



Tai Ji Quan and global cognitive function in older adults with cognitive impairment: A pilot study[☆]



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ABSTRACT

This study evaluated whether Tai Ji Quan: Moving for Better Balance (TJQMBB) could improve global cognitive function in older adults with cognitive impairment. Using a nonrandomized control group pretest–posttest design, participants aged ≥ 65 years who scored between 20 and 25 on the Mini-Mental State Examination (MMSE) were allocated into either a 14-week TJQMBB program ($n = 22$) or a control group ($n = 24$). The primary outcome was MMSE as a measure of global cognitive function with secondary outcomes of 50-ft speed walk, Timed Up&Go, and Activities-Specific Balance Confidence (ABC) scale. At 14 weeks, Tai Ji Quan participants showed significant improvement on MMSE (mean = 2.26, $p < 0.001$) compared to controls (mean = 0.63, $p = 0.08$). Similarly, Tai Ji Quan participants performed significantly better compared to the controls in both physical performance and balance efficacy measures ($p < 0.05$). Improvement in cognition as measured by MMSE was related to improved physical performance and balance efficacy. These results provide preliminary evidence of the utility of the TJQMBB program to promote cognitive function in older adults in addition to physical benefits.

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1. Introduction

It is estimated that as many as 20% of people age 65 and older have at least mild cognitive impairment (MCI) (Hanninen, Hallikainen, Tuomainen, Vanhanen, & Soininen, 2002; Lopez et al., 2003; Roberts et al., 2008), with an estimated annual conversion rate from MCI to dementia of 10% (Manly et al., 2008). Even for those without dementia, cognitive impairment can contribute to decreased quality of life, increased neuropsychiatric symptoms, and increased disability and healthcare costs (Alzheimer's Association, 2012; Plassman, Langa, & Fisher, 2008).

Behavioral interventions, such as exercise, can provide cognitive benefits to older adults with cognitive impairment (Chang, Pan, Chen, Tsai, & Huang, 2012; Dresler et al., 2013; Erickson & Kramer, 2009; Etnier & Chang, 2009; Hahn & Andel, 2011) and are often recommended as a therapy for cognitive health (US Department of Health and Human Services, 2012). While

conventional exercise modalities have been shown to improve cognition in older adults (Baker et al., 2010; Larson et al., 2006), there is emerging evidence to suggest that physical demands combined with mental challenges may have an additive effect on brain health and cognitive function (Curlik & Shors, 2013).

Tai Ji Quan, an alternative exercise regimen that incorporates both physical activity and cognitive requirements, is therefore posited to promote brain health (Chang, Nien, Tsai, & Etnier, 2010; Chang et al., 2011; Cheng et al., 2013). While findings from a limited number of existing studies (Burgener, Yang, Gilbert, & Marsh-Yant, 2008; Cheng et al., 2013; Lam, Chau, Wong, Fung, & Tam, 2012; Mortimer et al., 2012) have provided the scientific basis and therapeutic impetus to further explore the cognitive benefits of Tai Ji Quan, few studies have considered exploiting the explicit integration of multi-tasking and combined mental and physical skill learning that would uniquely tax physical, sensory, and cognitive function simultaneously in this regard. This pilot study addresses this limitation by serving as a proof of concept for the utility of an integrated evidence-based Tai Ji Quan program that has been widely studied as a fall prevention intervention in older adults, a population at significant risk of developing cognitive impairment.

Specifically, this study explored the potential value of TJQMBB (Li et al., 2008, 2013; Li, 2013), to benefit cognitive function in older adults. The TJQMBB program has been proven to enhance physical

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performance, balance, well-being, and sleep quality and, most recently, to reduce symptoms of Parkinson's disease (Li, 2013). Although promising, its potential benefit to cognition has not been explored. Therefore, the primary aim of this study was to determine whether TJQMBB, with an enhanced training feature of integrating dynamic postural movements and concurrently challenging multiple dimensions of cognitive ability (Li et al., 2013), could improve global cognitive function in older adults with cognitive impairment.

Additionally, because cognitive impairment may also be associated with impaired physical performance (Aqarwal, Wilson, Beck, Bienias, & Bennett, 2006) and Tai Ji Quan is specifically designed to stimulate both cognitive and physical capacities (Li, 2013), it was also of interest to examine the concurrent relationships of these domains as a result of Tai Ji Quan exercise. Therefore, a secondary aim of the study was to examine whether change in global cognitive function was related to change in physical performance-based outcome and balance efficacy measures.

2. Methods

2.1. Study design and participants

A nonrandomized control group pretest–posttest design was used. Participants assigned to the intervention group (Tai Ji Quan) participated in a 60-min group session twice weekly for 14 weeks. The study protocol was approved by an Institutional Review Board, and written informed consent was obtained from each participant.

Participants were recruited between April and August 2012 primarily through community-wide promotions, such as flyers, newsletters, and word of mouth at local senior and community activity centers in communities in Oregon, to participate in a community-based Tai Ji Quan dissemination project. Study eligibility criteria included (1) being ≥ 65 years of age, (2) being able to walk with or without an assistive device, (3) having MMSE (Folstein, Folstein, & McHugh, 1975) scores between 20 and 30, and (4) having a medical clearance from a healthcare provider.

Individuals who responded to the study promotions were initially contacted via phone for screening for age and mobility criteria and subsequently invited to a research facility where a detailed, face-to-face intake process, including signing consent forms and completing the MMSE and other baseline measures, was conducted. Prior to signing the informed consent, participants were given sufficient time in a private room to ask questions regarding the study protocol and Tai Ji Quan exercise. Research assistants trained and monitored by the first author performed the study screening and outcome assessments.

For the purposes of this study, a subsample of 46 participants who had a score between 20 and 25 on the MMSE was selected as having cognitive impairment (Folstein, Folstein, McHugh, & Fanjiang, 2001; Mungas, 1991; O'Bryant et al., 2008; Sperring et al., 2012; Vertesi et al., 2001). The decision to use this range of scores allows us to evaluate the relationship between Tai Ji Quan and cognitive function without a possible confounding effect of severe cognitive impairment. Of the total, those assigned to the control group ($n = 24$) were individuals who could not participate in the intervention class due to logistical reasons such as time constraints and/or location and transportation issues but who were willing to participate in a follow-up assessment.

2.2. Primary outcome variable: Global cognitive function

All study outcome measures were taken twice: at baseline and again upon completion of the 14-week intervention. The primary study outcome was cognitive function as measured by the MMSE (Folstein et al., 1975). The MMSE consists of 11 questions

concerning orientation, registration, attention and calculation, recall, and language and has a maximum score of 30. The 3-month test-retest reliability was 0.87.

2.3. Secondary outcome variables: physical performance and balance efficacy

Two physical performance measures consisted of (a) 50-ft speed walk (Reuben & Siu, 1990) and (b) Timed Up&Go test (Podsiadlo & Richardson, 1991). The 50-ft walk measured the time, in seconds, taken to walk 50 ft. The Up&Go measured the time, in seconds, taken to rise from a chair, walk 10 ft. (3 m), return, and sit down. Test and retest reliability for the two measures was 0.59 (Timed Up&Go) and 0.67 (50-ft walk), respectively. Balance efficacy was measured using the Modified ABC scale (Powell & Myers, 2005), which measures confidence in one's ability to avoid falling during activities of daily living. Participants were asked to rate their confidence in performing each activity without falling on a 1–5 scale; the average score across all 14 items was taken, with a minimum score of 1 indicating “not at all confident” and a maximum score of 5 indicating “completely confident” in performing the tasks without falling. The 3-month test-retest reliability for this measure was 0.87.

2.4. Other assessments

Participants completed a self-survey that collected their demographic, health status, and medical and chronic conditions information. The Physical Activity Scale for the Elderly (Washburn, Smith, Jette, & Janney, 1993) was used to assess occupational, household, and leisure time physical activities over a typical week.

2.5. Study conditions

Tai Ji Quan: The TJQMBB program (Li et al., 2008, 2013; Li, 2013) consisted of a set of movements designed specifically for older adults, with an emphasis on taxing motor performance, orientation, verbalization, visualization, and mental execution of simple-to-complex movements that have been shown to improve balance and mobility and reduce fear of falling and risk of falling. The 14-week training period was determined a priori based on studies that involve the use of MMSE (Burgener et al., 2008; Chang et al., 2011).

The training protocol began with a brief Tai Ji Quan-based warm-up activity followed by core training of movements contained in an 8-form routine and a set of therapeutic movements (Li et al., 2013). Unlike conventional Tai Ji Quan training which primarily involves participants learning forms by mimicking the instructor's movements, in the protocol used in this study, participants must follow the instructor's movement while simultaneously and deliberately responding to a variety of specific tasks designed to further tax cognitive function by adding attentional demands and memory interference. For example, in performing the form “Part the Wild Horse Mane,” participants had to recite the name of this form or an associated word/number, distinguish between a visual target movement and a conflicting auditory cue, and, when connected with other forms, change the sequence of forms when prompted by the instructor (requiring accurate recall and execution in a non-standard format). Practices were infused with multiple cognitive/motor tasks of these kinds through variations in configurations, teaching cues, and movement complexity.

To facilitate learning the Tai Ji Quan movements, ample practice opportunities were allocated during the first 6 weeks, with the emphasis on practicing single forms with multiple repetitions; the latter stage (the last 8 weeks) focused on practicing and repeating individual forms to strengthen integration of cognitive and

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