analyses conducted to predict Berg Balance Scale scores (Table 4), the covariates age, sex, and race were predictors of Berg Balance Scale scores (adjusted $r^2 = 0.301$, $F(3, 93) = 14.70$, $p =< .001$) in the first model, and BMI was significant when added to model 2 (adjusted $r^2 = 0.312$, $F(4, 91) = 11.76$, $p = < .001$). Subsequently, minutes of light and moderate physical activity were added to the third model (adjusted $r^2 = 0.313$, $F(6, 89) = 8.203$, $p \le 0.001$). Although significant in the correlation analyses, chronic conditions and medications were not statistically significant, weakened the model, and were removed. Regression models were run for the Timed Up and Go scores and variables entered in hierarchical steps as for the Berg Balance Scale. Due to reduced sample size, we included fewer predictor variables and focused on age, race, and light and moderate physical activity which were significantly associated in our correlation matrix and most often supported as factors related to falls in the literature (adjusted $r^2 = 0.443$, $F(2, 48) = 20.92$, $p = < .001$). Minutes in light and moderate physical activity were not significant in this model.

4. Discussion

Our hypothesis was that higher amounts of physical activity would be positively related to greater postural balance in rural community-dwelling adults age 65 years and older. While amounts of light and moderate physical activity correlated significantly with balance, age and sex were predictors but light and moderate physical activity were not when included together. In our study, as age increased, Berg Balance Scale scores decreased, and male participants had significantly higher Berg Balance Scale scores than females. In our study, we found no support that physical activity was associated with either Berg Balance Scale or Timed Up and Go, our measures of balance.

Age was the strongest predictor of Berg Balance Scale scores. These findings are in accordance with previous studies where age had a greater influence on balance and lower extremity performance than light physical activity (Osuka et al., 2015); and outcome measures of multimorbidity and disability (Ortlieb et al., 2014). With advancing age, structural and functional deterioration occurs in most physiological systems even in the absence of discernible disease (Hayashi, Gonsalves, & Parreira, 2012). These age-related physiological changes affect a broad range of tissues, organ systems, and functions that can cumulatively impact physical independence in older adults (Chodzko-Zajko & Proctor, 2009). Among the physiological changes associated with aging, those in the cardiorespiratory system and skeletal muscles most affect physical fitness (2009). Consequently, strength, mobility, and balance limitations associated with advancing age may reduce the energy expended by older people (Taylor et al., 2012). These limitations resulting from physiological changes of aging impose barriers to physical activity among older adults.

Like age, sex influenced the study outcome with women having significantly lower Berg Balance Scale than men, therefore at greater risk of balance impairment. Similarly, in 2014 the Centers for Disease Control and Prevention (2016) reported women were more likely to report falling than men and were more likely to report a fall injury. The source of sex differences in balance maintenance and recovery seems to be primarily in the muscle strengths and speeds of muscle contraction (American College of Sports Medicine, 2011). Reduced muscle strength is a risk factor for falls, and aging and female sex are associated with reduced muscle mass (Centers for Disease Control and Prevention, 2016; Schultz, Ashton-Miller, & Alexander, 1997).

In our study, the correlation between amounts of physical activity and Berg Balance Scale or Timed Up and Go was attenuated by the confounding variables. However, in previous studies, associations were found between increased time spent in light physical activity or MVPA and lower number of reported falls (Mississippi Office of Rural Health, 2017), and a positive linear association between balance and walking duration (Rapp et al., 2012). Other studies utilizing subjective measures of physical activity found that more active adults had better Berg Balance Scale (Fernandez-Alonso, Munoz-Garcia, & Touche, 2016); and that self-reported high levels of physical activity were associated with decreased odds of falls among older women (Butler, Menant, Tiedmann, & Lord, 2009).

While we had data from over 100 participants, our findings using subjective and objectively measured physical activity were contrary to other studies. Most of the other studies included larger sample sizes and different geographic regions, or didn’t focus on rural adults. The mean Timed Up and Go score for our sample was 9.11 s (SD 2.93), less time than the cut score for increased risk. In our sample, the mean Berg Balance Scale score was 50.53(6.05), again better than the cut score of < 45 set for greater risk of falls. The generally healthy and active population in this study had better balance performance on both measures, which could possibly support the non-significant association between physical activity and balance.

In our sample, we gleaned insights into several factors related to falls. The study variables age, sex, race, history of falls, BMI, medications, and medical conditions are similar to the predominant fall risk factors. Although not significant in the statistical model, race, medication use, and BMI are consequential as significant differences were noted in Berg Balance Scale scores in the group mean comparisons. Balance scores were significantly higher for rural Whites than Blacks in our study. Limited research exists on the causes for racial differences but these differences may be related to differences in health and behaviors (Centers for Disease Control, 2016). Participants taking medications identified as increasing fall risk had lower Berg Balance Scale scores than those not taking medications. Although this finding did not reach statistical significance, it may have clinical significance. Previous literature reported medication use as a risk factor; therefore, future studies should target a larger sample of the older population. In this study, participants with greater BMI had lower Berg Balance Scale scores. This finding is consistent with previous research (Chan et al., 2007).

Participants in these rural southern counties were eager to engage in the study. Better understanding of their needs, as well as the relationship between the amount of physical activity and postural balance, can lead to relevant policy to promote greater opportunities to increase physical activity in this age group and promote aging in place. Identifying the types of physical activity being done among rural community-dwelling older adults provides insight to inform future work within rural communities. Specific aims of *Healthy People 2020* include an increase in light, moderate, or vigorous leisure activities of sufficient frequency and duration to improve functional ability in older adults. These descriptive results can inform understanding and support initiatives such as Active Living by Design, an effort to provide opportunities for rural community-dwelling adults to participate in physical activity. Additionally, this study contributes to the knowledge that is necessary to achieve the national and global goals of reducing the risk of falls.

5. Strengths and limitations

This research offered a variety of measures, focused on rural community-dwelling older adults, and targeted postural balance as an indicator of fall risk. Strengths of this study included the use of objective and subjective measurements of physical activity and postural balance, compliance with accelerometer wear time, and sample size. Proper training of researchers, consistency of raters, and expert consultation regarding the use of measurements aimed to minimize changes in the study outcomes due to measurement error. This prospective sample included 101 rural community-dwelling adults who allowed investigation of the relationship between physical activity and postural balance. Identifying the amount of moderate to vigorous physical activity per week contributes to the knowledge of compliance with national recommendations for physical activity. Furthermore, identifying what types of physical activity rural community-dwelling older adults do and prefer can inform the strategic development and promotion of active living among rural community-dwelling older adults.

The convenience sample limits generalizability of the findings. Exclusion criteria resulted in a generally healthier and active group of individuals. Therefore, the physically inactive may be under-represented. Failure to carefully assess the space requirements prior to data collection resulted in limited analysis of the Timed Up and Go. This error could be prevented by early and accurate assessment of a straight, unimpeded walking path of the

Timed Up and Go's required distance. Instrumentation may pose a threat to the study's internal validity. The Jackson Heart Study Physical Activity Survey was based on self-report and prone to recall bias. However, it has been used successfully in other studies and has good psychometric properties. Notably, accelerometers lack sensitivity to all physical activities, such as cycling or upper body movement. Also, accelerometers are not worn during water activities such as swimming. Four participants reported swimming and water aerobics, and seven reported cycling in their daily activities. Confidence in detection of these activities is limited. However, the Jackson Heart Study Physical Activity Survey did include swimming, water aerobics, and cycling. Furthermore, activities on the Jackson Heart Study Physical Activity Survey have a metabolic equivalent and duration assigned according to the Jackson Heart Study Physical Activity Survey activity intensity algorithm that aligns with the Compendium of Physical Activities (Ainsworth, Haskell, & Herrmann, 2011). These calculations were included in the formula used to calculate index scores in this study.

We aimed to monitor physical activity via accelerometers for seven consecutive days. Assessment at various times throughout the year may have yielded different results. Seasonal or weather related changes may also influence the results of the study because physical activity estimates may vary between seasons. However, the combined nine-week period of data collection during late spring and early summer intended to reduce seasonal bias. Several participants voluntarily reported a heightened awareness of their own physical activity levels and personal balance with the knowledge of being under observation; therefore, a Hawthorne effect could have influenced the physical activity levels. Different wear times among the participants could have also introduced bias. An effort to reduce this threat was the calculation of the average minutes in light, moderate, and vigorous activity, which aligns with current research recommendations (Alhassan, Sirard, Spencer, Varady, & Robinson, 2008).

6. Conclusion

A need to focus on the dose response relationship between physical activity and balance continues. A larger sample size and sampling area would be beneficial to determine the effectiveness of physical activity on postural balance. Building on these results, more controlled studies to test specific interventions of the types of physical activity reported and physical activity within the four domains (transportation/active living, home and garden, occupation, exercise and sports) on postural balance is recommended for future research. Because age was a strong predictor of balance, a future study may include age stratification to examine amounts of physical activity and balance among older adults that are closer in age. Furthermore, a focus on oldest of old, age 80 years and above, should be considered to evaluate and address factors that contribute to functional performance and health behaviors.

Few studies report actual activities that older adults do. The literature is even more limited in studies of rural community-dwelling older adults. Because this population remains at high-risk for falls, more attention is warranted to preserve postural balance through physical activity as people age. Without intervention, the likelihood of falls and subsequent disparaging consequences will rise as the population of older adults increases. Maintaining or improving postural balance through physical activity offers the potential to reduce fall risk factors and prevent life-threatening injuries in our aging population.

Acknowledgments

Declaration of Competing Interest

We declare no conflicts of interest with respect to the research, authorship, and/or publication of this article. A research grant from the Theta Beta Chapter of Sigma Theta Tau and a seed grant from the University of Mississippi Medical Center School of Nursing, United States of America, supported this research. Jennifer C. Robinson is partially supported by the National Institute of General Medical Sciences of the National Institutes of Health under Award Number 1U54GM115428 and the Mississippi Center for Clinical and Translational Research. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

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Table 1

Demographics and health information ($N = 101$).

Characteristic	*n*	%
Age		
65–69	32	31.7
70–79	52	51.5
≥80	17	16.8
Gender		
Female	79	78.2
Male	22	21.8
Race		
Black	25	24.8
White	75	74.3
Other	1	1.0
BMI status		
Underweight	2	2.0
Healthy weight	41	40.6
Overweight	27	26.7
Obese	30	29.7
Missing	1	1.0
History of fall		
Yes	17	16.8
No	84	83.2
Chronic conditions		
Yes	35	35.0
No	65	65.0
Medications		
Yes	74	73.0
No	27	27.0

BMI (Body Mass Index) categories adapted from Centers for Disease Control and Prevention. Healthy weight [online], Available at https://www.cdc.gov/healthyweight/assessing/bmi/adult_bmi/index.html.

Age groups adapted from United States Census Bureau, [online], Available at: https://www.census.gov/content/dam/Census/library/publications/2016/demo/p95-16-1.pdf.

Table 2

Physical activity and balance measurement frequencies (*N* = 101).

Characteristic	Mean (SD)	Range	
		Low	High
Physical activity frequencies			
Average minutes in light PA	114.17 (55.91)	4.58	318.08
Average minutes in moderate PA	10.88 (11.91)	0.50	61.44
Average minutes in vigorous PA	0.52 (2.80)	0.00	27.94
Average minutes in MVPA	11.40 (13.11)	0.50	74.65
Jackson heart study survey scores			
JPAC cumulative index	6.41 (1.64)	2.42	10.57
JPAC active living index (*n* = 99)	3.08 (0.67)	1.00	5.00
JPAC home and garden index	2.14 (0.56)	1.0	3.86
JPAC sports and exercise index (*n* = 62)	1.32 (0.34)	0.75	2.25
JPAC occupational index score (*n* = 17)	2.65 (0.72)	1.75	4.25
Balance measurement frequencies			
Berg balance scale score	50.35 (6.05)	20	56
Timed up and go score (seconds)[a] *n* = 53	9.11 (2.93)	5.19	22.47

[a]Collected only at sites two and three.

Table 3

Correlations among variables.

	BBS	TUG	Age	Sex	BMI	Race	CC	Meds	Falls	Light	Mod	Vig	PAI	AL	H & G	S & E	Occ
BBS		−0.745**	−0.510**	0.269**	−0.215*	.224*	−0.285**	−0.236*	0.064	0.262**	0.276**	0.091	0.194	0.320**	0.324**	−0.037	0.231
TUG			0.555**	−0.221	0.184	−0.563**	0.377**	0.203	−0.240	−0.404**	−0.363**	−0.105	−0.353**	−0.268	−0.357	−0.134	0.306
Age				−0.128	−0.060	−0.020	0.029	0.185	−0.035	−0.197	−0.302**	−0.089	−0.110	−0.107	−0.294**	0.148	−0.077
Sex					−0.016	0.307**	−0.093	−0.223	−0.019	0.168	0.143	0.174	0.056	−0.049	0.222*	0.055	0.118
BMI						−0.370**	0.025	0.271**	−0.158	−0.329**	0.311**	−0.137	−0.113	−0.266**	−0.161	0.048	−0.273
Race							0.037	−0.143	−0.126	0.200*	0.149	0.070	−0.101	−0.012	0.079	−0.367**	0.116
CC								0.173	−0.190	−0.124	−0.165	−0.111	−0.128	−0.108	−0.141	−0.120	0.184
Meds									−0.212*	−0.377**	−0.325**	0.026	−0.206*	−0.119	−0.305**	−0.048	0.043
Falls										0.030	0.015	0.042	0.138	−0.079	0.127	0.159	−0.183
Light											0.703**	0.201*	0.199*	0.272**	0.383**	0.067	0.433
Mod												0.333**	0.253*	0.295**	0.311**	−0.100	0.156
Vig													−0.029	−0.131	−0.078	−0.045	−0.112
PAI														0.574**	0.237*	0.326**	0.571*
AL															0.127	0.135	0.175
H & G																0.045	−0.112
S & E																	0.011
Occ																	

Note: BBS, Berg Balance Scale; TUG, Timed Up and Go Test; Age, in years; Sex, (2) Female, BMI, Body Mass Index; Race, (2) White; CC, Chronic conditions; Meds, Medications; Falls, Falls; Light, Minutes in light PA; Moderate, Minutes in moderate PA; Vig, Minutes in vigorous PA; PAI, PA cumulative index score (JPAC); AL, Active living index score (JPAC); H&G, Home and garden index score (JPAC); S&E, Sport and exercise index score (JPAC); Occ, Occupational index score (JPAC)

* $p < .05$

** $p < .01$

BBS scores: $N = 98$ TUG Scores: $N = 53$.

Table 4

Linear regression models predicting berg balance scale scores ($n = 99$).

Variable	Model 1			Model 2			Model 3		
	B	SE B	β	B	SE B	β	B	SE B	β
(Constant)	79.482	5.718		81.336	5.501		77.62	6.26	
Age	−0.418*	0.075	−0.479	−0.347*	0.064	−0.465	−0.328*	0.068	−0.439
Sex	2.179	1.228	0.160	2.611*	1.031	0.229	2.426*	1.039	0.213
Race	2.110	1.198	0.158	0.132	1.075	0.012	0.021	1.078	0.002
BMI				−0.203*	0.081	−0.226	−0.164	0.086	−0.184
Light PA							0.013	0.011	0.146
Moderate PA							−0.006	0.049	−0.115
r^2	0.30			0.31			0.31		

Dependent variable = BBS scores.

Note. B = unstandardized beta; SE B = standard error; β = beta

* p value < .05.