Physical activity has many health benefits including maintaining or improving cognitive functioning in healthy older adults (Barnes, Yaffe, Satariano, & Tager, 2003; Colcombe & Kramer, 2003; Colcombe et al., 2003; Kramer, Bherer, Colcombe, Dong, & Greenough, 2004). Past studies have looked at aerobic exercise interventions in healthy but physically inactive older adults with mixed results. For example, Hill, Storandt, and Malley (1993) found little improvement in cognition, but Dustman et al. (1984) found that physical activity improved cognitive function. A meta-analysis by Colcombe and Kramer (2003) found that overall cognitive functioning was positively influenced by physical activity in healthy older adults. The role of physical activity in neurological disorders such as Alzheimer’s disease (AD) is less well-known (Burns, Cronk, et al., 2008). Currently, AD, whether it is mixed with other dementias or is “pure,” is one of the most common forms of dementia (Jellinger & Attens, 2010), and research has suggested that modifying health behaviors could decrease the prevalence worldwide (Barnes & Yaffe, 2011). Because of the expected increase in cases and costs associated with AD, it is important to find ways to prevent, delay, or alleviate its symptoms. Because of the relative affordability and modifiability of physical activity, it is important to explore whether engagement in physical activity can provide cognitive maintenance or gains in AD. With regard to research, examining a self-reported measure of physical activity in an AD-specific sample could illustrate whether the measure is appropriate to use on this sample or whether there are issues like floor effects. If this measure is not appropriate, new physical activity measures could eventually be constructed to capture which activities individuals with AD are likely to engage in.

**ABSTRACT.** Physical activity is believed to improve cognition, particularly executive function and working memory, in older adults. The current study investigated whether self-reported physical activity as measured by the Physical Activity Scale for the Elderly (PASE) and an objective fitness measure of submaximal oxygen volume intake, VO$_2$peak, predicted performance on tests of executive function and working memory in older adults with and without Alzheimer’s disease (AD). In a sample of 74 healthy older adults, we found that, of the individual PASE items, the walking-related question was the single best indicator of performance on executive function (verbal fluency-animals $\beta = .30, p = .01$) and working memory (digit span forward $\beta = .31, p = .04$). In the 72 participants with AD, the overall PASE score significantly predicted executive function performance (verbal fluency sum $\beta = .29, p = .02$), but neither the PASE individual items nor the VO$_2$peak significantly predicted the working memory tasks. Future studies should analyze longitudinal data to determine the relationship between physical activity and cognition over time.
Physical Activity and Cognition

Physical Activity and Executive Function

Physical activity’s role on cognition for healthy older adults (i.e., no neurological or physical disorder) is fairly widespread across multiple domains (Colcombe et al., 2003). One domain that receives significant benefit from physical activity is executive function, a “higher order” function that regulates “lower order” processes (Alvarez & Emory, 2006, p. 17). That is, executive function is conceptualized as the cognitive domain responsible for organizing and executing complex thoughts and behaviors such as balancing a checkbook. For a more in-depth review of physical activity and executive function, see Etnier and Chang (2009). A meta-analysis of randomized fitness intervention trials exploring the effect of physical activity on cognition found that the biggest gains from physical activity in healthy older adults are in executive function, although other cognitive domains (e.g., spatial) significantly improved as well (Colcombe & Kramer, 2003). Executive function is closely associated with the frontal cortex (Stuss & Alexander, 2000). In typical aging, the grey matter density associated with executive function declines most severely in the prefrontal, superior parietal, and middle/inferior temporal cortices; coincidentally, these areas receive the greatest benefits of aerobic fitness as well (Colcombe et al., 2003, Colcombe et al., 2006). It is possible that physical activity would decrease atrophy in regions associated with executive function, which may lead to improved performance or smaller observed deficits in executive function.

In mild AD, research has shown that executive function deficits exist, albeit not uniformly across various tests (LaFleche & Albert, 1995). Some studies have found improvement in executive function with exercise in older adults with AD (Yu, Kolanowski, Strumpf, & Eslinger, 2006). Clues to understanding the relationship between physical activity and executive function in individuals with Alzheimer’s disease may be found in the neural makeup of AD. In AD, amyloid-β, an abnormal protein, is linked to neurtic plaque formation (Pérez & Cancella Carral, 2008). Some research with mice has shown that, after 5 months of voluntary exercise, there was a decrease in extracellular amyloid-β plaques in the frontal cortex, among other places (Adlard, Perreau, Pop, & Cotman, 2005), likely due to limited ability to measure plaques in living humans. However, as new technologies develop to examine the brains of AD patients in vivo (e.g., Pittsburgh Compound B), future studies will likely address this issue.

Physical Activity and Working Memory

Another cognitive domain affected by physical activity and dementia is working memory (Belleville, Peretz, & Malenfant, 1996), defined as “the online storage and manipulation of information for a short period of time” (Kensinger, Shearer, Locascio, Growdon, & Corkin, 2003, p. 230). Working memory, like executive function, is associated with the prefrontal lobe (Funahashi & Kubota, 1994). Like executive function, it may receive great benefit from aerobic fitness (Colcombe et al., 2003; Colcombe et al., 2006). In Newson and Kems’ (2006) cross-sectional study of healthy individuals, processing resources including working memory were found to account for more variance between cardiorespiratory fitness and cognitive functioning than other measures.

In dementia (especially AD), the possible relationship between working memory and physical activity may be apolipoprotein E (APOE; Deeny et al., 2008), a plasma protein in the tangles and plaques of people with AD (Lehtovirta et al., 1995). APOE is a genetically inherited risk factor with three possible allele types: ε2, ε3, and ε4 (Rosen, Bergeson, Putnam, Harwell, & Sunderland, 2002). The APOE allele associated with increased risk of AD is ε4 (Bondi, Salmon, Galasko, Thomas, & Thal, 1999). A study examining the relationship found that ε4 carriers were less able to divide their attention than non ε4 carriers, suggesting that APOE may affect the central executive component of working memory (Rosen et al., 2002).

Physical activity appears to have benefits for ε4 carriers. A study by Deeny et al. (2008) found that physically active ε4 carriers fared better on various working memory tasks than physically inactive ε4 carriers. Physical activity also appears to have a positive effect for ε4 carriers with other memory tasks; it appears to increase the levels of brain-derived neurotrophic factor in the hippocampus, an important component in memory (Nichol, Deeny, Self, Camaclang, & Cotman, 2009). However, Nichol and colleagues’ finding was discovered in mice and has not yet been generalized to a human population. Because of the emerging support for physical activity’s effect on the brain, it is possible that the brain changes could impact cognition as well, especially cognitive domains like executive function and working memory, brain regions that are impacted by physical activity.
Research Questions and Hypotheses
The present study aimed to examine the relationship between self-reported and objective measures of physical activity with executive function and working memory in both healthy older adults and older adults with early stage AD. Currently, no studies have examined the appropriateness of administering older adult-specific physical activity questionnaires to individuals with AD. The current study examined whether a self-reported physical activity questionnaire and an objective fitness measure predict similar cognitive outcomes for both individuals with and without AD. Given that findings from previous studies support the relationship between physical activity and cognition, we expected to find a significant relationship between physical activity (both self-reported and objective) and executive function and working memory in healthy older adults, specifically that higher physical activity engagement would be associated with better performance on the cognitive tasks. For older adults with AD, we expected to find a significant relationship between objective physical activity and executive function, where higher levels of physical activity engagement would be associated with better performance on executive function tasks.

Method
Sample and Participant Selection
Healthy older adults (Clinical Dementia Rating, CDR, 0; n = 74) and early stage AD participants (CDR 0.5, n = 58; and CDR 1, n = 14; total N = 72) aged 65 and over were enrolled in an ongoing study, the Brain Aging Project, at a large midwestern university with a medical center. There were 139 European American (95%), six African American (4%), and one Native American (1%) participants in the study. The University of Kansas Institutional Review Board provided approval for the Brain Aging Project (Clinical Trials Identifier number: NCT00267124). Participants were recruited from a referral-based memory clinic and by media appeals. Study exclusions included neurologic disease other than AD, diabetes mellitus (defined as a clinical diagnosis and use of an antidiabetic agent), history of ischemic heart disease (acute coronary artery event, angina), schizophrenia, clinically significant depressive symptoms, abnormalities in B12, rapid plasma regain, or thyroid function, use of psychoactive and investigational medications, significant visual or auditory impairment, or systematic illness that would impair completion of the study.

Participants with early stage AD had a collateral source to record self-measures. Collateral sources included family members or caregivers. Collateral sources were secured to ensure that the data were not affected by the cognitive status of the participant. This is standard practice because individuals with dementia are often unreliable reporters (Kiyak, Borson, Teri, & Borson, 1994; Wadley, Harrell, & Marson, 2003; Weinberger et al., 1992).

Procedures
After participants consented to be in the study, data were collected in one appointment per participant and lasted anywhere from 2 to 3 hours. Participants were tested individually. A clinical assessment, described below, was administered at the beginning of the session. Medications, past medical history, education, demographic information, and family history were collected at this time. For individuals with AD, their collateral source, typically a caregiving family member, provided this information to a nurse clinician. Healthy older adults also had a collateral source, but they did not provide health information to the clinician. Blood pressure was collected, and physical and neurologic examinations were also performed. For both the healthy older adults and AD participants, their collateral source was administered the Geriatric Depression Scale (Hamilton, 1967) and the Neuropsychiatric Inventory (Galasko et al., 1997) to assess participants’ depression and presence and severity of neuropsychiatric symptoms, respectively. Functional activity levels were estimated using the Mild Cognitive Impairment Activities of Daily Living Scale (Galasko et al., 1997) using information collected from the collateral source.

After the clinical assessment was completed, a trained psychometrician administered a psychometric battery including measures of memory (Wechsler Memory Scale-Revised Logical Memory I and II, Wechsler & Stone, 1973; Free and Cued Selective Reminding Task, Grober, Buschke, Crystal, Bang, & Dresner, 1988), language (Boston Naming Task-5 item, Kaplan, Goodglass, & Weintraub, 1983), working memory (Wechsler Memory Scale III Digit Span Forward and Backward, Wechsler & Stone, 1973; Wechsler Adult Intelligence Scale Letter-number sequencing, Wechsler, 1955), executive function (Trail Making A and B, Armitage, 1946; Verbal Fluency animals and vegetables, Hanninen et al., 1994; and Stroop
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Color-Word Test, Stroop, 1935), and visuospatial ability (Wechsler Adult Intelligence Scale Block Design, Wechsler, 1955). As a measure of global cognition, the minimental status examination (Folstein, Folstein, & McHugh, 1975) was administered.

VO\textsubscript{2peak}, an objective measure of cardiorespiratory fitness examining the peak oxygen intake during a treadmill task, was then assessed using the method described below and previously (Burns, Cronk, et al., 2008). The Physical Activity Scale for the Elderly (PASE) was then administered. Additional data including the Physical Performance Test (Shah et al., 2004), a 14-sample intravenous glucose tolerance test, and dual energy x-ray absorptiometry to determine fat-free mass, fat mass, percent body fat, and total body mass, were collected at this time.

Assessments and Measures

Clinical assessment. The clinical assessment included a semistructured interview with the participant and with a collateral source knowledgeable about the participant. Diagnostic criteria for AD require the gradual onset and progression of impairment in memory and at least one other cognitive and functional domain (McKhann et al., 1984). The presence or absence of dementia, and its severity (if present), was determined using the clinical dementia rating scale (CDR; Hughes, Berg, Danziger, Coben, & Martin, 1982; Morris, 1993). These methods have a diagnostic accuracy for AD of 93% (Berg et al., 1988). On the basis of the collateral source and participant interviews, a global CDR score was derived from individual ratings in each domain such that CDR 0 indicates no dementia and CDR 0.5, 1, 2, and 3 represent very mild, mild, moderate, and severe dementia, respectively.

Executive function.

Trail Making A and B. Executive function was measured using three different tests. Trail Making A and B measure speed of processing, mental flexibility, scanning, and visual search information (Tombaugh, 2004). Trail Making A consists of “drawing lines sequentially connecting 25 encircled numbers distributed on a sheet of paper” (Tombaugh, 2004, p. 203). This portion of the test examines a person’s sequencing ability (Atkinson et al., 2009). Scores ranged from 16 to 63 for healthy older participants (\(M = 33.70, SD = 9.57\)), and scores ranged from 16 to 180 for participants with AD (\(M = 67.12, SD = 43.50\)). There were significant group mean differences, indicating that healthy older participants had significantly lower mean scores (i.e., better task performance).

In Trail Making B, the person must draw lines alternating between numbers and letters (e.g., 1, A, 2, B, 3, C). This examines the person’s shifting ability (Atkinson et al., 2009). Scores ranged from 37 to 150 for healthy older participants (\(M = 82.40, SD = 25.29\)), and scores ranged from 52 to 300 for participants with AD (\(M = 147.89, SD = 42.66\)). There were significant group mean differences, indicating that the healthy older participants had significantly lower mean scores (i.e., better task performance). The scores on A and B represent the amount of time it took to complete each task; lower scores indicate better performance.

Verbal fluency (animals and vegetables). The second test of executive function, verbal fluency, requires respondents to name as many types of a cue word as possible (i.e., for cue “animal,” as many animals as possible). The score is the number of appropriate responses given in a 60-s time period. The sum of verbal fluency was also calculated by adding an individual’s verbal fluency-animals and verbal fluency-vegetables scores. Verbal fluency-animals scores ranged from 9 to 29 for healthy older participants (\(M = 19.34, SD = 4.21\)) and 1 to 25 for participants with AD (\(M = 13.62, SD = 5.28\)). Verbal fluency-vegetables scores ranged from 8 to 25 for healthy older participants (\(M = 15.66, SD = 3.76\)) and 2 to 22 for participants with AD (\(M = 9.86, SD = 4.56\)). Mean performance on both tasks were similar across groups. Total fluency scores ranged from 22 to 51 for healthy older participants (\(M = 35.0, SD = 6.61\)) and 5 to 46 for participants with AD (\(M = 23.49, SD = 8.82\)). There were significant group mean differences, indicating that healthy participants had significantly better mean performance.

Stroop Color-Word Test. The Stroop Color-Word Test requires the respondent to read the name of the ink color, but the actual word is a different color (e.g., the word \textcolor{red}{red} is typed in blue ink; the correct response is \textcolor{blue}{blue}). The score indicates reaction time; smaller numbers indicate better performance. Because the color naming, as opposed to the word reading, is of interest, reaction times of the color naming were examined. The test has been shown to yield highly reliable measures in interference proneness, among other measures (Jensen & Rohwer, Jr., 1966). Past research has suggested that older adults with AD may experience inhibition breakdowns more quickly than healthy older adults.
(Spieler, Balota, & Faust, 1996).

Scores on color naming ranged from 50 to 97 for healthy older participants \( (M = 73.10, SD = 10.71) \), and scores for participants with AD ranged from 13 to 97 \( (M = 56.42, SD = 18.31) \). Scores on word reading ranged from 3 to 12 for healthy older participants \( (M = 6.84, SD = 2.23) \), and scores for participants with AD ranged from 2 to 10 \( (M = 7.61, SD = 18.93) \). There were significant mean differences in both Stroop scores, indicating that, for both, healthy older participants had better mean scores.

**Working memory.**

Wechsler Memory Scale III Digit Span Forward and Backward. The digit span tasks present a list of numbers, and participants are asked to repeat the numbers back (either forward or backward). If an individual repeats the sequence correctly, that person is given a longer list of numbers to repeat back (i.e., if an individual gets a list of three numbers and repeats it successfully, a list of four numbers is presented). The test continues until the person repeats a sequence incorrectly. The score is based on the highest number of digits a person is able to correctly recall. Digit span has been found to have high internal consistency and test-retest reliability (Iverson, 2001). Scores on digit span forward ranged from 5 to 14 for healthy older participants \( (M = 8.93, SD = 2.23) \), and scores for participants with AD ranged from 4 to 14 \( (M = 10.16, SD = 1.83) \). There were no significant mean group differences. Digit span backward scores ranged from 3 to 12 for healthy older participants \( (M = 6.84, SD = 2.14) \) and ranged from 2 to 11 for participants with AD \( (M = 5.22, SD = 1.77) \). Mean scores were similar across groups.

Wechsler Adult Intelligence Scale Letter-number sequencing. Letter-number sequencing is a verbal task that measures working memory. Respondents are presented with a random series of numbers and letters ranging from two to nine letter-number combinations. The person is then instructed to say the numbers first in order from lowest to highest and then the letters in alphabetical order; they can also present letters first and numbers after. Answers are considered correct if the person is able to create the correct sequence of numbers and letters. Their score is composed of the number of correct trials. Scores on letter-number sequencing ranged from 6 to 14 for healthy older participants \( (M = 10.16, SD = 1.83) \), and scores ranged from 1 to 14 for participants with AD \( (M = 7.45, SD = 2.70) \). There were significant mean group differences, indicating that healthy older participants had significantly better mean task performance.

Cardiorespiratory fitness. \( VO_2^{\text{peak}} \) is a standard of cardiorespiratory fitness (McAuley et al., 2011). It was measured during a symptom-limited graded treadmill test with a protocol designed for a geriatric population (described in Hollenberg, Ngo, Turner, & Tager, 1998). Participants wore a nonrebreathing facemask and were attached to a 12-lead electrocardiograph to monitor cardiac stability. \( VO_2^{\text{peak}} \) is the highest peak of oxygen intake during an incremental, submaximal physical test (Whipp, 2010). Because the testing to determine \( VO_2^{\text{max}} \) is more time consuming and may not yield the true highest attainable oxygen intake, the \( VO_2^{\text{peak}} \) is an appropriate measure to use to examine cardiorespiratory fitness. Washburn, McAuley, Katula, Mihalko, and Boileau (1999) also noted that older adults are often unable to obtain verifiable \( VO_2^{\text{max}} \), making \( VO_2^{\text{peak}} \) a more viable option in this population.

Scores on \( VO_2^{\text{peak}} \) ranged from 12.54 to 44.60 in the healthy older sample \( (M = 21.75, SD = 6.04) \), and scores ranged from 11.99 to 28.41 in the sample with AD \( (M = 19.46, SD = 3.94) \). There were significant group mean differences, indicating that healthy older participants had higher \( VO_2^{\text{peak}} \) than those with AD.

PASE. The level of habitual physical activity was measured using the PASE (Washburn, Smith, Jette, & Janney, 1993). It is a reliable and valid (Schuit, Schouten, Westerterp, & Saris, 1997; Washburn et al., 1999) measure of habitual activity. It is a self-report questionnaire that asks questions about physical activity in three domains: occupational, household, and leisure activities (i.e., walking, yardwork, caring for another person, or housework) over a 7-day period. The questions are a mix of yes or no, Likert scale, and open-ended questions. Scores on the PASE have a possible range from 0 to 361, with 0 being no engagement in physical activity. For healthy older participants, scores ranged from 27 to 276 \( (M = 127.11, SD = 57.45) \), and scores for participants with AD ranged from 0 to 267 \( (M = 85.20, SD = 55.33) \). There were no group mean differences in overall PASE scores. Validity and reliability for populations with dementia have not been established.

In the current study, the PASE was modified by administering it to the participant’s study partner for participants with AD. Instead of analyzing data by domains (occupational, household, leisure), the total PASE score and answers to specific items...
were analyzed. For the correlation and regression analyses, some individual PASE questions were modified (i.e., sports, housework, lawn, and garden) to combine overlapping questions. Other studies have used similar combinations to increase variability and to reduce the number of zeros (Dallosso et al., 1988). In the current study, participation in sports at light, moderate, and strenuous intensity were combined into a single indicator with a higher score indicating more strenuous sports participation. Due to the high degree of overlap between the lawn and yard work item with the gardening item, they were combined into a single item, called yardwork and gardening.

Results
Sample Characteristics
Sample descriptive statistics for demographic characteristics, cognitive test performance, and physical activity measures are presented in Table 1. The overall sample size was \( N = 146 \), and there were 74 healthy older adults and 72 older adults with early stage AD. The mean age for healthy older adults was \( 74 (SD = 7.20) \), and the mean age for older adults with AD was \( 74.90 (SD = 6.40) \). Of the healthy older adults, 56% of the sample were women, and 62% of the AD sample were men. The mean number of years of education for the healthy sample was 16.40 (\( SD = 2.80 \)) years and was 15.10 (\( SD = 3.10 \)) for the sample with AD.

\( VO_{peak} \) and Cognition
After controlling for age, sex, and education in a simultaneous multiple regression, \( VO_{peak} \) was not found to significantly predict performance on the executive function tests in adults with or without AD. In these models, education in adults without AD predicted performance on verbal fluency sum score (\( \beta = .24, p = .01 \)) such that higher education predicted higher verbal fluency performance. Age significantly predicted performance on Trail Making A (\( \beta = .32, p = .02 \)), Trail Making B (\( \beta = .41, p = .002 \)), and the Stroop task (\( \beta = .32, p = .02 \)); older adults performed significantly worse on the three tasks. Sex significantly predicted performance on verbal fluency-vegetables (\( \beta = .35, p = .03 \)) such that men performed significantly worse.

In individuals with AD, sex predicted performance on verbal fluency-animals (\( \beta = .36, p = .02 \)), indicating that men performed better than women on this task. In both individuals with and without AD, \( VO_{peak} \) did not significantly predict performance on working memory tests.

In older adults without AD, education significantly predicted digit span backward (\( \beta = .32, p = .01 \)), indicating that individuals with higher education performed significantly better on this task. Age significantly predicted performance on digit span substitution (\( \beta = .36, p = .03 \)) and letter number sequencing (\( \beta = .37, p = .01 \)) such that older adults performed significantly worse.

In older adults with AD, sex predicted performance on digit span forward (\( \beta = .39, p = .01 \)), and education predicted performance on digit span substitution (\( \beta = .35, p = .04 \)). Men performed significantly better on digit span forward, and individuals with higher education performed significantly better on digit span substitution.

PASE and Cognition
Results of multivariate analysis demonstrated that, after controlling for age, sex, and education, the PASE item walking predicted verbal fluency-animals (\( \beta = .30, p = .01 \)) for individuals without AD; individuals with a higher walking composite score performed better on this task.

In multivariate analysis adjusting for age, sex, and education, the total PASE score predicted the sum of verbal fluency categories (\( \beta = .29, p = \)})
physical activity scores predicted better task performance. No covariates significantly predicted performance on the executive function tasks.

In multivariate analysis adjusting for age, sex, and education for older adults without AD, the PASE item walking was found to significantly predict digit span forward ($\beta = .31, p = .04$), and the PASE item caring for another significantly predicted letter number sequencing ($\beta = .25, p = .03$). A higher walking composite score and caring for another are associated with better performance on digit span forward and letter number sequencing, respectively.

In older adults with AD, no PASE item or overall PASE score predicted performance on working memory items. Education significantly predicted performance on the digit symbol substitution task ($\beta = .35, p = .04$) such that higher education predicted better performance.

Discussion

The current study found that physical activity, as measured by the PASE and VO$_{2\text{peak}}$, is a poor predictor of cognition in older adults with and without AD. Overall, the PASE was a better predictor of performance on executive function and working memory tasks than VO$_{2\text{peak}}$. There are a few possible explanations for this finding. It could be that activities that older adults report are insufficient to impact their cardiorespiratory fitness but may be enough to see modest impacts on cognition. Although enhanced cardiorespiratory fitness in older adults without AD is associated with preventing cognitive decline, it could be that cardiorespiratory fitness does not have the same cognitive benefits in AD despite the fact that individuals with AD have comparable levels of cardiorespiratory fitness (Burns, Mayo, Anderson, Smith, & Donnelly, 2008). Relatedly, it is possible that the areas of the brain needed for executive function and working memory are already so damaged that cognitive improvement by physical activity engagement is unlikely. For example, it could be that so much neurological damage has occurred that neurogenesis from physical activity cannot replace the missing neurons. It could also be that the PASE captured some activity that the VO$_{2\text{peak}}$ was unable to capture. For example, instead of walking benefitting cognition, it could be that the social interaction with a walking partner provides cognitive stimulation. With regard to the individual PASE items, walking significantly predicted performance on cognitive tasks more often than any of the other items. This is likely because walking was one of the activities that participants most reported doing.

With regard to the covariates (age, sex, education), age was the largest predictor of cognitive tasks for participants without AD. The relationship between aging and the cognitive tasks suggested that the older that participants without AD were, the poorer their performance was on executive function and working memory tasks. These results supported previous findings that older age is associated with poorer executive function performance (de Frias, Dixon, & Strauss, 2006) and working memory (Dobbs & Rule, 1989). In participants with AD, education positively predicted performance on all of the working memory tasks, suggesting that more years of education are associated with better working memory. Previous research has found that individuals with early stage AD perform better on global cognition tests if they have higher educational attainment, but these benefits may be lost as the disease progresses in severity (Koepsell et al., 2008).

It is interesting to note that, in the executive function and working memory tests for participants without AD, the individual PASE questions were significant predictors of performance, whereas executive function tasks for individuals with AD were significantly predicted by the total PASE score. A possible reason for significant results obtained by looking at individual items is that some of the activities in the PASE were ones that participants did not do. More people engaged in walking, for example, than home repair. For many of the items, there was a floor effect. That is, many participants indicated that they did not participate in the activity. Because of the number of floor effects, this could suggest that the total PASE may not be an accurate reflection of the types of activities in which older adults engage. It is possible that fewer activities should be included in the PASE. More common activities like walking may be better correlates and predictors of cognitive function. In participants with AD, however, it could be that total PASE scores are more variable than scores on any one item, allowing for better prediction.

The data in the present study are cross-sectional, so we were unable to determine whether these results would be stable across time or how they might change with increasing dementia severity. A second limitation was that the PASE did not seem to measure much activity in this relatively physical inactive sample of older adults. Many of
the PASE items were activities in which participants did not engage. Future research should investigate better ways to measure physical activity in older adults with AD or very physically inactive older adults.

Despite the limitations, the current study suggested that there are effects of physical activity on cognition, and there was support for the relationship between the two that could be further explored in either a longitudinal study or a physical activity intervention study. Future studies should explore longitudinally whether physical activity over time influences performance on executive function and working memory tasks. It is possible that lifetime or long-term physical activity is needed to have lasting effects on the brain or has a stronger effect than short-term activity. Inactivity may be a risk factor for developing AD, caused by AD, or it may be both (Friedland et al., 2001).

The current study suggested that physical activity, especially walking, should be further explored to see whether it is able to longitudinally predict performance on cognition or if the results obtained were specific for this age and time period. Because the study sample was fairly physically inactive, the results might have underestimated the true relationship between physical activity and cognition. Future studies could explore ways to motivate older adults to engage in physical activity so its role in cognition could be more clearly defined. The present study showed that self-reported measures of physical activity did capture some variability in cognition in older adults with and without AD despite the messiness of the measure. Leading a physically active lifestyle may not just help the body but the mind as well.

References


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