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Post-exercise pulse pressure is a better predictor of executive function than pre-exercise pulse pressure in cognitively normal older adults

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Abstract

Exercise “stress tests” are widely used to assess cardiovascular function and to detect abnormalities. In line with the view of exercise as a stressor, the present study examined the relationship between cognitive function and cardiovascular activity before and after light physical exercise in a sample of 84 non-demented community-dwelling older adults. Based on known relationships between hypertension, executive function and cerebral white matter changes, we hypothesized that greater post-exercise reactivity, as indexed by higher pulse pressure, would be more related to worse performance on frontal-executive tasks than pre-exercise physiologic measures. All participants were administered a comprehensive neuropsychological battery and underwent a Six Minute Walk Test (6MWT), with blood pressure (BP) measures obtained immediately before and after the walk. Pulse pressure (PP) was derived from BP as an indicator of vascular auto-regulation and composite scores were computed for each cognitive domain assessed. As predicted, worse executive function scores exhibited a stronger relationship with post-exercise PP than pre-exercise PP. Results suggest that PP following system stress in the form of walking may be more reflective of the state of vascular integrity and associated executive dysfunction in older adults than baseline physiologic measures.

Keywords

Pulse pressure; Exercise; Older adults; Cognition; Executive function

Aging is associated with several changes in vascular health, including increases in systolic blood pressure (BP), declines in cardiac output and maximal heart rate (HR), as well as

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reduced cerebral blood flow (Allen & Morelli, 2011; Maillard et al., 2012). With a lifetime risk of nearly 90%, hypertension is a major risk factor for cerebrovascular accidents and dementia (Vasan et al., 2002). In normal elderly, hypertension is associated with periventricular and deep white matter signal abnormalities on magnetic resonance imaging (Au et al., 2006; Firbank et al., 2007; Raz, Rodrigue, Kennedy, & Acker, 2007; Tsao et al., 2013). These white matter changes are even observed among individuals with medication controlled hypertension (Gianaros, Greer, Ryan, & Jennings, 2006; Seshadri et al., 2004). The cognitive changes most frequently observed in hypertensive older adults include declines in attention and working memory, processing speed, and executive function (Gunstad et al., 2009; Jacobs et al., 2013; Tsivgoulis et al., 2009).

Declines in diastolic BP and increased arterial stiffening are associated with advancing age, resulting in elevations in a metric called pulse pressure (Elias et al., 2009; Malone & Reddan, 2010). Pulse pressure (PP) refers to the difference between systolic and diastolic BP and is an index of arterial stiffness and vasoreactivity (Malone & Reddan, 2010). A variety of studies have suggested that PP may be a more powerful predictor of health outcomes than other individual BP parameters. In part this suggestion relates to the fact that arterial stiffness (as indexed by PP) increases the risk of cardiovascular incidents with transitory elevations in BP. Importantly, increased PP values have been associated with increased mortality (12% death hazard), medial temporal lobe atrophy, and decrements in cognition and daily function in normal individuals (Klassen et al., 2002; Korf, White, Scheltens, & Launer, 2004; Obisesan et al., 2008) and those with Parkinson disease (Jones et al., 2014).

To date, the majority of studies examining the relationship between cardiovascular health and cognition in older adults have been limited in their use of resting measures of BP parameters. However, recent investigations suggest that a more sensitive assessment of an individual's cardiovascular functioning is provided by ambulatory monitoring, wherein BP is assessed during or immediately following physical activity (Clement et al., 2003; Dolan et al., 2005; Schwartz et al., 2007). BP parameters, including PP estimates, derived from ambulatory monitoring provide important information regarding BP variability and an individual's risk of cardiovascular events (Dolan et al., 2005). In line with the view of exercise as a stressor, the overall aim of the present study was to determine whether cardiovascular reactivity following light physical exercise was a better predictor of cognitive performance than pre-exercise cardiovascular factors in older non-demented adults. In the present study, cardiovascular reactivity was indexed by BP and PP, cognition was assessed using standard neuropsychological tasks across six domains, and light exercise involved the classic Six Minute Walk Test (Balke, 1963).

We had two hypotheses, both based on documented relationships among PP, executive function, and the putative underlying mechanisms for these associations (e.g., white matter brain changes). Our first, and primary hypothesis was that greater post-exercise physiologic reactivity (i.e., as indexed by increased BP and PP) would be associated with worse cognitive performance more so than pre-exercise physiologic measures. Moreover, this relationship would occur primarily for fronto-executive tasks rather than other cognitive domains due to increased sensitivity of frontal-subcortical regions to cardiovascular abnormalities. Our second hypothesis was that even baseline pre-exercise PP would be

associated with worse cognitive performance, again primarily in the fronto-executive domain.

Method

Participants

Participants included 84 community residing older adults who met initial screening criteria for the Village Interactive Training and Learning Study (VITAL), a 16 week intervention that involved combined exercise and cognitive training with baseline, post-intervention, and 3 month follow-up measures. Of the 84 participants who underwent screening and were included in the present study, 75 individuals went on to complete the full VITAL trial. Reasons for drop out ranged from illness, moving out of the area, inability to follow through with commitment, etc. This study was approved by the Institutional Review Board at the University of Florida and all participants provided informed consent.

Inclusion criteria included: 1) adults aged sixty years and older; 2) adequate vision and mobility as assessed by the Snellen Chart Vision Test, a GoodLite Sloan Letter Chart using a 10-foot distance, 14-Point Paragraph Reading (Cowboy Story), and the Instrumental Activities of Daily Living Scale (IADL: Morrow, 1999), respectively; 3) ability to provide informed consent and perform cognitive and exercise activities; 4) absence of significant behavioral or cognitive dysfunction based on the Mini-Mental State Exam (MMSE > 24); 5) minimum 8th grade reading level based on scores on the Wechsler Test of Adult Reading (Wechsler, 2001); 6) sedentary to moderately active lifestyle based on the Leisure-Time Exercise Questionnaire (LTEQ: Godin & Shephard, 1997) and the International Physical Activity Questionnaire (IPAQ: Booth et al., 2003); 6) medical clearance from primary care provider or specialist to safely undergo moderate to strenuous physical activity; and 7) on stable doses of major medications.

Exclusion criteria included: 1) unstable medical conditions (e.g., uncontrolled diabetes, uncontrolled cardiac disease and hypertension) that could increase the risk of side effects performing aerobic exercise; 2) physical impairments limiting ability to perform physical exercises; 3) history of multiple, significant falls (i.e., more than 2 falls within the month prior to screening) increasing fall risk while exercising; 4) history of significant neurological conditions (e.g., history of neurodegenerative disorder, previous major strokes, moderate to severe Traumatic Brain Injury); 5) previous participation in a cognitive training or exercise study within the last 6 months; 6) current engagement in moderate to heavy exercise (i.e., running, bicycling, etc.) > 125 minutes/week at 75% maximum target heart rate; 7) history of substance abuse within the past six months; 8) history of receiving neuropsychological testing within the last 6 months; and 9) vision or hearing loss that would preclude participation.

Procedure

Each participant completed three baseline visits within a two to three week period, during which no changes in major medications or health status were observed. Such flexibility in scheduling was required to accommodate participant availability and clinic resources. At the

initial visit, all received the Mini-Mental Status Examination (MMSE: Folstein, Folstein, & McHugh, 1975) and the Charleston Comorbidity Index (CCI: Deyo, Cherkin, & Ciol, 1992), which is a 17-item inventory used to categorize chronic comorbid diseases. The CCI along with participant self-report was used collect information regarding current medications and health history.

The Six Minute Walk Test (6MWT; Balke, 1963) was conducted during the second visit. During this task, individuals were instructed to walk at their own pace for six minutes around two cones spaced fifty feet apart. A nearby chair was available in case participants experienced any distress that required them to rest during the course of the task. None of the 84 participants opted to rest or use the chair. Two successive measures of BP were taken, using OMRON BP791IT (HEM-7222-ITZ) automatic monitors, immediately before and after the 6-minute walk. Baseline pre-walk measures were obtained after the participants sat quietly at a table for five minutes prior to the walk. Immediately following the walk, participants returned to the table and were seated while post-walk measures were obtained. The second value obtained at baseline and post-walk was used in subsequent analyses. Pulse pressure (PP) was derived from BP (i.e., systolic BP - diastolic BP) as an indicator of vascular auto-regulation. Higher PP values suggest worse cardiovascular regulation.

The cognitive outcome measures listed in Table 1 were administered as part of a comprehensive neuropsychological battery distributed over the course of the three baseline visits. All neuropsychological measures were administered and scored according to standardized procedures outlined in their respective administration manuals. Demographically normed scores for each neuropsychological measure were converted to *T*-scores with *M* = 50 and *SD* = 10. Composite scores were then computed for six cognitive domains by taking the average of the normed *T*-scores (See Table 1).

Statistical Analyses

Statistical analyses were conducted via IBM® SPSS version 22.0 for Windows. Pearson's correlations were utilized to examine relationships between variables, while multiple regression analyses were employed to investigate potential predictors of the outcome measures. Specifically, blocked hierarchical regression was used to predict cognitive composite scores, while stepwise linear regression analyses were used predict 6MWT variables (i.e., pre-walk PP, post-walk PP, and distance walked). Repeated measures analyses of variance (ANOVA) was used to compare cognitive composite scores, and one-way (between-subjects) ANOVA was used to examine potential effects of antihypertensive medications on cognitive composite scores and 6MWT variables.

Results

Participants ranged from 60 to 93 years of age, *M* = 78.0, *SD* = 7.51, with a mean of 16.8, *SD* = 2.36, years of education. Almost 69% were women and the majority were Caucasian. All scored in the non-demented range on the MMSE, *M* = 29.3, *SD* = 1.05. The most common health comorbidities in this sample were hypertension (47.6%), followed by coronary artery disease (8.3%), diabetes (7.1%), and arthritis (6.0%). Indeed, the majority of participants (77.4%) reported taking at least one type of cardiovascular-related medication

and 33 (39.3%) reported taking two or more at the time of testing. As shown in Table 2, fifty percent were taking anticoagulants (mostly baby aspirin), 47.6% were taking antihypertensives, 35.7% were taking statins, and 4.8% were taking cardiac medications. No significant differences were observed on any of the neurocognitive outcome measures between participants taking statins, anticoagulants, or cardiac medications versus those individuals who were not. More details about the sample characteristics are shown in Table 2. As a group, the participants walked an average of 1211.8 feet during the 6MWT, ranging from a low of 165 feet to a high of 1836 feet. The mean BP parameters (systolic, diastolic, PP) of the sample are shown in Table 3, both before the 6MWT and immediately after the walk.

Neurocognitive Performance

Performance on individual neurocognitive measures is shown in Table 4, along with the six domain composite scores: Executive Function, Processing Speed, Working Memory, Verbal Memory, Visual Memory, and Language. As a group, participants scored in the average range across all measures and across all cognitive domains, relative to others their age.

Results of a repeated measures ANOVA with cognitive domain type as the within-subjects factor and the mean z-score as the dependent variable, revealed a significant main effect of cognitive domain type, $F(5, 400) = 15.8$, $p < 0.001$, partial $\eta^2 = 0.165$. In post-hoc comparisons, the two lowest composite scores, Processing Speed: $M = 44.7$, Executive Function: $M = 49.2$, differed significantly from each other and all other cognitive domains at $p < 0.01$. The Visual Memory, $M = 55.3$, and Language, $M = 52.6$, composite scores differed significantly from each other at $p = 0.02$, but no other significant differences were observed.

Individual cognitive performance was further examined using a cutoff of 1.5 standard deviations below the normative mean to signify ‘impairment.’ Using this cutoff, 70 (83.3%) of participants obtained scores within normal limits on all composite scores, and 14 (16.7%) participants were classified as impaired in one or more cognitive domains. Impairment frequencies by cognitive domain were as follows: Processing Speed 10 (11.9%); Executive Function 6 (7.1%); Verbal Memory 5 (6.0%); Working Memory 4 (4.8%); Visual Memory 4 (4.8%); and Language 4 (4.8%). In terms of the number of domains impaired, 8 (9.5%) participants were impaired in only one cognitive domain, while the remaining 6 participants obtained scores in the impaired range on two (1.2%), three (2.4%), five (1.2%), and six (2.4%) domain composite scores.

Cognition, Pulse Pressure and Exercise

To address the relation between light exercise (6MWT) on cognitive functioning, we conducted a series of blocked hierarchical regression analyses for each of the cognitive domain composite scores. The blocks used within each analysis were as follows: Block 1 included age, education, gender, Total CCI scores, and distance walked during the 6MWT; Block 2 included Pre-Walk PP; and Block 3 included Post-Walk PP.

Executive Function—The results of the overall model predicting Executive Function composite scores were significant, $F(7, 79) = 3.17$, $p = 0.006$, Adj. $R^2 = 0.162$. In block 1,

education, $\beta = -0.243$, $p = 0.03$, and Total CCI Scores, $\beta = -0.219$, $p = 0.05$, were identified as significant predictors. In block 2, Pre-Walk PP was not found to be statistically significant. In the third and final block, Post-Walk PP was identified as a significant predictor variable, $\beta = -0.328$, $p = 0.007$, even after controlling for the aforementioned variables. The addition of Post-Walk PP increased the strength of the overall model, $F(1, 72) = 7.65$, $p = 0.007$, R^2 Change = 0.081. Thus, better Executive Function composite scores were associated with lower post-exercise PP, lower levels of education level, and fewer comorbid conditions.

Processing Speed—A significant model also emerged for the prediction of Processing Speed composite scores, $F(7, 79) = 5.32$, $p < 0.001$, Adj. $R^2 = 0.277$. In block 1, distance walked on the 6MWT, $\beta = 0.237$, $p = 0.03$, was the only significant predictor identified. In block 2, Pre-Walk PP, $\beta = 0.569$, $p < 0.001$, was also found to be significant. The addition of Pre-Walk PP significantly increased the strength of the model, $F(1, 74) = 15.8$, $p < 0.001$, R^2 Change = 0.174. In the third and final block, Post-Walk PP was added as a significant predictor variable, $\beta = -0.346$, $p = 0.002$, even after controlling for the aforementioned variables. The addition of Post-Walk PP significantly increased the strength of the overall model, $F(1, 72) = 9.85$, $p = 0.002$, R^2 Change = 0.090. Thus, better Processing Speed composite scores were associated with lower post-exercise PP, but higher baseline PP and greater distance walked on the 6MWT.

Other Cognitive Domains—No significant predictors were found for the remaining composite scores (i.e., Working Memory, Verbal Memory, Visual Memory, and Language). However, correlation analyses indicated that higher Executive Function composite scores were associated with higher Processing Speed, $r = 0.44$, $p < 0.001$, and Working Memory, $r = 0.35$, $p = 0.001$, composite scores.

Exploratory Analyses

Medication Effects—Differences emerged as function of antihypertensive medication use. Namely, those participants taking antihypertensive medications walked a significantly shorter distance (feet) on the 6MWT than those not taking antihypertensives, $F(1,83) = 6.27$, $p = 0.01$; Antihypertensive Group: $M = 341.7m$, $SD = 88.9$; No Antihypertensive Group: $M = 394.5m$, $SD = 102.8$. Additionally, those taking antihypertensives had significantly greater post-walk PP than individuals not taking antihypertensives, $F(1,83) = 4.74$, $p = 0.03$; Antihypertensive Group: $M = 65.1$, $SD = 13.9$; No Antihypertensive Group: $M = 58.6$, $SD = 13.5$.

PP Predictors—Pre-walk PP was significantly predicted by the use of antihypertensive medications, $F(1, 72) = 3.99$, $p < 0.05$, Adj. $R^2 = 0.039$, with patients taking antihypertensives exhibiting higher baseline PP. However, pre-walk PP was unrelated to age, body mass index (BMI) and comorbid conditions (e.g., hypertension) listed in Table 2. While post-walk PP exhibited a significant relationship with pre-walk PP and the use of antihypertensive medications ($p < 0.05$), only pre-walk PP significantly predicted post-walk PP, $F(1, 83) = 19.0$, $p < 0.001$, Adj. $R^2 = 0.178$, with participants with higher baseline PP also exhibiting higher PP after the 6MWT.

Distance Walked—A stepwise regression analysis was used to examine the utility of age and comorbid conditions (i.e., BMI and CCI Total scores) in the prediction of distance walked during the 6MWT. Results of this analysis indicated that significant predictors were age, $\beta = -0.247$, $p = 0.01$, BMI, $\beta = -0.274$, $p = 0.01$, and CCI Total scores, $\beta = -0.373$, $p < 0.001$; $F(3, 77) = 9.42$, $p < 0.001$, Adj. $R^2 = 0.246$. Specifically, shorter distances walked during the task were associated with older age at testing, higher BMI and greater health comorbidities (CCI). However, post-walk PP was not significantly related to distance walked on the 6MWT, age, and comorbid conditions (e.g., hypertension, BMI). The correlations between age, comorbid conditions, 6MWT variables and the cognitive composites predicted by distance walked on the 6MWT are provided in Table 5.

Discussion

The major findings of the present study were two-fold. First, we found that higher PP after light exercise was associated with worse executive function and processing speed performance. Moreover, post-exercise PP exhibited a stronger relationship with executive function than PP derived before beginning exercise. Such findings suggest that PP following system stress in the form of walking may be more reflective of the state of vascular integrity and associated executive dysfunction in older adults than baseline physiologic measures. These results are consistent with previous investigations demonstrating greater predictive power of BP variability, particularly ambulatory measures, than resting BP measures (Dolan et al., 2005; Schwartz et al., 2007). More broadly, the obtained findings are in alignment with the view of Baltes (1993) that ‘testing the limits’ may reveal vulnerabilities that are not as readily apparent under less demanding contexts.

Second, in contrast to our secondary hypothesis, we did not find that resting or baseline BP or PP values were associated with cognitive performance in our sample of 84 independent community living older adults. This was observed even though 47.6% were being treated with at least one antihypertensive medication. However, we did find that greater pre-walk PP was associated with faster processing speed. This relationship is counter to expectations and its basis is unclear (but see Obisesan et al., 2008).

The basis for our observation that worse executive function was associated with increased post-walk PP is also unclear. One possibility, drawing from the literature, is that it relates to suboptimal modulation of hypertension and dysfunctional autoregulatory mechanisms that disrupt fronto-subcortical networks (Hajjar, Zhao, Alsop, & Novak, 2010; Silvestrini et al., 2006). This interpretation is consistent with a recent study in older adults by Hajjar et al. (2010), suggesting that hypertensive patients exhibit impaired cerebral vasoregulation in all cortical regions, with the most prominent deficits in vasoreactivity observed in fronto-parietal regions. Thus, the combination of age-associated cardiovascular abnormalities and cerebrovascular vulnerability may account for the cognitive changes observed in hypertensive older adults via disruption of fronto-subcortical networks (Raz, Rodrigue, & Acker, 2003). However, in order to verify such mechanisms underlying executive declines in older adults with hypertension, further research employing functional neuroimaging techniques as well as near-infrared spectroscopy-based indices of cerebral autoregulation is warranted.

Despite the observed relationship between worse Executive Function composite scores and higher post-walk PP, only six participants in our community-dwelling older adult sample scored in the impaired range on this index with a cutoff of 1.5 standard deviations. Thus, the present results imply a latent vulnerability in this cognitive domain associated with abnormal cardiovascular responses to stressors. This raises questions regarding what would happen with additional stressors (e.g., neurodegenerative conditions) and what can be done to minimize these cognitive changes. Moreover, such findings suggest that ambulatory BP parameters are more important than resting BP parameters in detecting cardiovascular abnormalities and determining the need for initial therapeutic intervention and adjunctive treatment.

The findings of the current study must be interpreted with caution given the small sample size and the high number of statistical comparisons. Of note, post-walk PP, while important, was not the only driver of executive function as the medium effect size reported for the prediction of Executive Function composite scores was produced for the total model rather than the unique effect of post-walk PP. Moreover, the dosage of cardiovascular and psychotropic medications was also not considered in the examination of physiological and cognitive differences between patients receiving treatment with such drugs and those who were not at the time of testing. Medication dosages may also have varied based on the severity of participants underlying medical conditions. Additional factors to consider include drug side effects and potential interactions with other medications that participants may have been taking at the time of testing. Additionally, the potential for volunteer bias must also be considered, as the current sample consisted of older adults living independently with adequate health and mobility to allow them to be eligible for participation in the study. Future research should investigate the relative risks versus benefits of cardiovascular exercise interventions in non-demented older adults.

Conclusion

Hypertension is a major cardiovascular risk factor associated with cognitive changes in normal older adults. Although resting physiological measures have traditionally been employed in investigations linking cardiovascular abnormalities with neurocognitive decline, the present findings suggest that cardiovascular reactivity following light physical exercise is more closely associated with declines in executive function than resting cardiovascular activity. Such findings suggest that ambulatory BP parameters are more important than resting BP parameters in detecting cardiovascular abnormalities and determining the need for initial therapeutic intervention and adjunctive treatment. Moreover, the current results highlight the importance of optimal BP control in the aging population and suggest that early intervention may be beneficial in reducing the risk of declines in executive function with advancing age.

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Table 1

Neuropsychological measures administered.

Composite Score	Measures Included
Working Memory	<u>WAIS-III Digit Span</u> : Total score (Wechsler, 1997a) <u>WMS-III Spatial Span</u> : Total score (Wechsler, 1997b)
Processing Speed	<u>Trail Making Test, Part A</u> : Total time (Reitan, 1992) <u>Stroop Word Reading</u> : Word total score (Golden, 1978)
Verbal Memory	<u>WMS-III Logical Memory</u> : Delayed recall (Wechsler, 1997b) <u>Hopkins Verbal Learning Test</u> : Delayed recall (Brandt & Benedict, 2001)
Visual Memory	<u>WMS-III Visual Reproduction</u> : Delayed recall (Wechsler, 1997b) <u>WMS-III Family Pictures</u> : Delayed recall (Wechsler, 1997b)
Language	<u>Boston Naming Test</u> : Total score (Kaplan et al., 2001) <u>Animal Fluency</u> : Total score (Heaton, Miller, Taylor, & Grant, 2004)
Executive Function	<u>Trail Making Test, Part B</u> : Total time (Reitan, 1992) <u>Stroop Color-Word Test</u> : Color-Word total score (Golden, 1978) <u>Controlled Oral Word Association</u> : Total score (Heaton et al., 2004)

Table 2

Sample Characteristics - Demographic and Health Related

Variable	Mean (SD) / Frequency (%)	Range
Age	78.0 (7.51)	60 – 93
Education (years)	16.8 (2.36)	12 – 20
Gender (% female)	57 (68.7%)	—
<u>Ethnicity</u>		—
Caucasian	78 (92.9%)	
African American	3 (3.60%)	
Hispanic	1 (1.20%)	
Other	2 (2.40%)	
Mini Mental State Examination (MMSE)	29.3 (1.05)	26 – 30
Body Mass Index (BMI)	26.0 (4.44)	19 – 42
Charleston Comorbidity Index (CCI)	1.06 (1.37)	0 – 6
<u>Cardiovascular Comorbidities</u>		—
Hypertension	40 (47.6%)	
Coronary artery disease	7 (8.30%)	
Diabetes mellitus	6 (7.10%)	
Congestive heart failure	2 (2.40%)	
Peripheral vascular disease	1 (1.20%)	
Cerebrovascular disease	1 (1.20%)	
<u>Medications</u>		—
Antihypertensives ^a	40 (47.6%)	
Aspirin/Anticoagulants	42 (50.0%)	
Cardiac medications ^b	4 (4.80%)	
Statins	30 (35.7%)	
Diabetic medications	3 (3.60%)	
Thyroid medications	17 (20.2%)	
Anticholinergics	10 (11.9%)	
Cholinesterase inhibitors	1 (1.20%)	
Antidepressants	15 (17.9%)	
Benzodiazepines	10 (11.9%)	
Opiates	3 (3.60%)	

^a Calcium channel blockers (amlodipine, diltiazem, verapamil), alpha adrenergic antagonists (doxazosin, terazosin), alpha 2 adrenergic agonists (clonidine), beta blockers (metoprolol, atenolol), angiotensin II receptor blockers (valsartan, losartan, irbesartan, olmesartan), angiotensin converting enzyme inhibitors (lisinopril, captopril, quinapril, ramipril, fosinopril, trandolapril), and renin inhibitors (alkisiren).

^b Antiarrhythmic drugs (flecainide acetate).

Table 3

Pre- and post-6MWT measures.

6MWT Measures	Pre-Walk	Post-Walk
Systolic BP	137.1 (18.0)	143.2 (17.0)
Diastolic BP	79.5 (11.8)	81.5 (11.8)
Pulse Pressure	56.2 (15.3)	61.7 (14.0)

Note. Mean distance (feet) walked = 1211.8 (SD = 326)

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Table 4

Neuropsychological measures.

Measure	Mean (SD)	Range
<u>Working Memory Composite</u>	54.0 (7.88)	35 – 73
WAIS-III Digit Span Total	54.2 (9.72)	37 – 80
WMS-III Spatial Span Total	53.6 (9.92)	26 – 73
<u>Processing Speed Composite</u>	47.4 (6.88)	28 – 60
TMT-A Total Time	47.6 (9.85)	18 – 69
Stroop Word Total	47.3 (8.25)	24 – 68
<u>Verbal Memory Composite</u>	54.7 (8.84)	33 – 69
WMS-III LM Delayed Recall	57.3 (9.48)	34 – 72
HVLT Delayed Recall	51.5 (10.3)	29 – 65
<u>Visual Memory Composite</u>	55.3 (8.91)	28 – 72
WMS-III VR Delayed Recall	57.9 (10.3)	23 – 77
WMS-III FP Delayed Recall	52.7 (9.98)	30 – 73
<u>Language Composite</u>	52.6 (9.13)	30 – 71
BNT Total	56.9 (11.9)	24 – 76
Animal Fluency Total	48.4 (9.61)	26 – 68
<u>Executive Function Composite</u>	49.7 (6.08)	34 – 75
TMT-B Total Time	49.3 (8.94)	16 – 79
Stroop Color-Word Total	51.1 (8.23)	24 – 68
COWA Total	49.2 (10.0)	31 – 73

Note: Mean scores are provided as T-scores (M = 50, SD = 10).

Table 5

Correlations.

	<u>Comorbidities</u>		<u>6MWT Variables</u>			<u>Composite Scores</u>	
	CCI Total	BMI	Pre-Walk PP	Post-Walk PP	Distance Walked	Executive Function	Processing Speed
Age	ns	−0.29*	ns	ns	−0.24*	ns	ns
CCI Total		ns	ns	ns	−0.36**	−0.28*	ns
BMI			ns	ns	−0.23*	ns	ns
<u>6MWT</u>							
Pre-Walk PP				0.43***	ns	ns	0.39***
Post-Walk PP					ns	−0.28*	ns
Distance Walked						0.32**	0.21 ^a
<u>Composite Scores</u>							
Executive Function							0.23*
Processing Speed							-