

## The Effectiveness of Tai Chi in Improving Motor and Non-Motor Symptoms of Parkinson's Disease: A Narrative Review

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### INTRODUCTION

James Parkinson, a London physician, first described the illness as a shaking palsy in 1817. Parkinson's disease today is known as a progressive, neurological disorder due to deterioration of neurons in a region of the brain responsible for movement – the *substantia nigra*. This deterioration produces a shortage of dopamine in the corpus striatum. Parkinsonism is characterized by five primary motor signs or symptoms: tremor, cogwheel rigidity, slow movement (bradykinesia), postural instability (balance problems), and walking/gait problems.<sup>2</sup> Associated rigidity and its sequelae do not adequately respond to first-line or suboptimal medications. These physical dysfunctions can lead to increased incidence of falls with patients exhibiting difficulties in performing common activities of daily living (ADLs). Non-motor dysfunction in Parkinson's disease can be even more disturbing and disabling for patients than motor symptoms. These include mood disorders such as anxiety, depression, irritability and apathy; and cognitive changes such as the inability to focus attention needed for planning, slowing of thought, language and memory difficulties, personality changes, dementia, and overall, a reduced quality of life.<sup>3</sup>

### Traditional Therapy for Parkinson's Disease

The management of Parkinson's disease is complex and tailored to meet individual needs of each patient. Conventional or modern therapy for PD consists of medications designed to replace levodopa. This therapy and numerous other drug amalgamations attain improvements in the initial stage of Parkinson's, specifically in motor difficulties.<sup>4</sup> Another treatment option for PD, deep-brain stimulation (DBS), changes the brain firing pattern by utilizing an electrical stimulus to control signals in neural circuits to and from mapped areas in the brain in order to palliate Parkinson's disease symptoms. However, DBS does not slow the advancement of neural deterioration. Furthermore, significant adverse effects are associated with the implantation of this device, specifically in areas of the brain responsible for speech, mood, and cognitive function.<sup>5</sup>

Parkinson's disease (PD) is an illness with significant adverse effect on the patient's physiological and psychological health. Postural unsteadiness is one of the major complications reported by patients. Animal, clinical, and neuroanatomical studies on subjects with and without Parkinson's suggest a significant link between the incidence of difficulties with balance and anxiety, depression, and apathy. Considering that difficulties with balance is a prevalent sign in PD, it may be presumed that by controlling this dysfunction, we could positively affect the patient's

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mental disposition. Difficulties with balance have been cited as the foremost motor factor of poor quality of life. In particular, falls, shuffling, and difficulty turning resulting from a postural instability are reported to be problematic. Approximately 70% of patients report falls often resulting in serious consequences such as fractures or social stigma caused by the embarrassment of falling in public. Fear of falling may keep patients from participating in outdoor and social activities, further reducing the quality of life.<sup>6</sup>

### **Complementary Therapy for Parkinson's Disease**

Since Parkinson's disease is a progressive neurodegenerative condition, patients continue to experience a decline in physical function and ability to perform daily activities despite conventional medical or surgical care.<sup>7</sup> It is therefore understandable for patients with PD to look to complementary or alternative therapy in hopes of improving their quality of life. In the United States, approximately 40% of PD stated that they use at least one form of complementary therapy.<sup>8</sup> Mind-body therapies are common complementary treatment modalities and are based on the beliefs of the interaction between the mind and body. The goal of these practices is to focus mainly on tension or stress reduction and improving individual well-being.

Tai Chi, a mind-body exercise, is a traditional Chinese martial art that combines deep breathing and relaxation with deliberately slow movements while maintaining various postures (Figure 1). Probable mechanisms for the effects of mind-body movement modalities include normalizing dopamine levels, strengthening of muscles, and balancing. In addition, there is neurophysiological control through the increasing of cerebral output.<sup>9</sup> Tai Chi has been associated with a decreased incidence of falls in the elderly, decreased blood pressure, improvement of lung and cardiac functions, psychological dysfunction, insomnia, and low back pain, assisting in the rehabilitation of stroke victims, slowing of rheumatic disease progression, and dementia.<sup>10</sup> Probable mechanisms underlying the efficacy of Tai Chi in fall reduction risks include improved fitness, proprioception and internal awareness of the participants' positioning relative to his environment. From reported gains, Tai Chi demonstrates potential to help both the motor and non-motor symptoms due to Parkinson's disease.<sup>10</sup>

### **Limitations**

This review is limited by the amount of quality literature available for review of Tai Chi and its efficacy in the improvement of motor and non-motor symptoms in Parkinson's disease

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patients. In conventional Western practice, medical providers tend to address symptoms separately. Eastern modalities, such as Tai Chi, address disease as a mind and body continuum. Therefore, the amount of literature may be limited given that the preponderance of therapy for Parkinson's disease continues to be traditional Western medicine.

### **Method**

Major literature search engines including PubMed, Ovid, Cumulative Nursing and Allied Health Literature (CINAHL), and Google Scholar were used to conduct a literature search. English-language, human subject studies were evaluated for relevant content. Peer-reviewed articles published within the last 5 years were included. The following search terms were used: Parkinson's disease, Parkinsonism, motor symptoms, non-motor symptoms, Tai Chi, mind-body exercise, postural stability, fall prevention, quality of life. Additional literature was found from citations and references in articles. More than 200 potential articles were identified. After removal of systematic reviews and meta-analyses, duplicate articles, editorials, commentaries, and protocols for future studies, 7 randomized controlled trials (RCTs) are presented in this literature review.

### **Outcome measures**

Developed in the 1980s, the *Unified Parkinson's Disease Rating Scale* (UPDRS) has become the most prevalent clinical rating scale utilized for Parkinson's disease. The UPDRS has been the scale used to determine the treatment-related benefits for the majority of clinical trials evaluating new treatments for the disorder. The UPDRS-III covers dopaminergic responsiveness and evaluating motor disability and includes ratings for tremor, slowness (bradykinesia), stiffness (rigidity), and balance.<sup>11</sup>

The *Berg Balance Scale* (BBS), developed by Katherine Berg in 1989, is utilized to determine static and dynamic ability among the elderly. It is a qualitative measure that evaluates balance by carrying out purposeful activities such as reaching, bending, transferring, and upright movement. This scale also integrates most components of postural control: shifting between chairs; standing with feet apart and together, single-leg stance, and feet in the tandem Romberg position with eyes open or closed; reaching and bending down to pick something from the floor. The BBS is considered reliable (both inter- and intratester) and has concurrent and construct validity.<sup>12</sup>

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The *Timed Up and Go* (TUG) test is another commonly used screening tool for fall risk in the inpatient and the community setting. The patient is timed while moving from an arm chair and walking at a controlled stride to a line on the floor about three meters away. The patient then turns and walks back to the chair and sits down again. The patient is allowed to familiarize him or herself once before being timed to become familiar with the test. If needed, normal or customary footwear and walking aid are provided. Improved functional performance is denoted by a faster time and a score of  $\geq 13.5$  seconds is used as a marker to identify individuals in the community setting with an increased risk of falling. The TUG is recommended by the American Geriatric Society and the British Geriatric Society for routine screen for falls. Guidelines by the National Institute of Clinical Evidence (NICE) also advocate utilization of TUG for assessment of gait and balance in the prevention of falls in the elderly.<sup>13</sup>

*Maximum excursion* is an evaluation of the limits of self-initiated movements as patients alter their center of gravity, without falling, toward the theoretical limit (100%) in each of eight target directions. Directional control, a measure of accuracy in movement, is assessed by comparing the amount of movement toward the target with the amount of unnecessary movement. Scores on both measures range from 0 to 100%, with higher percentages indicating better balance or control.<sup>14</sup>

A commonly used health questionnaire explicitly for PD is the *Parkinson's disease Questionnaire-39* (PDQ-39). Individuals are asked to reply "never", "occasionally", "sometimes", "often" or "always or cannot do at all."<sup>15</sup>

*Tinetti's Falls Efficacy Scale* is an index often used to determine confidence in various, increasingly difficult activities of daily living (ADLs). Each item is answered on a scale of one (i.e., very confident) to ten (i.e., not confident at all).<sup>16</sup>

*PDQ-8* and the *Vitality Plus Scale* (VPS) are utilized in assessing perceived benefits ascribed to exercise participation.

### DISCUSSION

*Effects on motor symptoms.* Postural instability and gait dysfunction are two incapacitating signs in Parkinson's disease patients. These complications lead to diminished movement and frequent falls in PD patients. Nearly 70% of PD patients fall during the course of the disease, many resulting in significant consequences.<sup>17</sup> Probable mechanisms attributed to the effectiveness of Tai Chi in

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fall reduction risks include improved fitness, proprioception and internal awareness of patients' positioning relative to his environment. Lower extremity disability causing difficulties with ambulating and postural unsteadiness also have significant effects on reported physical and psychological quality of life.<sup>18</sup> Therefore, improvement in gait is invariably cited as one of the more relevant outcomes needed to consider a treatment for Parkinson's effective.

Tsang (2013) conducted a randomized controlled trial blinded to outcome assessment to determine if an improvement in postural control was possible with Tai Chi treatments in patients with Parkinson's disease. In this study, 40 to 85-year-old patients with PD able to walk with or without assistance were included. Participants (n=195) were randomized 65 allocated to each of Tai Chi, resistance (8 to 10 leg muscle strengthening exercises), and stretching groups (upper and lower extremity stretching exercises). Intervention for groups lasted 24 weeks (60 minutes for each session, with two sessions a week). Baseline outcome measures were assessed, 12 and 24 weeks, and 3 months after termination of the intervention. Primary outcomes measure for postural stability measured maximum excursion and directional control derived from active posturography. Secondary outcomes included timed-up-and-go test (TUG), and UPDRS III. Change in maximum excursion in the Tai Chi group was substantially more in the resistance group than the stretching group. In addition, improvement in direction control was also substantially more in the Tai Chi group compared with the resistance group and the control group. The variation in timed-up-and-go test and UPDRS III score in the Tai Chi group was also significantly more than that in the stretching group, but not the resistance group. The occurrence of falls was also much lower in the Tai Chi group than the stretching group during the 6-month training period.<sup>19</sup>

Amano et al. (2013) conducted a randomized control trial to examine the outcome of Tai Chi exercise on dynamic postural control during initiation of gait and performance in PD patients. Forty-five participants with PD were randomly designated to either a TC group, which completed a 16-week TC regimen, or a control group of no exercise in the 16-week duration. Neurologists specializing in movement disorders, blind to the intervention, evaluated participants' degree of PD-related motor symptoms using the UPDRS-III. The outcomes showed Tai Chi did not meaningfully improve UPDRS-III score, designated gait initiation determinants or gait performance for either group. Results from both groups suggested that 16 weeks of instructor-led Tai Chi were unsuccessful in improving either gait initiation, gait performance, or reduction of

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disability in this subset of persons with PD.<sup>20</sup> This study may have benefitted from a larger sample size with perhaps a more intensive or longer duration protocol. In addition, outcome measures not utilized in this study may be more sensitive to the potential benefits of TC in this population.

Choi et al. (2013) found modest positive effects on PD patients when they measured UPDRS-III along with motor and physical functions after a 12-week program of 60-minute Tai Chi. The Tai Chi group, as compared to the control group randomized to no exercise, exhibited changes in cognition, behavior, mood, and motor assessment of the UPDRS. There was also substantial interaction between the time and intervention group on ADL and effects in balance and agility. Although the number of participants were smaller than in the Amano et al. investigation, significant interaction effects for balance, reaction time, and activities of daily living (ADLs) were found. Overall, PD participants in the TTC group reported an improvement in their ability to engage in their activities of daily living.<sup>21</sup>

Gao et al. (2014) randomized 76 PD patients to a 60-minute, 3 times a week for 12 weeks Tai Chi regimen or to a no exercise control group. To assess the effectiveness of Tai Chi on balance and fall prevention in PD patients, the investigators utilized the Berg Balance Scale, Timed Up and Go (TUG), and recorded occurrences of falls, in addition to determining patients' UPDRS-III scores. The investigators found that the intervention group showed a significant improvement over the control group on the BBS ( $p < 0.05$ ), though there was no difference on the UPDRS-III and TUG scores. Notably, only 8 (21.6%) out of the 37 patients in the Tai Chi group reported falling compared to 19 (48.7%) of the 39 in the control group.<sup>22</sup> This data suggest that Tai Chi intervention could improve balance and decrease morbidity associated with falls in PD patients.

*Effects on non-motor symptoms.* A sizeable number of people with PD have incapacitating psychological symptoms including insomnia, decline in cognition and depression. Advanced cognitive decline also contributes to the deterioration of physical function commonly demonstrated in PD.<sup>23</sup> Cognitive function and a delay in cognition has been shown with physical exercise. Possible mechanisms for the positive effect include improved brain perfusion from increased blood flow as well as exercise-induced production of growth factors which enhance neurogenesis.<sup>24</sup> Even though the positive effect of exercise on cognition and perception of well-being are known and accepted, the ideal therapy has yet to be found. Nocera et al. (2013) conducted a pilot investigation to determine if Tai Chi was effective in the improvement of non-motor symptoms in Parkinson's

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disease. Twenty-one patients with PD were randomized to either 60-minute Tai Chi sessions three times per week (n=15) or a non-contact control group (n=6), for 16 weeks. Before and after intervention measurements included indices of executive function with visuomotor tracking and selective attention, working memory, inhibition, processing speed and task switching.

Furthermore, participants were evaluated on the Parkinson's disease Questionnaire-39 and Tinetti's Falls Efficacy Scale. Outcomes indicated that the TC intervention group had impressively better results than the control group on the PDQ-39 as well as the emotional well-being subscore.<sup>25</sup> Markers for improvement were also seen for the Tai Chi group on Tinetti's Falls Efficacy Scale and the ADL and communication subscores of the PDQ-39. In this pilot study, Tai Chi was effective at lowering the decline of the patients' perceptions of their disease-related quality of life as reflected in the PDQ-39 total score. The control group experienced a significant deterioration in their perception of disease related quality of life perception.

*Exercise adherence.* A vital component to executing any exercise routine is to ensure adherence which can be motivated by individual perception of their disease process. Li et al 2014 conducted a randomized controlled trial with 195 participants with 176 (90%) completing assigned interventions (Tai Chi, n=56, resistance training, n=59, stretching, n=61) and 185 (95%) provided complete data on the outcome measures (Tai Chi, n=61, resistance training, n=62, and stretching, n=62). The intervention lasted 24 weeks with no major changes in antiparkinsonian medications. Two determinants measuring perceived benefits ascribed to exercise participation were used: the shortened version of the Parkinson's Disease Questionnaire (PDQ-8) and the Vitality Plus Scale (VPS). Clinical improvement in the PDQ-8 and statistically meaningful change scores for VPS were found in the TC group. Furthermore, after conclusion of the 6-month trial, 123 study participants (62%) reported that they continue to exercise during the 3-month follow-up. Significantly more individuals in the TC group (n = 47) than for either resistance training (n = 41) or stretching (n = 35) conditions continued the exercise.<sup>26</sup>

Belief of positive effects of health outcomes from participating in Tai Chi improved to a clinically pertinent degree in individuals with Parkinson's disease. These patient-reported results appear to be notably associated with adherence to exercise. In short, how patients view the benefits of an exercise intervention may be more significant in motivating them to continuing exercising than their actual clinical status. These results suggest the need to accentuate improving participant



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perceptions of health benefits to make the most of the positive effect of exercise interventions through continuous participation.

### CONCLUSION

Parkinson's disease (PD) is a progressive neurodegenerative disorder that results in motor and non-motor disability. Without therapy, PD progresses to a stiff, akinetic condition in which patients are not able to care for themselves. Complications of immobility may result in death due to aspiration pneumonia and pulmonary embolism.<sup>1</sup> Unfortunately, recurrent falls are associated with PD with a reported 60.5% patients experiencing at least one fall and 39% experiencing frequent falls.<sup>27</sup> Falls may lead to loss of mobility, decline in function, depressive symptoms, and a decrease in the quality of life. Fractures secondary to falls are the second most common reason leading to hospital admissions for PD patients.<sup>28</sup>

There is increasing awareness of the importance of both motor and non-motor disability associated with PD, and how these symptoms can be intimately linked. Practitioners who take care of patients with PD are increasingly cognizant of the interplay of motor and non-motor complications and the impact on their quality of life. Western medicine emphasizes the management of each symptom separately with motor and non-motor dysfunction addressed one at a time. A patient may receive a medication for PD-associated tremor, another for depression, and yet another for insomnia. An alternative approach incorporated by complementary alternative medicine therapies, is to focus therapy on individual wellness premised on mindfulness and mind-body therapies.

Research on the effects of Tai Chi exercise on gait dysfunction and postural instability in individuals with PD has produced hopeful results, albeit, with small sample sizes. Methodology in a significant number of studies were found to be flawed in that the nature of the intervention prohibited blinding to the research subjects although evaluators were appropriately blinded. Furthermore, with inconsistencies in the length of intervention, it is difficult to determine whether or not additional improvement of symptoms would have been gained with longer Tai Chi exercise. Nonetheless, Tai Chi may be considered an alternative practice that addresses the motor and non-motor dysfunction in PD concurrently.

With increased prevalence of Parkinson's disease and interest in non-traditional therapies, Tai Chi offers a creative, effective, safe non-pharmacological method aimed at improving balance

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and having a positive impact on patients' perception of quality of life. Based on current data, Tai Chi is a mind-body intervention that is an effective form of exercise that is likely to foster adherence and reduce disability associated with Parkinson's disease.

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Figure 1. (source unknown)

