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Tai Chi for Older Adults with Chronic Multisite Pain: A Randomized Controlled Pilot Study

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Abstract

Background—Chronic pain is associated with poorer cognition and mobility, and fall risk in older adults.

Aims—To investigate the feasibility of a randomized trial of mind-body exercise (Tai Chi) versus light physical exercise in older adults with multisite pain.

Methods—Adults aged ≥65y with multisite pain who reported falling in the past year or current use of an assistive device were recruited from Boston area communities. Participants were randomized to either a Tai Chi or a light physical exercise program, offered twice weekly for 12 weeks. The primary outcomes were feasibility and acceptability. Secondary outcomes included pain characteristics, cognition, physical function, gait mobility, fear of falling, and fall frequency.

Results—Of 176 adults screened, 85 were eligible, and 54 consented and enrolled (average age 75±8y; 96.30% white; 75.93% female). The dropout rate was 18% for Tai Chi and 12% for light physical exercise. For those completing the study, exercise class attendance was 76% for Tai Chi and 82% for light physical exercise. There were no significant group differences in most secondary outcomes. Tai Chi significantly lowered pain severity (4.58±1.73 to 3.73±1.79, $p<0.01$) and pain interference (4.20±2.53 to 3.16±2.28, $p<0.05$), reduced fear of falling (90.82±9.59 to 96.84±10.67, $p<0.05$), and improved several single-task and dual-task gait variables, while light physical exercise did not change these measures

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Conflict of Interest

Peter Wayne, one of our research consultants, is the founder and owner of the Tree of Life Tai Chi Center. He was consulted on Tai Chi design and manuscript preparation. The authors declare no other conflicts of interest.

Discussion and Conclusions—This study demonstrated the feasibility and acceptability of conducting a larger randomized controlled trial in older adults with multisite pain. Study findings and challenges encountered will inform future research.

Keywords

Chronic Pain; Mind-Body Exercise; Mobility; Falls; Feasibility

Introduction

Chronic multisite musculoskeletal pain is prevalent and contributes to disability and falls in older adults [1, 2]. Current evidence supports that presence of chronic multisite pain or severe pain, in particular, is associated with poorer cognition and mobility, and higher risk for falls [2–4]. We know that physical exercise prevents or slows down the development of physical disabilities [5], and also may improve cognitive function in older adults [6]. Furthermore, studies have demonstrated the link between cognition, mobility, and falls even in healthy older individuals [7, 8], suggesting that mind-body exercise may be more beneficial than light exercise alone for maintaining mobility and independent functioning in older adults with pain who are especially vulnerable to falls.

Older adults with chronic pain are less likely to engage in exercise, in part to avoid aggravating their already painful conditions [9]. Sedentary elders living with pain not only risk a cycle of declining mobility related to decreased activity, evidence is showing that pain also seems to contribute to cognitive decrements, which potentially could worsen mobility decline [10]. Physical activity might address part of this pathway to disablement but greater benefits may be gained through mind-body exercise such as Tai Chi [11, 12]. Studies have shown that Tai Chi can improve both cognitive and physical function, and reduce fall risk in older adults [13–16]. In a recent meta-analysis examining the effects of Tai Chi for clinical outcomes in people with musculoskeletal pain, fifteen randomized controlled studies were identified, and there was moderate-quality evidence that Tai Chi was more effective than no treatment or usual care on pain and disability [17]. However, current studies have not assessed the feasibility and acceptability of a Tai Chi intervention in older adults with multisite pain, nor did they examine the potential cognitive-motor benefits of Tai Chi in older adults with chronic pain.

Therefore, the purpose of this study was: 1) to assess the feasibility and acceptability of a randomized controlled trial of a 12-week Tai Chi versus light physical exercise program in preparation for a larger trial in older adults with chronic multisite pain who are at increased risk of falling and 2) to obtain preliminary information about possible benefits and effect estimation of the Tai Chi versus light physical exercise intervention on pain, cognition, cognitively mediated mobility, and falls for the future larger intervention study. The secondary outcomes will further examine the hypothesized pathway in which Tai Chi may improve brain function and cognitively-mediated mobility in older adults with chronic multisite pain.

Methods

The Helping Elders Living with Pain (HELP) Study was a single-blind randomized controlled trial (RCT). The primary outcomes of this study were feasibility and acceptability of a 12-week Tai Chi program in older adults with chronic multisite musculoskeletal pain and an increased risk for falls. The secondary outcomes were pain characteristics, cognition, physical function, gait mobility, fear of falling, and fall frequency. All protocols for the study and consent procedures were approved by the Institutional Review Board of the University of Massachusetts Boston.

Recruitment/Eligibility

All participants were recruited from Boston and surrounding areas through mailed invitations, community flyers, study brochures, local newspaper and TV ads, and internet/social media messages. Inclusion criteria for participants were: 1) adults aged 65 years and older, 2) reported chronic multisite (2 sites) musculoskeletal pain, 3) an increased fall risk based on 1 or more falls in the past year or current use of a cane or walker, 4) ability to walk 20 feet without personal assistance, and 5) ability to communicate in English. Exclusion criteria were: 1) engaged in moderate to vigorous exercise for more than 40 minutes/week, 2) current Tai Chi practice, or 3) diagnosis of a disease/condition that would interfere with their study participation (e.g. cancer, rheumatoid arthritis, Parkinson's disease, Alzheimer's disease, dementia).

Interested individuals were invited to call the study phone line for a phone interview to determine interest and eligibility. Multisite pain was assessed using the 13-item joint pain questionnaire to ascertain pain in musculoskeletal joint and back sites lasting 3 or more months in the past year and present in the previous month [18, 19]. Individuals were asked whether they had one or more falls in the past year [20], or were using a cane or walker.

After initial screening for eligibility, participants were scheduled for a baseline assessment visit in our study clinic at the University of Massachusetts Boston, which included the informed consent, and further screening for cognitive impairment [21], health interview, pain assessments and functional tests. Participants with moderate to severe cognitive impairment based on the Mini-Mental State Examination (MMSE) score of 18 or lower were excluded [22].

Randomization

After the baseline assessment, participants were randomly assigned to either the Tai Chi group or the light physical exercise control group. Classes were conducted in neighborhood community centers with easy access to transportation and parking. Randomization was performed using a SAS block randomization procedure according to four groups based on age and sex, with group assignments according to random blocks of 2 and 4 subjects per block.

Intervention

Individuals in the Tai Chi group participated in the 12-week group based program (one hour per class, two classes per week) led by an experienced Tai Chi instructor. Based on the Yang Style 8-Form. Each session included 10 minutes of warm-up that included joint rotations and balance games, 45 minutes of Tai Chi practice that included Tai Chi walking drills and the 8 forms (with 12–15 minutes of breaks), and 5 minutes of cool down and breathing exercises.

Individuals in the light physical exercise group participate in the 12-week group based program (one hour per class, two classes per week for 12 weeks) taught by a certified exercise physiologist (E.G.). Previous studies have shown that increase in exercise intensity or exercise duration may improve cognitive function among older adults [23, 24]. Therefore the control program for this study was selected to allow us to evaluate the benefits of Tai Chi beyond the light physical exercise aspects of the intervention. In other words, we selected the control exercise program to match the physical aspects of Tai Chi in terms of intensity and duration, but not include the cognitively challenging aspects of Tai Chi. Each control exercise session included 10 minutes of warm up, 30 minutes of normal walking, light intensity resistance exercise and stretching, and 20 minutes of health education discussions. The discussion component was included to enhance participation and attendance in the control group.

Individuals in both groups were also directed to websites that provided videos covering movement sequences learned from the class and handouts created by exercise instructor demonstrating exercise used in the classes. Participants were encouraged to practice at home at least once per week. Exercise attendance and reasons for absences were recorded by exercise instructors.

Study Assessment

We conducted in-person assessments at baseline and 12 weeks. All subjects underwent post-intervention testing on a day at least 48 hours after the last Tai Chi/light physical exercise session and study assessors were blinded to group assignments.

Feasibility and Acceptability—Study feasibility and acceptability were evaluated by 1) the number of study participants that we recruited and retained in the study, 2) the implementation of the treatment in the community setting and 3) the percent adherence within each treatment group. Attendance was recorded for each exercise session. A participant was identified as adherent to the protocol if he/she attended more than 80% of the assigned classes.

Demographic and Health Characteristics—Sociodemographic information was collected including age, sex, race, ethnicity, education, and marital status. Participants were queried on presence of physician-diagnosed major chronic conditions. Height was measured using a stadiometer, and weight was measured using a digital scale.

Pain Variables—Pain location was assessed using the joint pain questionnaire described above, and pain severity and pain interference with daily activities were assessed using the

Brief Pain Inventory (BPI) subscales, which have been validated in individuals with musculoskeletal pain and is widely used with older adults [25, 26].

Cognition—Attention was assessed using four subscales of the Test of Everyday Attention (TEA) [27]. The TEA subscales we used are the following: map search (visual selective attention), visual elevator (attentional switching), and telephone search with and without dual task (sustained and divided attention). To measure executive function, the Trail Making Tests (TMT) A and B were used [28].

Physical Function and Mobility—Physical function was measured by the Short Physical Performance Battery (SPPB) [29, 30]. There are three components to the SPPB, including standing balance which measures ability to perform 3 stands unassisted for up to 10 seconds each, measured usual-paced 4-meter walk, and time needed for 5 repeated chair stands performed without using arms.

Gait was measured using 2 conditions: single task walking and dual task walking, with cognitive attentional challenges (serial subtraction by 3 from 100). Gait testing was performed using a 16-foot sensed gaitmat (Protokinetics Inc., Havertown, PA). The gaitmat software records location and timing of individual steps, which then computes spatio-temporal gait parameters including gait speed, stride length, stride time, swing time, and gait asymmetry [31]. These gait measures have been validated and found to predict falls and disability in older adults [32, 33].

Falls and Fear of Falling—Fear of falling was measured using the Tinetti Falls Efficacy Scale [34]. Our scoring was reverse-coded, with higher values reflecting greater self-efficacy to avoid a fall. Participants recorded the occurrence of falls using monthly fall calendars [35]. At the first exercise class of each month, participants returned their completed fall calendars to the exercise class. After each participant completed the 12-week exercise program, fall calendars were provided and returned by mail each month for an additional 6-month follow-up period.

Sample Size Estimation—A previously published trial of Tai Chi for treatment of fibromyalgia found a significant effect of Tai Chi on patient's global pain severity score (0–10 scale) [36]. The intervention produced a standardized mean difference of 0.83 points in the severity score by the end of 12 weeks [36]. A sample size of 24 in each group would have 80% power to detect the same effect size using a Student's t-test with a 0.05 two-sided significant level. Assuming a 20% attrition rate, we planned to enroll 30 subjects for each group into the study.

Statistical Analyses

All analyses were performed using SAS software version 9.4 (SAS Institute Inc., Cary, NC). Baseline differences in the demographics and fall risk factors of the participants in the Tai Chi and light physical exercise group were compared using independent t-tests and chi-square statistics. Normality of distribution of each continuous variable at each time point was examined, and outliers were identified by applying the interquartile range rule, and were recoded to either the upper outlier bound or lower outlier bound.

Paired t-tests were used to compare outcome measures before and after the 12-week exercise programs within each treatment group. Independent t-tests were used to compare the pre-post differences between the treatment groups. Analysis of Covariance (ANCOVA) and multivariable linear regression were performed to compare group differences in outcome variables or pre-post changes in outcome measures, while adjusted for age, gender and education. Negative binomial regression models with an offset variable for log total days of follow-up were used to examine the effect of the exercise programs on rate of falls. The analysis of outcomes was conducted using an intention to treat approach. Statistical significance was determined by the two-sided p-value <0.05.

Results

Primary Outcomes

Our original enrollment target was 60 participants with an anticipated dropout rate of 20%. Of the 176 older adults screened, 85 were eligible and 54 consented to participate and were randomized, including 28 to the Tai Chi group and 26 to the exercise control group (Figure 1). To meet our timeline within budget, we terminated our recruitment after 54 participants enrolled.

The average age of participants was 75 ± 8 years; 96% were white, and 76% were female. Of the 54 who were randomized, 45 (83%) completed the follow-up assessment, including 22 (79%) in the Tai Chi group and 23 (88%) in the light physical exercise group. Study participants, who did not complete the study, were significantly older ($p=0.05$), and had marginally higher BPI pain severity score ($p=0.06$) compared to those who completed the study. The reasons for dropping out or not completing post-intervention testing are shown in Figure 1.

Among those who completed the study, overall exercise class attendance rate was 79%, with 76% for the Tai Chi group and 82% attendance for the light physical exercise control group. Among the Tai Chi group 9 participants (41%) adhered to the exercise program (attendance rate 80%) and 14 participants (61%) in the light physical exercise group adhered to the program. Common reasons for absences were doctors' appointments, family commitments, health complications, transportation challenges, fatigue, musculoskeletal pain, and vacations.

There were no major injuries attributed to the interventions or testing during this study. All minor events were recorded, reported, and followed up with no lasting effects. Minor events included one testing-related discomfort, one minor injury during Tai Chi exercise and two minor injuries reported at home that were unrelated to exercise class during the intervention.

Secondary Outcomes

Among those who completed the study, there were no between-group differences at baseline according to age, gender, race, body mass index, walking distance per day, MMSE score, number of pain sites and presence of chronic conditions (Table 1). However, there was a significant group difference in education level, with fewer Tai Chi group participants reporting having graduated from college than those in the light physical exercise group ($p<0.05$).

As shown in Table 2, there were no significant differences in pain measures, cognition and physical function scores between the two groups at baseline, or in their pre-post changes over the 12-week intervention period. However, Tai Chi participants had lower pain severity scores (-18.56%, $p<0.01$) and pain interference (-25.00%, $p<0.05$) scores at follow-up compared to baseline, while pre-post scores in the light physical exercise group were not significantly different. There were no material differences between baseline and follow-up scores in cognition and physical function scores in either group. All outcome variables were further adjusted for age, gender, and education and we did not observe any significant group differences.

Single-task and dual-task gait characteristics before and after the 12-week intervention period are shown in Table 3. We did not find significant between group differences in single-task and dual-task gait measures at baseline. Over the 12-week intervention period, there were no between-group differences observed in changes of single-task and dual-task gait measures, except for a significantly improved dual-task gait asymmetry in the Tai Chi group compared to the light exercise control group, ($p<0.05$). After further adjusting for age, gender, and education, the group differences for dual-task gait asymmetry remained significant ($p=0.02$). Participants in the Tai Chi intervention had decreased stride time ($p<0.05$) and increased percent swing time ($p<0.05$) for single-task gait and decreased gait asymmetry ($p<0.05$) for dual-task gait from baseline to follow-up. We did not observe significant differences in pre-post gait characteristics in the light physical exercise group.

As shown in Table 2, there were no significant differences in fear of falling (measured as fall self-efficacy scores) between the two groups at baseline, or in their pre-post changes over the 12-week intervention period. However, Tai Chi significantly increased fall self-efficacy scores from baseline to follow-up ($p<0.05$), indicating a decreased fear of falling, while there was no change in the light physical exercise group. During the 9-month falls follow-up, participants in the Tai Chi group had an average rate of 1.23 falls/year compared to 2.57 falls/year in the light physical exercise group. (incidence rate ratio(IRR)=0.46, $p=0.05$). This difference diminished after adjusting for age, gender, and education ($p=0.13$).

Discussion

The findings from our primary outcomes of this pilot study support the feasibility and acceptability of conducting a larger Tai Chi clinical trial as compared to light physical exercise in older adults with multisite pain who have an increased risk for falls. Specifically, the retention and adherence rates met or exceeded our expectations. We also observed trends of improvements in pain symptoms, fall rates and gait functions in the Tai Chi intervention group but not in the light physical exercise group.

As our original enrollment target was 60 participants with an anticipated dropout rate of 20%, retention of 45 out of the 54 older adults enrolled in the trial is satisfactory for a pilot study in this vulnerable population. Recruitment costs were higher than initially expected though we found that we were most successful recruiting participants through targeted mailing in communities surrounding the areas where exercise classes were held. This recruitment method will inform future studies involving this challenging study population.

We found no previous report involving similar community-based populations with regards to retention or attendance; the 83% study retention and 79% class attendance were very successful for this older population living with chronic pain and fall risk. Exercise class attendance was strongly encouraged by all exercise and Tai Chi instructors through conversations in class and reminder phone calls. Study procedures contributed to the comfort and safety of participants and their engagement in the program, contributing to the high attendance. We included the health education discussion component in the light physical exercise group also to promote engagement and attendance. The additional social interaction that was provided in the light physical exercise group may have influenced class attendance and adherence to the program.

Our preliminary yet provocative findings from the secondary outcomes indicate that the two groups had differential changes from baseline to follow-up in several hypothesized outcomes, though need to be interpreted with caution due to our small sample size. Specifically, Tai Chi exercise reduced pain severity and pain interference scores, but, in contrast, we found that the light exercise control group did not experience measurable improvements in pain. Although there were no between-group statistical differences in these changes, the trend showed improvements ranging from 19% to 25% in the Tai Chi group. Previous studies support that Tai Chi may be better than stretching, and is comparable to physical therapy in improving pain symptoms in middle-aged and older patients with knee osteoarthritis [37, 38]. However, our findings are among the first to compare benefits of Tai Chi to light physical exercise, showing greater improvement in chronic pain symptoms with Tai Chi.

Although we did not observe improvements in attention and SPPB scores, we did see changes in single-task and dual-task gait performance. Likely due to the small sample size, we observed few statistically significant effects. However, there was a trend toward improvement in characteristics such as stride time and swing time with Tai Chi that was not observed with the control intervention. Furthermore, similar trends were seen in fear of falling and in the fall rate among the Tai Chi participants. These findings support that Tai Chi may improve mobility and fall-related outcomes, consistent with our hypothesis about the functional benefits of Tai Chi for older adults with pain.

We were somewhat surprised by the lack of an effect on attention measures with the Tai Chi intervention as this exercise involves concentration when performing body movements and it has a meditative aspect as well. It is possible that measurable cognitive benefits might require a longer intervention or a more regular Tai Chi practice. The very modest change in a single measure of attention in the control group was unexpected, and possibly spurious. Considering the low baseline score in this measure, the Map Search test, the observed improvement also might be attributed to a regression to the mean effect.

Overall, our pilot findings related to pain measures, gait function, fear of falling and fall rate support that Tai Chi may lead to reduced pain symptoms, and improved brain and mobility functioning in older adults who have chronic multisite pain. Tai Chi may be beneficial for fall prevention in older adults because it is a multimodal strategy with apparent benefits to both cognition and mobility. Such a multimodal strategy is advocated for improving balance

and reducing fall risk [39, 40]. However, the effects of Tai Chi on fall risk among persons with chronic pain may be in part, also through alleviation of pain, as supported by our findings. The mechanisms through which Tai Chi improves chronic pain, mobility and pain-related brain functions will need to be clarified in future studies. Understanding the underlying mechanisms will also inform new approaches for pain management in older adults.

There are several potential limitations to our study. First, the sample size of the study was relatively small and could have resulted in type II error. Second, we did not have a passive control group for comparison. We have chosen light physical exercise for the control group because we were addressing the importance of Tai Chi as a mind-body exercise, but not just a general body exercise for older adults with chronic pain and an increased risk of falls. Third, our MMSE cutpoint of 18 for eligibility might include those with mild cognitive impairment and may have impacted our ability to observe cognitive benefits in a 12-week period. Fourth, it is possible that 12-week Tai Chi was not sufficient to effect change in this vulnerable population. Therefore, future research may need to consider increasing the sample size and the intervention period. Finally, adding a third passive control group to examine the effects in two arms may be beneficial.

In conclusion, this pilot study demonstrated the feasibility and acceptability of conducting a randomized controlled Tai Chi trial in older adults with multisite pain who are at risk for falls. Specifically, the 12-week Tai Chi intervention provided evidence that this approach may improve pain symptoms and gait performance, and reduce fall risk. Data collected and challenges encountered will inform a future larger clinical trial in this vulnerable population.

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Figure 1.
The enrollment and participation flow diagram

Table 1

Baseline sociodemographic and health characteristics in 45 study participants

Characteristics	Tai Chi Group (n=22)	Light Physical Exercise Group (n=23)
Age (years)	74.27±7.48	74.78±7.17
BMI (kg/m ²)	32.03±7.23	30.40±6.16
MMSE	27.59±1.82	28.30±1.99
Number of Blocks	14.04±16.40	19.65±27.26
Walked/Week		
Number of Pain Sites	3.86±0.96	3.57±1.38
Gender		
Male	6(27.27)	4(17.39)
Female	16 (72.73)	19(82.61)
Race		
White	20(90.91)	23(100.00)
Asian	1(4.55)	0 (0)
Other	1(4.55)	0 (0)
Education *		
High school graduate	13(59.09)	7(30.43)
College graduate	9(40.91)	16(69.57)
Heart Disease	9(40.91)	9(39.13)
Diabetes	5(22.73)	2(8.70)
Peripheral Artery Disease	5(22.73)	3(13.04)
Fell in the Past Year	17(73.91)	21(91.30)
Walking Aid Use	9(40.91)	8(34.78)
Bifocal or Multifocal	12(52.17)	8(34.78)
Eyeglass Use		
Psychoactive Medication Use (>2)	5(26.32)	6(28.57)

All in Mean±SD or n(%).

* p<0.05 chi-square test comparing two groups.

BMI=Body Mass Index, MMSE= Mini-Mental State Examination.

Pain characteristics and functional outcomes in the mild exercise and Tai Chi groups before and after the 12-week intervention

Table 2

	Tai Chi Group (n=22)			Light Physical Exercise Group (n=23)		
	Pre	Post	Change	Pre	Post	Change
Pain Severity	4.58±1.73	3.73±1.79**	-0.85±1.41	3.95±1.82	3.46±2.08	-0.49±1.66
Pain Interference	4.20±2.53	3.16±2.28*	-1.05±2.20	4.31±2.10	3.87±2.87	-0.44±1.98
Selective Attention - Map Search	41.95±15.38	42.19±15.70	0.24±8.35	35.00±14.05	38.87±14.78*	3.87±7.11
Attentional Switching - Visual Elevator	4.29±1.28	4.17±1.26	-0.12±0.64	4.28±0.91	4.10±1.01	-0.19±0.77
Selective Attention - Telephone Search	5.03±1.46	4.88±1.31	-0.15±0.96	5.27±1.72	4.76±1.35 [†]	-0.51±1.35
Sustained Attention - Telephone Search while Counting	6.24±2.67	5.63±1.85	-0.61±1.66	6.52±2.75	6.11±2.14	-0.42±2.24
Divided Attention - Dual Task Decrement Score	2.08±2.18	1.58±2.38	-0.50±2.51	2.28±2.71	2.46±2.44	0.19±2.57
Trailmaking A	42.33±19.41	44.01±17.31	1.68±12.33	47.87±16.45	46.04±19.56	-1.83±19.72
Trailmaking B	100.5±44.18	104.8±40.82	4.35±39.08	102.9±40.88	91.20±28.91	-11.71±31.77
SPPB	8.20±2.38	8.23±2.86	0.03±1.97	7.96±2.88	8.17±2.53	0.22±1.51
Fall Efficacy	90.82±9.59	96.84±10.67*	6.02±12.3	89.43±16.1	90.24±10.28	0.80±13.40

All in Mean±SD.

[†] p<0.10,

* p<0.05,

**

p<0.01 paired t-test comparing post- to pre-intervention measures within each treatment group.

SPPB=Short Physical Performance Battery.

Table 3

Gait measures in the mild exercise and Tai Chi groups before and after the 12-week intervention

	Tai Chi Group (n=19)			Light Physical Exercise Group (n=22)		
	Pre	Post	Change	Pre	Post	Change
Single-Task Gait						
Gait Speed (m/s)	0.90±0.23	0.95±0.23 [‡]	0.05±0.11	0.96±0.55	0.98±0.25	0.02±0.07
Stride Length (m)	1.06±0.23	1.08±0.23	0.02±0.07	1.09±0.21	1.10±0.21	0.01±0.06
Stride Time (s)	1.20±0.11	1.16±0.10 [*]	-0.04±0.08	1.14±0.14	1.13±0.10	-0.01±0.06
Swing Time (%)	31.77±3.20	32.23±2.82 [*]	0.47±0.96	32.98±2.61	33.38±2.37	0.396±1.33
Gait Asymmetry	3.97±2.83	3.70±3.53	-0.27±3.23	4.24±3.98	3.91±4.75	-0.33±3.98
Dual-Task Gait						
Gait Speed (m/s)	0.80±0.21	0.83±0.22	0.03±0.11	0.88±0.24	0.90±0.25	0.02±0.08
Stride Length (m)	1.00±0.25	1.01±0.25	0.02±0.08	1.04±0.22	1.05±0.22	0.01±0.06
Stride Time (s)	1.26±0.13	1.22±0.11 [‡]	-0.04±0.08	1.20±0.16	1.17±0.12	-0.03±0.08
Swing Time (%)	31.19±3.03	31.27±3.16	0.08±1.02	32.27±2.51	32.58±2.59	0.32±1.29
Gait Asymmetry	5.40±3.92	2.87±3.07 [*]	-2.53±4.41 [‡]	4.73±5.41	5.31±6.22	0.58±3.54

All in Mean±SD.

^{*} Paired t-test comparing post- to pre-intervention measures within each treatment group, p-value<0.05,

[‡] p-value<0.10.

[‡] Independent t-test comparing pre-post changes between mild body exercise group and Tai Chi group, p-value<0.05.