5-17-2019

Physiotherapy is Associated with Improvements in Gait and Balance in Individuals with Cognitive Impairment: A Retrospective Analysis

Steven Jackson
University of Nevada, Las Vegas, Stevenjackson318@gmail.com

Elbert Chen
University of Nevada, Las Vegas, Chenelbert12@gmail.com

Jason Phan
University of Nevada, Las Vegas, Jhphan1@gmail.com

PHYSIOTHERAPY IS ASSOCIATED WITH IMPROVEMENTS IN GAIT AND BALANCE IN INDIVIDUALS WITH COGNITIVE IMPAIRMENT: A RETROSPECTIVE ANALYSIS

By

Elbert Chen
Steven Rauland Ballard Jackson
Jason Phan

A doctoral project submitted in partial fulfillment
of the requirements for the

Doctor of Physical Therapy

Department of Physical Therapy
School of Allied Health Sciences
Division of Health Sciences
The Graduate College

University of Nevada, Las Vegas
May 2019

UNLV | GRADUATE COLLEGE

Doctoral Project Approval

The Graduate College
The University of Nevada, Las Vegas

May 17, 2019

This doctoral project prepared by

Elbert Chen

Steven Jackson

Jason Phan

entitled

Physiotherapy Is Associated with Improvements in Gait and Balance in Individuals with Cognitive Impairment: A Retrospective Analysis

is approved in partial fulfillment of the requirements for the degree of

Doctor of Physical Therapy
Department of Physical Therapy

Daniel Young, Ph.D.
Research Project Coordinator

Kathryn Hausbeck Korgan, Ph.D.
Graduate College Dean

Merrill Landers, Ph.D.
Research Project Advisor

Merrill Landers, Ph.D.
Chair, Department of Physical Therapy

ABSTRACT

BACKGROUND: Evidence suggests that individuals with cognitive impairment (CI) exhibit significant motor impairments; however, these motor impairments receive little treatment attention compared to more prominent CI. Moreover, there is a lack of evidence about physiotherapy (PT) in individuals with CI.

OBJECTIVE: The purpose of this study was to determine if PT was effective at improving gait and balance in individuals with Alzheimer disease (AD), vascular dementia (VaD), dementia with Lewy bodies (DLB), and mild cognitive impairment (MCI).

METHODS: Retrospective data of 173 individuals with CI conditions and an initial evaluation for PT were extracted from electronic records from January 2016 to December 2017 at a neuro-rehabilitation clinic. The individuals were grouped according to diagnosis (67 with AD, 34 with VaD, 35 with DLB, and 37 with MCI). The following outcomes before and after a month of PT were extracted from records: Montreal Cognitive Assessment (MoCA), miniBESTest, 5 Times Sit-To-Stand, Timed Up and Go (TUG), TUG cognitive, preferred gait speed, fast gait speed, 6 Minute Walk Test, and the modified Fear of Falling Avoidance Behavior Questionnaire.

RESULTS: The mean number of PT sessions over a month was 3.4 (±1.8). All groups showed improvements in balance and at least two gait outcome measures. Those with MCI improved in every gait and balance outcome measure. Lastly, MoCA scores improved in individuals in the AD, VaD, and MCI groups.

CONCLUSIONS: Results of this study offer preliminary evidence that one month of PT may produce benefits to gait and balance in individuals with CI. Moreover, it may afford cognitive benefit.

KEY WORDS: Alzheimer disease, vascular dementia, dementia with Lewy bodies, mild cognitive impairment, dementia, exercise, physiotherapy, rehabilitation

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

Between 2012 and 2050, the population aged 65 years and older within the United States is expected to nearly double from 43.1 million to 83.7 million.[1] This growth will have wide-ranging implications for healthcare systems and its management of chronic diseases. Of particular concern are cognitive impairment (CI) disorders including Alzheimer disease (AD), vascular dementia (VaD), dementia with Lewy bodies (DLB), and mild cognitive impairment (MCI). Because of their progressive nature, these disorders can result in the loss of independence which strains individuals, families, and society.[2]

Dementia is an umbrella term for a broad range of cognitive symptoms that cause functional impairment.[3] It encompasses a variety of subtypes that are categorized based on disease timing, severity of cognitive symptoms, and other specific diagnostic criteria.[3] With a prevalence of 5.3 million cases in the U.S. in 2015, AD is the most common cause of dementia in older adults and the most common neurodegenerative disease overall.[4] It is characterized by beta-amyloid and phosphorylated-tau pathology.[5] In comparison, DLB is the second most diagnosed type of dementia, and it is characterized by a primary tauopathy that causes protein deposits, called Lewy bodies, in the brain.[3] The presence of visual hallucinations and spontaneous motor features of parkinsonism, following the onset of cognitive symptoms, makes DLB distinguishable from other dementias.[6] VaD is yet another type of dementia that is distinct from the others because it is caused by vascular events in the brain.[7] MCI, a potential precursor to dementia, is marked by slight, but detectable, decline in cognitive abilities not reaching the threshold of dementia diagnosis.

Evidence suggests that another contributor to functional decline in persons with CI is motor impairment.[8-10] These motor impairments have received less treatment and research attention compared to the more prominent cognitive impairments. Subsequently, physiotherapy (PT) to address the motor impairment has not been considered a primary intervention for individuals with CI.[11] However, evidence suggests that exercise may mitigate some of the cognitive and motor impairment.[8,9] Hence, there is a need to further explore the role of exercise and PT in individuals with CI disorders.

A closer inspection of the motor impairments associated with CI is justifiable and necessary because evidence suggests a link between the two.[10] Specifically, individuals with dementia exhibited slower gait speeds compared to healthy controls, and more severe dementia was associated with more severe declines in gait.[8,9] Recognizing and addressing this connection is crucial because declining gait characteristics have been correlated with decreased survival and independence in older adults.[12] Another important motor impairment in individuals with CI is decreased balance which, combined with the gait deficits, may significantly increase the risk for falls.[13-15] Approximately 60% of individuals with CI fall annually, twice as frequently as their cognitively intact counterparts.[16,17] Individuals with CI have higher rates of mortality and institutionalization post fall[18,19] and are more likely to have falls resulting in injuries, with up to a three-fold increase in hip fracture incidence over individuals without CI.[18] Falls with resultant injuries have been shown to warrant extensive medical care including long-term hospitalization and rehabilitation which not only diminishes the quality of life of the individual but also comes with significant economic costs.[20]

Because CI disorders are associated with loss of independence or future loss of independence, it is important to address potentially mitigable motor impairments which may exacerbate or hasten disability. Targeting motor impairments early may potentially prevent loss of function and also may delay the progression of CI.[10,21] While evidence has suggested a connection between diminished mobility and diminished cognition, the opposite is also true: improving mobility has been shown to improve cognition. In fact, evidence suggests that improvements in the Six Minute Walk Test correlated with significant increases in the Barthel Index of Activities of Daily Living and the Mini-Mental State Examination in those with AD.[22]

Currently, treatments for CI include both pharmacological and non-pharmacological interventions. Appropriate cognitive pharmacotherapy (e.g., cholinesterase inhibitors for AD) produces improvements in gait velocity, stride time, and fall risk.[23] Aerobic exercise has been shown to preserve mental speed and attention in individuals with AD.[24] Moreover, dual-task-based training can improve gait and balance in individuals with dementia.[23,25]

With all this emerging evidence promoting the importance of mobility for individuals with CI, some medical doctors have started prescribing PT.[26] Referral to PT for the primary treatment of CI is not currently considered a first-line intervention because there is no consensus on its efficacy. In fact, although several studies have investigated this topic, it remains unclear whether individuals with CI will benefit from PT with respect to motor performance and fall risk prevention.[27-29] Therefore, the aim of this study was to determine if PT focused on addressing motor impairment and function is effective in improving gait and balance measures in individuals with CI. A secondary aim of this trial was to determine if PT could also positively affect cognition.

METHODS

Design

A retrospective, pre- and post-PT cohort design was used in which balance and gait performance scores of individuals with CI disorders were extracted from medical records at the (blinded) at the start and end of one month of PT. Specific demographic items that were extracted include sex, race, age, diagnoses, ICD 10 codes, assistive device usage, acetyl cholinesterase inhibitor use, and fall history in the 12 months prior to PT. None of the treating physiotherapists were involved in the data extraction process. To determine what kind of treatment was offered, the total number of PT sessions were recorded, billing codes were analyzed, and treating therapists were interviewed regarding treatment structure and goals. Treatment was organized into general categories (e.g., aerobic activity, strengthening, balance training, dual task training, education, and functional training).

Participants

All individuals, ages 50 to 90, with an initial PT evaluation at (blinded) in 2016 and 2017 were identified from billing records. CCLRCBH considers PT to be an integral part of treatment for individuals with CI; therefore, individuals with CI are referred to PT regardless of their motor impairment status. Clinical diagnosis of disorders of cognition was completed by neurologists using specific sets of contemporary evidence-based criteria.[5,30-33] Inclusion criterion for this study was a referral to PT for training and development of a comprehensive individualized exercise program aimed at prevention of progression of their CI disorder. Individuals were excluded if they did not complete one month of PT for any reason. One month of PT was chosen as this was the standard duration prior to reassessment. Individuals were also excluded

if they were referred to PT for primary treatment of impairments such as vestibular dysfunction, amputation, significant lower extremity osteoarthritis, acute lower extremity surgery, lower extremity injury (fractures, strains, sprains), or other neurologic disorders (e.g., traumatic brain injury, Parkinson disease). The original intent was to analyze the data for as many CI disorders that have sufficient numbers for analysis: subsequently CI disorders with small numbers were excluded (Figure 1). Data from 173 medical records were extracted; and, of those, 67 were classified as having AD, 34 as VaD, 35 as DLB, and 37 as MCI (Table 1, Figure 1).

Outcome measures

Outcome measure data from the following three domains (detailed below) were extracted from the medical record: cognition, gait, and balance. The minimal detectable change (MDC) and minimal clinically important differences (MCID) used in these analyses were from individuals with dementia when available. When the particular test did not have a MDC or MCID available in individuals with dementia, the value was taken for a population that nearest approximated the sample in this study.

Cognition. Cognition was measured using the Montreal Cognitive Assessment (MoCA).[34] This study utilized 2 different versions of the MoCA for the pre and post assessments to avoid any learning effects influencing performance at the post-assessment. The MoCA has been shown to have excellent test-retest reliability (correlation coefficient = 0.92) and excellent positive and negative predictive values for AD (89% and 100%, respectively).[34] The minimal detectable change (MDC) for the MoCA is 4 scale points for older adults.[35]

Gait. Scores from the following gait measures were included: Preferred Gait Speed (PGS),[36] Fast Gait Speed (FGS),[36] Six Minute Walk Test (6MWT),[37] Timed Up and Go Test (TUG),[38] and Timed

Up and Go Cognitive Test (TUGcog).[39] Both the PGS and FGS have excellent reliability in elderly individuals (ICC = 0.94 and 0.96, respectively).[40] The MDC for the PGS and FGS is 0.13 meters/second and 0.21 meters/second scale points for people with AD.[41] The 6MWT has excellent test-retest reliability (ICC = 0.982-0.987), interrater reliability (ICC = 0.97-0.99), and intrarater reliability (ICC = 0.76-0.9) for individuals with AD.[41,42] Its MDC is 33.5 meters for people with AD.[41] The TUG has excellent test-retest reliability (ICC = 0.987), intrarater reliability (ICC = 0.91), and interrater reliability (ICC = 0.92) for individuals with AD.[41] The MDC of the TUG in people with AD is 4.09 seconds.[41] The TUGcog was performed following the TUG and utilized a secondary cognitive task of serial backwards counting by 3. Individuals were instructed to perform both the motor and cognitive tasks as quickly, and accurately as possible. The MDC for the TUGcog is 4.69 seconds in AD.[43]

Balance. Scores from the Mini Balance Evaluation Systems Test (MBT)[44] and the Five Times Sit-to-Stand Test (5STS)[45] were included to describe balance performance. The MBT measures postural, anticipatory, and reactive balance as well as sensory orientation and dynamic gait. The MBT has excellent interrater reliability (ICC = 0.98), a MDC of 3.4 scale points in people with Parkinson disease).[46,47] Although it is typically used to measure functional lower limb strength, the 5STS is also considered a measure of dynamic balance in older adults.[48] The 5STS has excellent test-retest reliability for community-dwelling elderly (ICC = 0.957) and an MDC of 2.73 seconds in people with AD.[49] [43]

Fear of Falling Avoidance Behavior. Scores from the Modified Fear of Falling Avoidance Behavior Questionnaire (mFFABQ) were included to describe avoidance behavior due to fear of falling.[50,51] The mFFABQ is a self-administered 14 item questionnaire score out 56 possible scale

points. The mFFABQ has good overall test-retest reliability (ICC = 0.796) with a 90% MDC of 15.8 scale points in individuals with Parkinson's disease.[51]

Treatment approach

Referral to the physiotherapists from the neurologists at (blinded) consisted of instructions to evaluate and treat. Physiotherapists then determined the most appropriate frequency of visits. Typically, the individuals were instructed to come to PT once per week (mean PT treatments = 3.4 ± 1.8) for one month. PT consisted of the following treatment parameters: aerobic activity (20-25 minutes), strengthening (15-20 minutes), and balance training (15-20 minutes). Cognitive and motor dual-tasking and functional training were incorporated into all three parts of the treatment program. Education to individual and caregiver and a simplified home exercise program, consisting of simplified activities with in the same domains, were also included in each treatment session. Table 2 contains a more detailed description of the PT treatment program.

Data Analysis

All analyses were conducted using SPSS 24.0 (IBM SPSS Statistics for Windows, Armonk, NY: IBM Corp) with $\alpha = 0.05$. Missing values were imputed using the last observation carried forward method. A paired samples t-test was used to compare the pre and post scores on all of the variables for each of the pathologies. The pre and post difference scores on all of the variables were analyzed for improvement beyond the MDC values. The percentage of those who improved beyond the MDC were calculated for each outcome measure. Severity of cognitive impairment prior to beginning intervention was investigated for inclusion as a covariate ($r>0.60$) and was not included for all of analysis, with the exception of the mFFABQ.

RESULTS

Alzheimer disease

Refer to Table 3 for a more detailed listing of pre- and post-PT outcome measure scores. Scores on the MoCA improved over the month of PT for those with AD (p=.006) and 20.8% improved beyond the MDC (Figure 2). Although there was only 6.2% improvement in gait distance on the 6MWT, it was a statistically significant improvement (p=.003) and almost half improved beyond the MDC (46.2%) (Figure 3). In addition, scores improved on the MBT (p<.001) and the 5STS (p=.014) with 30.4% and 27.9% improving beyond the MDC, respectively (Figure 4). Lastly, individuals reported less fear of falling avoidance behavior on the mFFABQ (p=.017).

Vascular dementia

Refer to Table 4 for a more detailed listing of pre- and post-PT outcome measure scores. In general, there were fewer outcome measures with statistically significant improvement for those with VaD. Scores on the MoCA improved over the month of PT for those with VaD (p=.005), but only 9.7% improved beyond the MDC (Figure 2). Scores also improved on the MBT (p=.008) with 29.2% improving beyond the MDC (Figure 4). Individuals with VaD were able to improve their FGS over the month of PT (p=.024) with 30.8% improving beyond the MDC. While not statistically significant for the group statistic, 44.8% of individuals with VaD improved beyond the MDC on the 5STS test (Figure 4).

Dementia with Lewy Bodies

Refer to Table 5 for a more detailed listing of pre- and post-PT outcome measure scores. As a group, those with DLB did not improve on the MoCA (p=.154) despite 19.4% improving

beyond the MDC (Figure 2). There was improvement on the 6MWT (p=.015) with 41.7% improving beyond the MDC (Figure 3). Scores on the MBT (p=.001) and 5STS (p=.014) improved after a month of PT with 26.7% and 43.8% improving beyond the MDC, respectively (Figure 4). In addition, the PGS (p=.004) and FGS (p=.002) improved as well.

Mild Cognitive Impairment

Refer to Table 6 for a more detailed listing of pre- and post-PT outcome measure scores. Scores on the MoCA (p=.012) and MBT (p=<.001) improved over the month of PT for individuals with MCI with 29.7% and 27.3% improving beyond the MDC, respectively (Figures 2 and 4). Scores on the 5STS (p=.011) also improved with 30.3% improving beyond the MDC (Figure 4). Improvements in TUG (p=.001), TUGcog (p=.035) were also observed; however, only 8.1% improved on the TUG beyond the MDC (Figure 3). Lastly, PGS (p=.008), FGS (p=.009) and 6MWT (p=.016) improved with MDC improvements ranging from 24.2% to 35.3%.

DISCUSSION

The aims of this study were to investigate how one month of PT affected cognition, balance, and gait in individuals with CI. Each group with CI showed significant improvement in at least two of the aforementioned domains. Collectively, it appears that multicomponent PT (aerobic activity, strengthening, balance training) with a rather low treatment session frequency over one month (3.4 visits on average) and the implementation of an individualized home exercise program was sufficient to drive meaningful improvement across the four different CI diagnoses. In addition, it is interesting to note that all groups but DLB had statistically significant improvements in cognition. However, based on the design of this study,

we caution interpretation of these results as we cannot rule out a learning effect on any of the outcome measures.

The MCI group appeared to benefit the most from PT as they improved in 8 of 9 outcome measures across the four different assessment domains. The AD and DLB diagnoses improved in 5 outcomes whereas the VaD group only improved in 3. Since MCI is considered a symptomatic prodromal dementia, it is generally in the early stages and less severe cognitively. The mean MoCA scores of the four groups in this study support that notion (Figure 2). Taken together, the fact that the MCI group appeared to have more robust improvements may suggest that cognitive capacity may be important to balance and gait improvement. These results parallel the findings of previous research which suggest that older adults with MCI are more likely to experience benefits from exercise compared to those with dementia.[52] Furthermore, our results are consistent with literature proposing that early treatment of gait and balance problems in individuals with CI may improve function and mobility.[10] These findings are especially important because they support research, which suggests that administering treatment during the preclinical phase may be more effective than waiting until symptoms arise.[53] Specifically with AD, the subtle pathophysiological changes are thought to occur at least one decade before the clinical phase.[54,55] With many AD drug trials showing lackluster results in the later stages of disease, researchers are advocating further investigation into preclinical detection and treatment strategies as a way to mitigate or even prevent cognitive decline.[54,55]

Balance was significantly improved in each of the four CI groups (Figure 4). Nearly all groups improved in both balance outcome measures, the exception being the VaD group, which

improved only with the MBT and not the 5STS. However, the VaD group demonstrated a trend toward improvement with the 5STS and was likely underpowered. Interestingly, the VaD group improved the least overall despite initial hypotheses that it might have more potential for improvement than the AD and DLB groups due to higher baseline cognitive scores (Table 4). One possible explanation may be that the VaD group had higher fear of falling behavior overall which can result in reduced physical activity in elderly individuals.[50]

While it has been previously demonstrated that exercise can benefit individuals with CI with respect to mobility, these findings have not been specifically observed in the context of PT. Previous studies using rehabilitation methods like those found in PT did show that exercise improved functional mobility in individuals with CI.[27] More specifically, studies that prescribed proprioception training and dynamic balance training found improvement in their individuals' mobility.[56,57] Compared to a simple progressive exercise protocol, PT offers individualized, impairment-based care in which a movement expert assists individuals in achieving mobility goals using therapeutic exercise, patient education, feedback, a home exercise program, and appropriate rehabilitation technologies. These differences may explain why the individuals in this study were able to make significant improvement in cognition, balance, and gait measures within a short time (1 month) and with few treatment visits (3.4 ± 1.8).

Improvements were not as robust with the mFFABQ in which only the AD group experienced an improvement. Perhaps one month is too short a time for these individuals to gain balance confidence and decrease avoidance behavior due to a fear of falling. In support of this theory, a meta-analysis on six treatment programs for fear of falling in the elderly population showed that the best outcomes were reached after four months of intervention.[58]

Because the current study only examined the effects of one month of intervention, it is likely that there was not enough time to improve fear of falling avoidance behavior across the majority of the groups. The meta-analysis also found that programs combining exercise and education were the most successful in reducing fear of falling.[58] Exercise and education were both key components of the PT intervention that was investigated in the current study; however, it is possible that the education was not retained well due to the individuals having CI. Overall, these findings suggest that either the one month of PT treatment was not long enough or that it was not effectively designed to modify fear of falling avoidance behavior in individuals with CI.

Considering the progressive nature of these CI disorders, the findings of this study are noteworthy. With one month of PT, there were relatively high proportions of individuals that experienced improvement beyond the MDC for motor and cognitive function. At this point, it is premature to make conclusions that PT should be a first-line therapy for individuals with CI. However, based on these preliminary findings, more rigorous study designs are certainly warranted. Future studies should investigate the dosing, duration, and frequency of PT and also experiment with extending the follow-up periods.

It has been reported that acetyl cholinesterase inhibitors can influence physical outcomes in individuals with CI.[59] To investigate this as a potential contributor to the improvements seen in this study, acetyl cholinesterase inhibitor use was analyzed. No meaningful differences were found in any group between those who were using acetyl cholinesterase inhibitors and those who were not. Nor were there difference between those who started acetyl cholinesterase inhibitors in the last 6 months.[59] Though acetyl

cholinesterase inhibitor use does not appear to influence these results there are several other possible contributing factors. These factors include the effects of socialization, education, caregiver support, and learning to perform tasks with the existing function without achieving physiological change; however, the influence of each of these is generally a part of a structured rehabilitation program.

While the findings are auspicious, it is important to address the limitations of this study. First, it is a retrospective cohort study with no control group. Thus, results from this study should be interpreted with caution as this design is not appropriate for causal inference. Also, many of the non-significant results were trending in the right direction but were not statistically significant; thus, type II errors are probable when considering the relatively small sample sizes. This study utilized as one its outcomes the mFFABQ, a self-report measure of avoidance behavior due to fear of falling, which has not been established in dementia or CI. Self-report measures are generally not as reliable in patients with CI. As a result, the findings regarding this questionnaire should be interpreted with caution. While adherence to HEP was encouraged and an integral part of the intervention, adherence was not tracked. Lastly, the interventions were based on individual impairment instead of a standardized exercise program. This method can be seen as both a strength and a weakness as this impairment-based treatment is most consistent with clinical practice whereas it introduces more varied treatment than is typical of a well-controlled trial.

CONCLUSION

One month of PT addressing motor impairment and function may be an effective treatment as a primary intervention for motor and cognitive impairments in individuals with CI.

APPENDIX

Table 1. Characteristics of the individuals with Alzheimer's disease, vascular dementia, Lewy body dementia, and mild cognitive impairment (MCI).

	Alzheimer's disease N = 67	**Vascular dementia N = 34**	**Lewy body dementia N= 35**	**MCI N = 37**
Sex				
Male	32	18	24	18
Female	35	16	11	19
Race				
White	53	27	29	29
African American	3	1	3	3
Asian or Pacific Islander	1	1	1	2
Two or more	1	3	0	2
Missing	9	2	2	1
Assistive device				
None	47	18	21	28
Cane	6	3	6	7
Front Wheel Walker	4	5	3	1
Rollator	6	3	3	1
Wheelchair	1	3	0	0
Missing	3	2	2	0
Faller status				
Faller (>1 fall in last year)	37	22	22	19
Non-fallers	28	12	12	16
Missing	2	0	1	2
Miscellaneous				
Age (mean ± standard deviation)	78.8 ± 8.4	76.4 ± 9.3	77.0 ± 6.0	74.0 ± 9.0
Number of physiotherapy treatment sessions (mean ± standard deviation)	3.1 ± 1.8	3.5 ± 1.6	3.8 ± 4.0	3.6 ± 1.9
Number of falls in the last year (mean ± standard deviation)	1.1 ± 1.0	2.0 ± 3.6	3.8 ± 8.7	3.1 ± 7.9

Table 2. Overview of basic treatment program for individuals with memory impairment disorders.

<table>
<tr><td colspan="2">Aerobic Activity (20-25 minutes)</td></tr>
<tr><td colspan="2">

Treadmill, over ground gait, recumbent stepper
Goal: Heart rate at 65-80% max zone or RPE: 13-15/20

Patient’s and caregivers were instructed to achieve one of the following three criteria as per CDC’s physical activity guidelines for older and were provided with the CDC’s physical activity guidelines:

provided with heart rate chart and target zone
Can talk but not sing
Use RPE of 13-15/20

Dual tasking: Consistent utilization of a secondary task, either motor or cognitive (see below)

</td></tr>
<tr><td colspan="2">Strengthening (15-20 minutes)</td></tr>
<tr><td colspan="2">Utilization of simple and/or functional strengthening activities based on the components of OTAGO program.[60]</td></tr>
<tr><td colspan="2">Balance Training (15-20 minutes)</td></tr>
<tr><td colspan="2">Training included incorporation of static, anticipatory, and reactive aspects of postural control; with application to functional tasks.[61]</td></tr>
<tr><td colspan="2">Utilization of Dual Task (DT) Training</td></tr>
<tr><td colspan="2">Dual tasking was utilized during every type of intervention, modifying to the specific level of the individual and to the primary task.</td></tr>
<tr><td>Examples of secondary cognitive tasks</td><td>Examples of secondary motor tasks</td></tr>
<tr><td>

Executive function (Attention, visual scanning, switching, etc.)
Problem Solving and Planning
Working Memory (Short term memory, rehearsal, etc.)

</td><td>

Functional – completion of ADLs/IADLs (dressing, cleaning, cooking, etc.)
Carrying or manipulating objects

</td></tr>
<tr><td colspan="2">Educational Interventions</td></tr>
<tr><td colspan="2">

All sessions completed with individual and primary caregiver when available with time spent educating caregiver on appropriate cueing and engagement strategies (implicit learning, strength – based approach, etc.).
Education on cognitive benefits of exercise and recommendations for exercise as well as promotion of brain health related activities.
Simplified and individualized home exercise program handouts designed for individuals with cognitive impairment and their caregiver.

</td></tr>
<tr><td colspan="2">Functional Training</td></tr>
<tr><td colspan="2">Functional training oriented to the specific level and function of individual with extensive caregiver involvement in cueing and training strategies, including training with assistive device when appropriate.</td></tr>
</table>

Table 3. Pre and post test scores across the assessment battery for individuals diagnosed with Alzheimer's disease.

	N	Pre mean	Post mean	Pre SD	Post SD	t-test p value	% improved beyond MDC
MoCA (scale points)	53	14.6	15.8	5.2	6.3	.006	20.8%
MBT (scale points)	56	17.6	20.0	4.2	4.2	<.001	30.4%
5STS (seconds)	61	17.0	15.1	11.7	10.0	.014	27.9%
TUG (seconds)	64	14.6	13.4	9.9	12.1	.114	14.1%
TUGcog (seconds)	58	20.8	19.7	12.2	14.2	.367	19.0%
PGS (meters/second)	64	0.86	0.90	0.30	0.30	.227	26.6%
FGS (meters/second)	62	1.32	1.38	0.37	0.42	.082	16.1%
6MWT (meters)	39	319.1	338.9	112.7	118.3	.003	46.2%
FFABQmod (scale points)	51	16.4	13.1	15.8	14.5	.017	7.8%

Table 4. Pre and post test scores across the assessment battery for individuals diagnosed with vascular dementia.

	N	Pre mean	Post mean	Pre SD	Post SD	t-test p value	% improved beyond MDC
MoCA (scale points)	31	20.39	21.45	5.3	5.3	.005	9.7%
MBT (scale points)	24	17.58	19.17	3.4	3.7	.008	29.2%
5STS (seconds)	29	17.86	15.68	10.4	12.7	.212	44.8%
TUG (seconds)	34	20.64	16.57	29.1	16.6	.198	17.6%
TUGcog (seconds)	26	19.40	18.89	14.4	19.7	.777	23.1%
PGS (meters/second)	27	0.96	.085	0.67	0.37	.374	37.0%
FGS (meters/second)	26	1.13	1.29	0.46	0.64	.024	30.8%
6MWT (meters)	22	273.7	294.5	147.0	158.5	.064	36.4%
FFABQmod (scale points)	21	20.10	17.48	17.6	14.9	.235	9.5%

Table 5. Pre and post test scores across the assessment battery for individuals diagnosed with dementia with Lewy bodies.

	N	Pre mean	Post mean	Pre SD	Post SD	t-test p value	% improved beyond MDC
MoCA (scale points)	31	16.87	17.77	6.7	6.9	.154	19.4%
MBT (scale points)	30	18.23	20.37	4.4	4.5	.001	26.7%
5STS (seconds)	32	19.28	14.70	13.5	5.6	.014	43.8%
TUG (seconds)	30	13.49	11.14	10.2	6.7	.165	16.7%
TUGcog (seconds)	34	19.72	16.07	13.8	7.2	.080	26.5%
PGS (meters/second)	32	0.90	1.00	0.27	0.27	.004	37.5%
FGS (meters/second)	32	1.31	1.43	0.30	0.37	.002	28.1%
6MWT (meters)	24	347.69	381.13	105.2	120.6	.015	41.7%
FFABQmod (scale points)	26	16.31	15.65	11.8	12.0	.667	0%

Table 6. Pre and post test scores across the assessment battery for individuals diagnosed with mild cognitive impairment.

	N	Pre mean	Post mean	Pre SD	Post SD	t-test p value	% improved beyond MDC
MoCA (scale points)	37	22.38	23.81	4.2	4.1	.012	29.7%
MBT (scale points)	33	19.91	21.94	4.2	3.4	<.001	27.3%
5STS (seconds)	33	16.95	13.73	9.2	5.1	.011	30.3%
TUG (seconds)	37	12.38	10.68	7.5	6.8	.001	8.1%
TUGcog (seconds)	36	17.83	14.83	12.6	14.6	.035	25.0%
PGS (meters/second)	34	0.95	1.01	0.30	0.30	.008	35.3%
FGS (meters/second)	33	1.31	1.40	0.37	0.40	.009	24.2%
6MWT (meters)	29	341.07	360.88	129.7	130.2	.016	30.0%
FFABQmod (scale points)	32	15.16	13.38	12.6	12.0	.274	6.3%

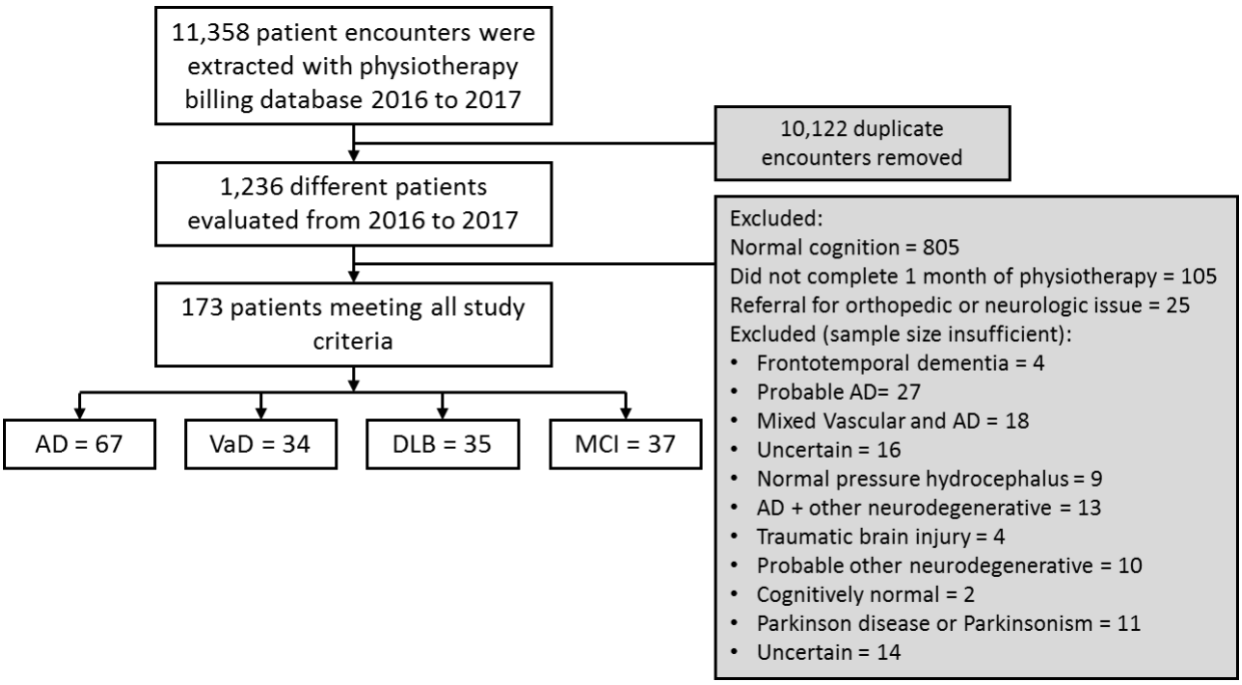

Figure 1. Date extraction flow diagram for individuals with Alzheimer disease (AD), vascular dementia (VaD), dementia with Lewy bodies (DLB), and mild cognitive impairment (MCI).

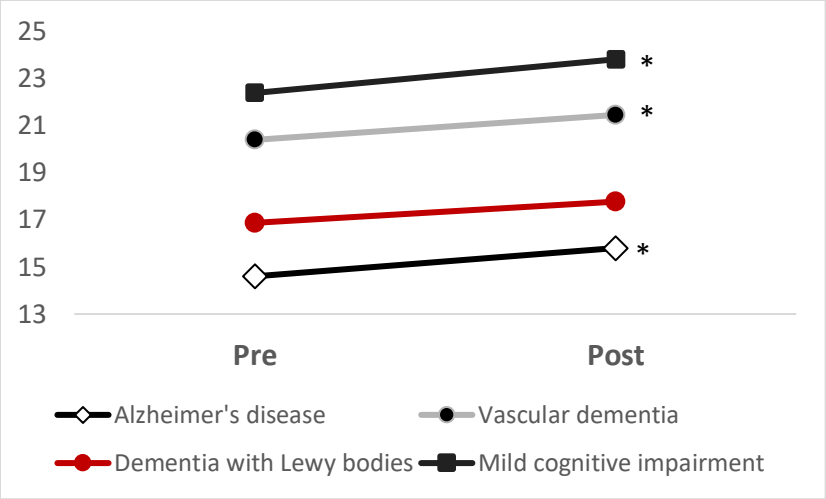

Figure 2. Pre and post test MoCA scores for each of the four cognitive impairment diagnoses. *statistically significant pre and post difference at p<.05.

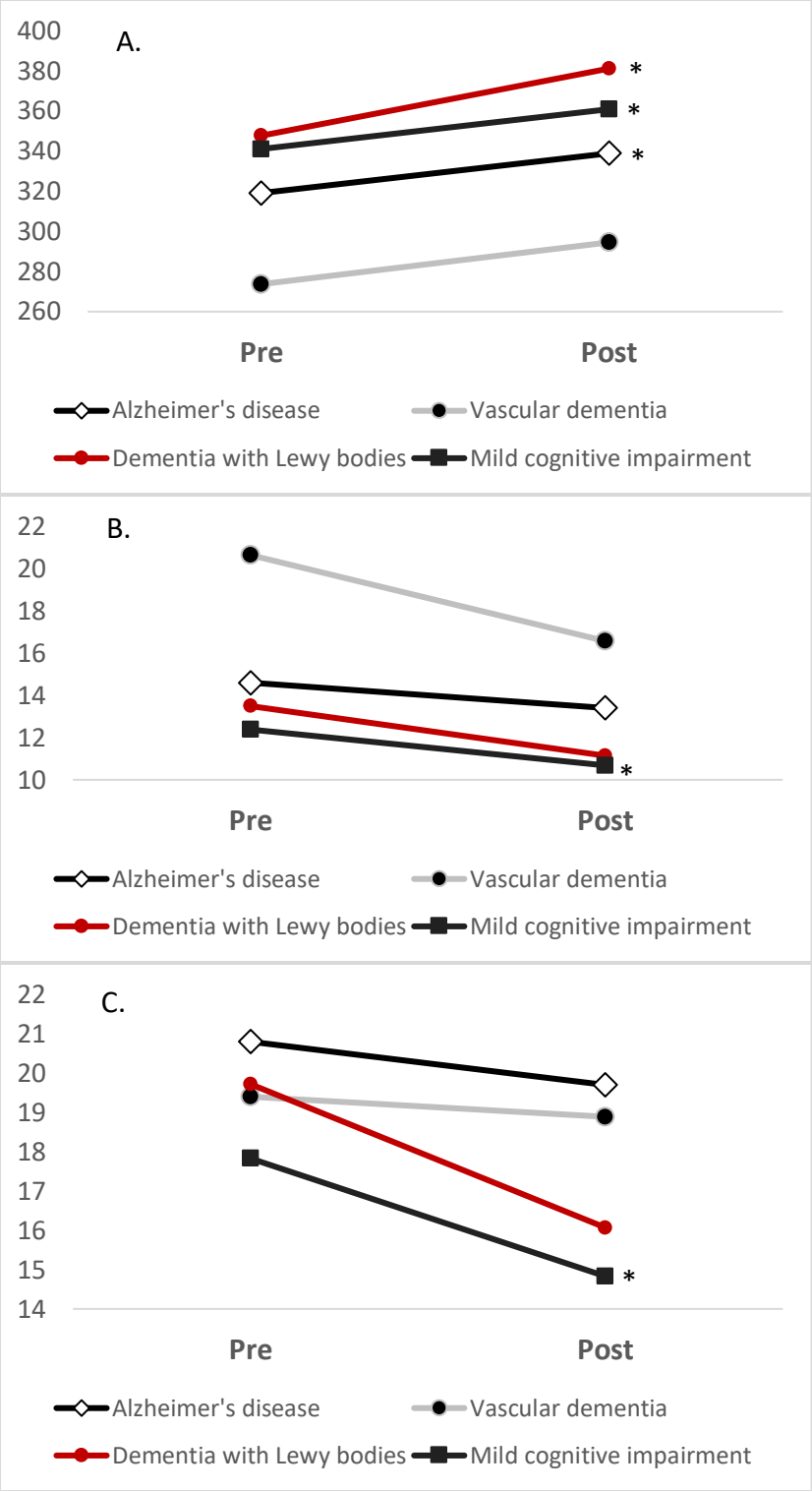

Figure 3. Pre and post test scores on measures of gait: A. 6MWT; B. TUG; and, C: TUGcog. *statistically significant pre and post difference at p<.05.

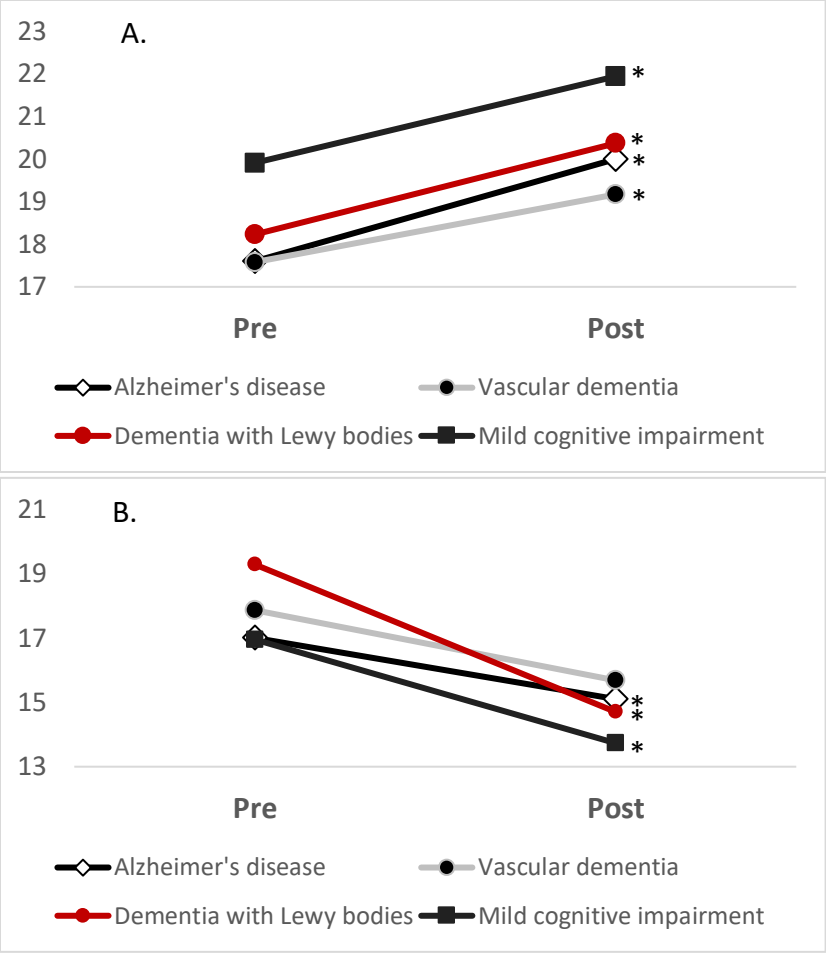

Figure 4. Pre and post test scores on measures of balance: A. MiniBESTest; and, B. Five Times Sit-to-Stand Test. *statistically significant pre and post difference at p<.05.

REFERENCES

1. Ortman JM, V.A. Velkoff, and H. Howard. *An Aging Nation: The Older Population in the United States.* Washington, DC: U.S. Census Bureau;2014.
2. Plassman BL, Langa KM, Fisher GG, et al. Prevalence of dementia in the United States: the aging, demographics, and memory study. *Neuroepidemiology.* 2007;29(1-2):125-132.
3. Zaccai J, McCracken C, Brayne C. A systematic review of prevalence and incidence studies of dementia with Lewy bodies. *Age Ageing.* 2005;34(6):561-566.
4. Alzheimer's A. 2015 Alzheimer's disease facts and figures. *Alzheimers Dement.* 2015;11(3):332-384.
5. McKhann GM, Knopman DS, Chertkow H, et al. The diagnosis of dementia due to Alzheimer's disease: recommendations from the National Institute on Aging-Alzheimer's Association workgroups on diagnostic guidelines for Alzheimer's disease. *Alzheimers Dement.* 2011;7(3):263-269.
6. McKeith IG, Galasko D, Kosaka K, et al. Consensus guidelines for the clinical and pathologic diagnosis of dementia with Lewy bodies (DLB): report of the consortium on DLB international workshop. *Neurology.* 1996;47(5):1113-1124.
7. Roman GC, Tatemichi TK, Erkinjuntti T, et al. Vascular dementia: diagnostic criteria for research studies. Report of the NINDS-AIREN International Workshop. *Neurology.* 1993;43(2):250-260.
8. Visser H. Gait and balance in senile dementia of Alzheimer's type. *Age Ageing.* 1983;12(4):296-301.
9. van Iersel MB, Hoefsloot W, Munneke M, Bloem BR, Olde Rikkert MG. Systematic review of quantitative clinical gait analysis in patients with dementia. *Z Gerontol Geriatr.* 2004;37(1):27-32.
10. Lam FM, Huang MZ, Liao LR, Chung RC, Kwok TC, Pang MY. Physical exercise improves strength, balance, mobility, and endurance in people with cognitive impairment and dementia: a systematic review. *J Physiother.* 2018;64(1):4-15.
11. Petersen RC, Lopez O, Armstrong MJ, et al. Practice guideline update summary: Mild cognitive impairment: Report of the Guideline Development, Dissemination, and Implementation Subcommittee of the American Academy of Neurology. *Neurology.* 2018;90(3):126-135.
12. Studenski S, Perera S, Patel K, et al. Gait speed and survival in older adults. *JAMA.* 2011;305(1):50-58.
13. Shaw FE. Prevention of falls in older people with dementia. *J Neural Transm (Vienna).* 2007;114(10):1259-1264.
14. Suttanon P, Hill KD, Said CM, Dodd KJ. A longitudinal study of change in falls risk and balance and mobility in healthy older people and people with Alzheimer disease. *Am J Phys Med Rehabil.* 2013;92(8):676-685.
15. Borges Sde M, Radanovic M, Forlenza OV. Fear of falling and falls in older adults with mild cognitive impairment and Alzheimer's disease. *Neuropsychol Dev Cogn B Aging Neuropsychol Cogn.* 2015;22(3):312-321.

16. Tinetti ME, Speechley M, Ginter SF. Risk factors for falls among elderly persons living in the community. *N Engl J Med.* 1988;319(26):1701-1707.
17. Allan LM, Ballard CG, Rowan EN, Kenny RA. Incidence and prediction of falls in dementia: a prospective study in older people. *PLoS One.* 2009;4(5):e5521.
18. Baker NL, Cook MN, Arrighi HM, Bullock R. Hip fracture risk and subsequent mortality among Alzheimer's disease patients in the United Kingdom, 1988-2007. *Age Ageing.* 2011;40(1):49-54.
19. Lord SR. Predictors of nursing home placement and mortality of residents in intermediate care. *Age Ageing.* 1994;23(6):499-504.
20. Burns ER, Stevens JA, Lee R. The direct costs of fatal and non-fatal falls among older adults - United States. *J Safety Res.* 2016;58:99-103.
21. Farina N, Rusted J, Tabet N. The effect of exercise interventions on cognitive outcome in Alzheimer's disease: a systematic review. *Int Psychogeriatr.* 2014;26(1):9-18.
22. Venturelli M, Scarsini R, Schena F. Six-month walking program changes cognitive and ADL performance in patients with Alzheimer. *Am J Alzheimers Dis Other Demen.* 2011;26(5):381-388.
23. Montero-Odasso M, Verghese J, Beauchet O, Hausdorff JM. Gait and cognition: a complementary approach to understanding brain function and the risk of falling. *J Am Geriatr Soc.* 2012;60(11):2127-2136.
24. Hoffmann K, Sobol NA, Frederiksen KS, et al. Moderate-to-High Intensity Physical Exercise in Patients with Alzheimer's Disease: A Randomized Controlled Trial. *J Alzheimers Dis.* 2016;50(2):443-453.
25. Schwenk M, Zieschang T, Oster P, Hauer K. Dual-task performances can be improved in patients with dementia: a randomized controlled trial. *Neurology.* 2010;74(24):1961-1968.
26. Hirschman KB, Hodgson NA. Evidence-Based Interventions for Transitions in Care for Individuals Living With Dementia. *Gerontologist.* 2018;58(suppl_1):S129-S140.
27. Blankevoort CG, van Heuvelen MJ, Boersma F, Luning H, de Jong J, Scherder EJ. Review of effects of physical activity on strength, balance, mobility and ADL performance in elderly subjects with dementia. *Dement Geriatr Cogn Disord.* 2010;30(5):392-402.
28. Hauer K, Becker C, Lindemann U, Beyer N. Effectiveness of physical training on motor performance and fall prevention in cognitively impaired older persons: a systematic review. *Am J Phys Med Rehabil.* 2006;85(10):847-857.
29. Hageman PA, Thomas VS. Gait performance in dementia: the effects of a 6-week resistance training program in an adult day-care setting. *Int J Geriatr Psychiatry.* 2002;17(4):329-334.
30. McKeith IG, Boeve BF, Dickson DW, et al. Diagnosis and management of dementia with Lewy bodies: Fourth consensus report of the DLB Consortium. *Neurology.* 2017;89(1):88-100.
31. Skrobot OA, O'Brien J, Black S, et al. The Vascular Impairment of Cognition Classification Consensus Study. *Alzheimers Dement.* 2017;13(6):624-633.
32. Albert MS, DeKosky ST, Dickson D, et al. The diagnosis of mild cognitive impairment due to Alzheimer's disease: recommendations from the National Institute on Aging-

Alzheimer's Association workgroups on diagnostic guidelines for Alzheimer's disease. *Alzheimers Dement.* 2011;7(3):270-279.
33. Skrobot OA, Black SE, Chen C, et al. Progress toward standardized diagnosis of vascular cognitive impairment: Guidelines from the Vascular Impairment of Cognition Classification Consensus Study. *Alzheimers Dement.* 2018;14(3):280-292.
34. Nasreddine ZS, Phillips NA, Bedirian V, et al. The Montreal Cognitive Assessment, MoCA: a brief screening tool for mild cognitive impairment. *J Am Geriatr Soc.* 2005;53(4):695-699.
35. Feeney J, Savva GM, O'Regan C, King-Kallimanis B, Cronin H, Kenny RA. Measurement Error, Reliability, and Minimum Detectable Change in the Mini-Mental State Examination, Montreal Cognitive Assessment, and Color Trails Test among Community Living Middle-Aged and Older Adults. *Journal of Alzheimer's disease : JAD.* 2016;53(3):1107-1114.
36. Bohannon RW. Comfortable and maximum walking speed of adults aged 20-79 years: reference values and determinants. *Age Ageing.* 1997;26(1):15-19.
37. Laboratories ATSCoPSfCPF. ATS statement: guidelines for the six-minute walk test. *American journal of respiratory and critical care medicine.* 2002;166(1):111-117.
38. Podsiadlo D, Richardson S. The timed "Up & Go": a test of basic functional mobility for frail elderly persons. *J Am Geriatr Soc.* 1991;39(2):142-148.
39. Hofheinz M, Schusterschitz C. Dual task interference in estimating the risk of falls and measuring change: a comparative, psychometric study of four measurements. *Clin Rehabil.* 2010;24(9):831-842.
40. Marchetti G, Hodges M, Brown R, Krohn K. Test-retest reliability, external structure validity and responsiveness of gait parameters for older adult females walking at preferred and maximum velocity. *Journal of Geriatric Physical Therapy.* 2005;28(3):114.
41. Ries JD, Echternach JL, Nof L, Gagnon Blodgett M. Test-retest reliability and minimal detectable change scores for the timed "up & go" test, the six-minute walk test, and gait speed in people with Alzheimer disease. *Phys Ther.* 2009;89(6):569-579.
42. Tappen RM, Roach KE, Buchner D, Barry C, Edelstein J. Reliability of physical performance measures in nursing home residents with Alzheimer's disease. *J Gerontol A Biol Sci Med Sci.* 1997;52(1):M52-55.
43. Suttanon P, Hill KD, Dodd KJ, Said CM. Retest reliability of balance and mobility measurements in people with mild to moderate Alzheimer's disease. *Int Psychogeriatr.* 2011;23(7):1152-1159.
44. Franchignoni F, Horak F, Godi M, Nardone A, Giordano A. Using psychometric techniques to improve the Balance Evaluation Systems Test: the mini-BESTest. *J Rehabil Med.* 2010;42(4):323-331.
45. Guralnik JM, Simonsick EM, Ferrucci L, et al. A short physical performance battery assessing lower extremity function: association with self-reported disability and prediction of mortality and nursing home admission. *J Gerontol.* 1994;49(2):M85-94.
46. Godi M, Franchignoni F, Caligari M, Giordano A, Turcato AM, Nardone A. Comparison of reliability, validity, and responsiveness of the mini-BESTest and Berg Balance Scale in patients with balance disorders. *Phys Ther.* 2013;93(2):158-167.

47. Lofgren N, Lenholm E, Conradsson D, Stahle A, Franzen E. The Mini-BESTest--a clinically reproducible tool for balance evaluations in mild to moderate Parkinson's disease? *BMC neurology.* 2014;14:235.
48. Goldberg A, Chavis M, Watkins J, Wilson T. The five-times-sit-to-stand test: validity, reliability and detectable change in older females. *Aging Clin Exp Res.* 2012;24(4):339-344.
49. Bohannon RW, Shove ME, Barreca SR, Masters LM, Sigouin CS. Five-repetition sit-to-stand test performance by community-dwelling adults: A preliminary investigation of times, determinants, and relationship with self-reported physical performance. *Isokinet Exerc Sci.* 2007;15(2):77-81.
50. Landers MR, Durand C, Powell DS, Dibble LE, Young DL. Development of a scale to assess avoidance behavior due to a fear of falling: the Fear of Falling Avoidance Behavior Questionnaire. *Phys Ther.* 2011;91(8):1253-1265.
51. Landers MR, Lopker M, Newman M. Reliability and validity of the modified Fear of Falling Avoidance Behavior Questionnaire in Parkinson's disease. *Movement Disorders.* 2014;29:S177-178.
52. Ohman H, Savikko N, Strandberg TE, Pitkala KH. Effect of physical exercise on cognitive performance in older adults with mild cognitive impairment or dementia: a systematic review. *Dement Geriatr Cogn Disord.* 2014;38(5-6):347-365.
53. Brini S, Sohrabi HR, Peiffer JJ, et al. Physical Activity in Preventing Alzheimer's Disease and Cognitive Decline: A Narrative Review. *Sports Med.* 2018;48(1):29-44.
54. Sperling RA, Aisen PS, Beckett LA, et al. Toward defining the preclinical stages of Alzheimer's disease: recommendations from the National Institute on Aging-Alzheimer's Association workgroups on diagnostic guidelines for Alzheimer's disease. *Alzheimers Dement.* 2011;7(3):280-292.
55. Langbaum JB, Fleisher AS, Chen K, et al. Ushering in the study and treatment of preclinical Alzheimer disease. *Nat Rev Neurol.* 2013;9(7):371-381.
56. Pomeroy VM, Warren CM, Honeycombe C, et al. Mobility and dementia: is physiotherapy treatment during respite care effective? *Int J Geriatr Psychiatry.* 1999;14(5):389-397.
57. Toulotte C, Fabre C, Dangremont B, Lensel G, Thevenon A. Effects of physical training on the physical capacity of frail, demented patients with a history of falling: a randomised controlled trial. *Age Ageing.* 2003;32(1):67-73.
58. Dukyoo J, Juhee L, Lee SM. A meta-analysis of fear of falling treatment programs for the elderly. *West J Nurs Res.* 2009;31(1):6-16.
59. Montero-Odasso M, Speechley M, Chertkow H, et al. Donepezil for gait and falls in mild cognitive impairment: a randomized controlled trial. *European journal of neurology : the official journal of the European Federation of Neurological Societies.* 2019;26(4):651-659.
60. Thomas S, Mackintosh S, Halbert J. Does the 'Otago exercise programme' reduce mortality and falls in older adults?: a systematic review and meta-analysis. *Age Ageing.* 2010;39(6):681-687.
61. Horak FB, Wrisley DM, Frank J. The Balance Evaluation Systems Test (BESTest) to differentiate balance deficits. *Phys Ther.* 2009;89(5):484-498.

CURRICULUM VITAE

Elbert Chen, SPT
Department of Physical Therapy, University of Nevada, Las Vegas
4505 Maryland Parkway, Las Vegas, Nevada 89154
Chenelbert12@gmail.com

Education

DPT	University of Nevada, Las Vegas- Las Vegas Nevada	2016-Current	Physical Therapy
BS	California State Polytechnic University, Pomona- Pomona, California	2012-2016	Kinesiology- Exercise Science

Clinical Experiences

Spring Valley Hospital Jan 2019-Mar 2019
Comprehensive Therapy Centers Oct 2018- Dec2018
Valley Hospital Medical Centers July 2018- Sept 2018
ATI- Desert Valley Therapy July 2017- Aug 2017

Certifications

- Otago Exercise Program Certified
- Stopping Elderly Accidents, Deaths & Injuries (STEADI)
- Collaborative Institutional Training Initiative
- BLS provider
- HIPPA Training Certified
- Blood-borne Pathogens Training Certified

Current Research Activity

Longhurst, J., Phan, J., **Chen, E**., Jackson, S., Landers, M., J., Nash, J. Physiotherapy is associated with improvements in gait and balance in individuals with cognitive impairments: a retrospective analysis.

Service

- Volunteer: UNVPT Prospective Student Interviews (Feb 2017, Feb 2018)
- Volunteer: Rock Steady Boxing for Parkinson´s (Sept 2017)
- Volunteer: SPORTS section meeting (Dec 2016)
- Volunteer: Rock 'N' Roll Las Vegas Marathon (Nov 2016)
- Participant in: Influence of Intramuscular Electromyographic Electrode Insertion on Lower Back Muscle Performance and Activation (Oct 2016)
- Attendee- October Nevada Physical Therapy Association Social (Oct 2016)
- Attendee- September Nevada Physical Therapy Association Social (Sept 2016)
- Volunteer- Dry Needling Course Nellis AFB 2016. (July 2016)

Continuing Education Attended (last 3 years)

- Attendee- Runner´s leg Dystonia- The Mystery Movement Disorder (March 2018)
- Attendee- Inter-professional Education (March 2018)
- Attendee – NVPTA Pt social (March 2018)
- Attendee- Brown Bag Lecture – Managing Stress in College Students with the Koru Mindfulness Program (Feb 2018)
- Attendee- Brown Bag Lecture – (Vestibular Rehab and Concussion Management (Dec 2017)
- Attendee- Spanish Club (Nov 2017- current)
- Attendee-Distinguished Lecture Series-APTA, Pursuing our Transformative Vision (Oct 2017)
- Attendee- Brown Bag Lecture-WorkWright Industrial Solutions and SCiATHLETE High Performance Training (Oct 2017)
- Attendee- Student Manual Therapy Club (Sept 2017- current)
- Attendee- Adriann Louw Seminar (Pain, the Brain, and Plasticity) (April, 2017)
- Attendee- Brown Bag Lecture- Student Loan (March 2017)
- Attendee- Brown Bag Lecture- AvaMed (Feb 2017)
- Attendee- Brown Bag Lecture – Coping with Death and Dying (Feb 2017)
- Attendee- Distinguished Lecture Series (Nov 2016)
- Attendee- Children's Heart Conference of Nevada 20th Annual Heart Conference, Las Vegas, Nevada (OCT 15, 2016)
- Attendee- Dr. Kent didactic: SLAP tears (July 2016)

Steven Rauland Ballard Jackson
Department of Physical Therapy, University of Nevada, Las Vegas
4505 Maryland Parkway, Las Vegas, Nevada 89154
Stevenjackson318@gmail.com

Education

DPT University of Nevada, Las Vegas - Las Vegas, Nevada2 016-2019 Physical Therapy
BS University of Utah- Salt Lake City, Utah 2012-2015 Exercise & Sport Science

Licensure

- Licensure pending upon graduation
- NPTE test date: April 23, 2019- Passed

Certifications

- OTAGO certified (March 2018)
- STEADI certified (February 2018)
- Certified Hawkgrips Practitioner-Level 1 IASTM (August 2017)
- American Heart Association, BLS for Healthcare Providers (March 2017 - March 2019)
- Collaborative Institutional Training Initiative (February 2016)
- HIPPA Training Certified (August 2016)
- Blood-borne Pathogens Training Certified (August 2016)

Employment/Clinical Experience

- Physical Therapist- Registered Physical Therapists- South Jordan (starting June 2019)
    - South Jordan, Utah
    - Clinic Director: Drew Norwood, MPT
- Student Physical Therapist- Registered Physical Therapists- South Bangerter (January 2019- March 2019)
    - Riverton, Utah
    - Supervised by: Dr. Michael DePola, DPT
- Student Physical Therapist- University of Utah Hospital (October 2018-December 2018)
    - Salt Lake City, Utah
    - Supervised by: Dr. Emma Johnson, Dr. Stephanie DeCaria
- Student Physical Therapist- Advanced Healthcare of Las Vegas (July 2018-September 2018)
    - Las Vegas, Nevada
    - Supervised by: Dr. Gavin Hillman
- Research Assistant- Department of Physical Therapy, University of Nevada, Las Vegas (September 2017-May 2018)
    - Las Vegas, Nevada
    - Supervised by: Dr. Merrill Landers, PhD, DPT
- Student Physical Therapist- Family and Sport Physical Therapy (July 2017-August 2017)
    - Las Vegas, Nevada
    - Supervised by: Jeff Bowers, MPT

Current Research Activity

- Longhurst J, Phan J, Chen E, **Jackson S**, Landers M. Physiotherapy is associated with improvements in gait and balance in individuals with cognitive impairment: a retrospective analysis, *awaiting publication*.

Invited Presentations

- Longhurst J, Phan J, Chen E, **Jackson S**, Landers M. Physiotherapy is associated with improvements in gait and balance in individuals with cognitive impairment: a retrospective analysis. University of Nevada, Las Vegas Department of Physical Therapy Thesis Presentation. May 17th, 2019. Las Vegas, NV.
- Longhurst J, Phan J, Chen E, **Jackson S**, Landers M. Physiotherapy is associated with improvements in gait and balance in individuals with cognitive impairment: a retrospective analysis. 2019 World Confederation of Physical Therapy Congress poster presentation. May 10-13, 2019. Geneva, Switzerland.

Membership in Professional Organizations

- Member American Physical Therapy Association (2016 - present)
- Member Utah Physical Therapy Association (2017 - present)
- Member Sport Section of the American Physical Therapy Association (2017 - present)
- Member Orthopedic Section of the American Physical Therapy Association (2017 to 2018)
- Member Nevada Physical Therapy Association (2016 - 2018)

Service

- UNLV Physical Therapy- Class of 2019 President
- AAMOPT sSIG- Vice President, IT management (2018-2019)
- UNLV Journal club- President (2017-2019)
- Volunteer: USA Rugby 7's Tournament- masseuse - (February 2017)
- Volunteer: Community Youth Group Volunteer Leader- (2017- 2019)
- Volunteer: Baseline concussion screening- Bishop Gorman High School (August 2017)
- Nevada Health Fair screening (December 2017)
- UNLV Journal club- President (2017-2019)
- AAMOPT sSIG- Vice President, IT management (2017-2018)

Continuing Education (last 3 years)

- STEADI (February 2018)
- OTAGO (March 2018)
- Sport Section Team Concept Conference (December 2017)
    - Performance Enhancement for the Athlete and the Science and Application of Blood Flow Restriction Therapy in Sports Medicine
    - Linking the Segments of the Lower Extremity in Return to Running for the Athlete with Knee Pain
    - Treatment of the Throwing Athlete's Shoulder
    - The Throwing Shoulder

    - The Difficult Hip
    - Cutting Edge Techniques in Treating the Injured Shoulder
    - Instrumented Soft Tissue Manual Therapy
    - New Techniques of Patellofemoral Pain Syndrome
    - Patellofemoral Pain Syndrome in the Runner
    - An Update on the Usage of Modalities in Sport Medicine
- Hawkgrips Level 1: IASTM Fundamentals- Las Vega, Nevada (August 2017)
- Combined Sections Meeting (February 2017)
    - The Role of Physical Therapy in Exercise is Medicine: A Collaborative Symposium With the ACSM
    - Managing the Chaos: Rehab of Multiple Ligament Knee Injuries
    - From Gameday to Postseason: Shoulder Injuries in Football Along the Continuum
    - Fibromyalgia, Chronic Fatigue Syndrome, Etc.: Treat the Patient, Not the Label
    - Science Meets Practice: The Great Foot Strike Debate
    - Enhancing the Warrior Athlete: Dry Needling in the Treatment of Tendinopathy
    - Manual Therapy in the Aging Population: It's Never Too Late!

Teaching Activity

- Teaching assistant- Human Biology 110, University of Utah, Salt Lake City, Utah (2015)

Honors and Awards

- Department Honors- Exercise and Sport Science- University of Utah (2015)
- College of Health graduation honors- University of Utah (2015)
- Regents Undergraduate Grant (2013-2014)

Jason Phan, SPT
Department of Physical Therapy, University of Nevada, Las Vegas
4505 Maryland Parkway, Las Vegas, Nevada 89154
Jhphan1@gmail.com

Education

DPT	University of Nevada, Las Vegas – Las Vegas, Nevada	2016-2019	Physical Therapy
BS	University of Nevada, Reno – Reno, Nevada	2011-2015	Biochemistry and Molecular Biology

Licensure

- Licensure pending upon graduation

Certifications

- Collaborative Institutional Training Initiative
- BLS Provider
- HIPAA Training Certified
- Blood-borne Pathogens Training Certified

Clinical Experiences

Jan 2019 – Mar 2019	**Summerlin Hospital,** 657 N Town Center Dr., Las Vegas, NV 89144
Oct 2018 – Dec 2018	**Cleveland Clinic Lou Ruvo Center for Brain Health,** 888 W Bonneville Ave, Las Vegas, NV 89106
July 2018 – Sep 2018	**Southern Hills Hospital**, 9300 W Sunset Rd, Las Vegas, NV 89148
July 2017 – Aug 2017	**Select Physical Therapy**, 6048 South Durango Drive, Suite 100 & 105, Las Vegas, NV 89113

Current Research Activity

- Longhurst J, **Phan J**, Chen E, Jackson S, Landers M. Physiotherapy is associated with improvements in gait and balance in individuals with cognitive impairment: a retrospective analysis, *awaiting publication*.

Service

- Volunteer: Rock Steady Boxing for Parkinson's (September 2017)

- Volunteer: Bishop Gorman High School baseline concussion testing for athletes (August 2017)
- Volunteer: UNLVPT Prospective Student Interviews (February 2017)
- Volunteer: SPORTS section meeting (November 2016)
- Research participant: Ho K, Turner C, Benson B, Nelson T, McGee II W. Reliability and validity of using a mobile application to assess knee motion in healthy and post-Anterior Cruciate Ligament reconstruction, *data collection stage* (November 2016)
- Sports medicine volunteer: Rock 'N' Roll Las Vegas Marathon (November 2016)
- Volunteer: "Introduction to Trigger Point Dry Needling with Clinical Correlation" (July 2016)

Honors and Awards

- UNLVPT Scholars Award (2016)

Continuing Education Attended (last 3 years)

- Distinguished Lecture Series
    - Sharon Dunn distinguished lecture: "APTA: Pursuing our Transformative Vision" (October 26-27, 2017)
    - Carolee J. Winstein distinguished lecture: "Past, Present, and Future of Neurologic Physical Therapy" (November 17-18, 2016)
- UNLVPT Lecture Series
    - Tyler Billings and Bryan Wright: "WorkWright Industrial Solutions and SCiATHLETE High Performance Training (October 19, 2017)
    - Joseph Reinke: "Student Loan Tips You Need to Know" (March 2, 2017)
    - Brian Ward: "Innovative healthcare staffing solutions for PTs" (February 9, 2017)
    - Maria Barton: "Coping with death and dying" (Feb 2, 2017)
    - Sally Basta: "Vestibular rehab and concussion management" (December 1, 2017)
    - Ron Gallagher brown bag lecture: "Why cash pay clinic is the future of PT" (November 3, 2016)
- Student Manual Therapy Club meeting (September 2017 to present)
- Adriaan Louw seminar: "Pain, the Brain, and Plasticity" (April 28, 2017)
- Nevada Physical Therapy Association meeting: Student Special Interest Group Board Elections (October 20, 2016)
- Children's Heart Center Nevada's 20th Annual Heart Conference, Las Vegas, NV (October 15, 2016 – 6 hours)
- Dr. Kent didactic: SLAP tears (July 25, 2016)