

Therapeutic Benefits of Tai Chi Exercise: Research Review

Alice M. Kuramoto, PhD, RN, BC, FAAN

INTRODUCTION

Tai Chi is the popular abbreviation for T'ai Chi Chuan (pronounced "tie chee chuwan") and is translated as "The Supreme Ultimate Boxing System." Tai Chi began as a martial art form. It is an ancient Chinese exercise consisting of slow, relaxed movements for total self-development; for the body it is an exercise, for the mind it is a study in concentration, for the soul, it is a system of spiritual meditation.¹ There are many styles of Tai Chi and each style has its own form. All styles of Tai Chi are usually done in a standing position and can be performed either as a solo or 2-person exercise. Each Tai Chi movement is a series of coordinated sequences. It is often called "meditation in motion," since it is performed with total concentration and inner stillness. This inner calm within the movement improves the flow of qi (pronounced "chee"), the vital life energy that Chinese philosophy believes sustains and improves health.²

Tai Chi is also a preventative and curative branch of Chinese medicine. Since ancient times, Tai Chi practitioners have declared a number of beneficial health effects. Tai Chi appears to be safe and effective in promoting balance, flexibility, and cardiovascular fitness in older patients with chronic conditions.³ This article will review some of the research studies on Tai Chi and the health outcomes.

A systematic review of reports on the physical and psychological effects of Tai Chi on various chronic medical conditions was conducted by Wang, Collet, and Lau.⁴ A computerized search of 11 English and Chinese databases was done. Data were extracted for the study objective, population characteristics, study setting, type of Tai Chi intervention, study design, outcome assessment, duration of follow-up, and key results. There were 9 randomized controlled trials, 23 nonrandom-

ized controlled studies, and 15 observational studies in the reviews. It was concluded that Tai Chi appears to have physiological and psychosocial benefits and also appears to be safe and effective in promoting balance control, flexibility, and cardiovascular fitness in older patients with chronic conditions.

PAIN REDUCTION

Lam,⁵ a physician and Tai Chi master, designed a Tai Chi program for people with arthritis. This Tai Chi program was used in a research study conducted by Song, Lee, Lam, and Bae⁶ and was one of few studies that explore the potential effects of relatively new intervention to manage arthritis symptoms. A randomized study examined the changes in pain, balance, muscle strength, and physical functioning in older osteoarthritis patients at the completion of a 12-week Tai Chi program. The 72 women with osteoarthritis were assigned randomly to 2 groups: 38 women performed Tai Chi exercise for 12 weeks, while the other 34 women received only the standard treatment at the outpatient clinic. Compared to the control group, the Tai Chi group had 35% less pain, 29% less stiffness, 29% more ability to perform daily tasks (like climbing stairs), as well as improved abdominal muscles and better balance. The control group reported no change or even worse physical functioning. No significant group differences were found in flexibility and upper body or knee muscle strength in the post-test scores. It was concluded that older women with osteoarthritis were able to safely perform the Tai Chi exercise for 12 weeks, and this was effective in improving their arthritic symptoms, balance, and physical functioning. A longitudinal study with a larger sample size is now needed to confirm the potential use of Tai Chi exercise in arthritis management.

IMPROVED BALANCE AND FALL PREVENTION

The National Institute on Aging sponsored 2 studies on Tai Chi for older people. The Frailty and Injuries: Cooperative Studies of Intervention techniques

Dr Kuramoto is a professor emeritus at the University of Wisconsin-Milwaukee College of Nursing. Please address correspondence to: Alice M. Kuramoto, PhD, 933 W Heritage Ct. #109, Mequon, WI 53092; e-mail alicek@uwm.edu.

(FICSIT) were conducted at Emory University and the University of Connecticut. These were the first studies involving Tai Chi in a special frailty reduction program. This initiative was launched in 1990 to improve physical function in old age. The first study, conducted by Wolf and colleagues⁷ at the Emory University School of Medicine, found that older people taking part in a 15-week Tai Chi program reduced their risk of falling by 47.5%. Regular Tai Chi practice can reduce falls in the elderly or those with balance disorders. A total of 200 participants (162 women and 38 men, mean age of 76.2 years) were in the prospective, randomized, controlled clinical trial. The objective of the study was to evaluate the effects of 2 exercise approaches—Tai Chi and computerized balance training—on biomedical (strength, flexibility, cardiovascular endurance, body composition), functional, and psychosocial indicators of frailty and occurrence of falls. The results showed that Tai Chi had a favorable impact on defined biomedical and psychosocial indices, reduced falls, lowered blood pressure, and reduced fear of falling. It is also important to note that Tai Chi is a low technological, inexpensive group activity, whereas the computerized balance approach relied on an expensive, high technological approach performed individually.

The second FICSIT study was conducted at the University of Connecticut Health Center, using sophisticated techniques for measuring balance and strength training. Wolson and colleagues⁸ found several interventions to improve balance and strength among older people. These improvements, particularly in strength, were preserved over a 6-month period while participants did Tai Chi exercise. One hundred ten healthy community dwellers (mean age 80) were evaluated to determine the effect on balance and strength training gains over 3 months, followed by Tai Chi maintenance. The primary goal of the study was to determine the feasibility and effectiveness of 3 months of high intensity strength and/or balance training in improving balance of older community dwellers free of clinically detectable disease that would affect balance. A secondary objective was to assess whether improvements in balance and strength could be maintained for 6 months through a program of reduced intensity training in the form of weekly Tai Chi classes.

Unlike previous studies, this study incorporated all of the following: (1) a 2 X 2 randomized controlled trials design to factor out the relative contributions of 3 months of intensive balance and/or strength training; (2) inclusion-exclusion criteria based on medical history and physical examination; (3) blinded testing; (4) repli-

cable and defined intervention methodology; and (5) a reduced intensity 6-month group balance and strength maintenance on a Tai Chi program.

The design was randomized control interventions with 4 groups: (1) balance training, (2) strength training, (3) balance plus strength training, and (4) education controls. All subjects then received long-term group Tai Chi instruction (1 hour, 1 time/week over 6 months).

The intervention protocol consisted of balance training of 3 45-minute training sessions per week, with each session divided into “platform” (center of pressure biofeedback equipment) and “non-platform” (exercises on foam or firm surfaces). The strength training consisted of 3 supervised, 45-minute exercise sessions per week, which consisted of a combination of sandbag/bodyweights with the lower extremities and resistive machines. Subjects in the balance plus strength training completed 45 minutes of balance and 45 minutes of resistance training 3 times per week. Balance exercises were always performed first, with a 5-minute rest between the balance and resistance sessions. The educational control group subjects were encouraged to continue their usual activities. All 4 groups participated in an educational component consisting of 5 90-minute sessions dealing with fall prevention and stress management.

The balance intervention improved 3 aspects of balance function (losses of balance during sensory organization testing, single stance time, and voluntary limits of stability). Resistance training increased isokinetic torque of 8 lower extremity movements and single stance time. The Tai Chi maintenance program sustained improvements in balance and strength for 6 months after the intervention. This study demonstrated that relatively healthy older people can realize meaningful short-term gains in balance and strength by means of a high-intensity, laboratory-based training program and can sustain those gains through a low-intensity maintenance program of Tai Chi practice.

Tsang and Hui-Chan⁹ studied the joint proprioception and balance control during weight shifting. The objective of the study was to examine whether experienced golfers had attained similar improvement when compared with Tai Chi practitioners, as well as healthy elderly subjects and young university students. The subjects included 12 experienced elderly Tai Chi practitioners, 11 experienced elderly golfers, 12 healthy elderly subjects, and 12 young university students, all male, and used: 1) passive knee joint repositioning tests to assess their joint proprioceptive acuity and 2) limits of stability tests to assess their ability to voluntarily weight shift

within their base of support. The results showed that both Tai Chi practitioners and golfers had better knee joint proprioceptive acuity than did the elderly control subjects ($P<0.05$). Of special interest is that their performance was similar to that of the young subjects. In the limits of stability test, Tai Chi practitioners and golfers had faster reaction time, leaned further without losing stability, and showed better control of leaning trajectory than did elderly control subjects (all $P<0.05$). The latter 2 outcome measures were also comparable to those of the young subjects.

Scientists at the Oregon Research Institute studied Tai Chi and fall reductions in older adults. Li, Harmer, Fisher, and colleagues¹⁰ concluded that a 3-times-per-week, 6-month Tai Chi program is effective in decreasing the number of falls, the risk for falling, and the fear of falling; and it improves functional balance and physical performance in physically inactive persons. This was a randomized controlled trial involving a sample of 256 physically inactive, community-dwelling adults aged 70 to 92 (mean age, 77.48 years) who were recruited through a patient database in Portland, Ore. Participants were randomized to participate in a 3-times-per-week Tai Chi group or to a stretching control group for 6 months. The primary outcome measure was the number of falls; the secondary outcome measures included functional balance (Berg Balance Scale, Dynamic Gait Index, Functional Reach, and single-leg standing), physical performance (50-foot speed walk, Up&Go), and fear of falling, assessed at baseline, 3 months, 6 months, and at a 6-month post-intervention. After adjusting for baseline covariates, the risk for multiple falls in the Tai Chi group was 55% lower than that of the stretching control group. Compared with the stretching control participants, the Tai Chi participants showed significant improvements ($P<.001$) in all measures of functional balance, physical performance, and reduced fear of falling.

IMPROVED AEROBIC CAPACITY

Taylor-Piliae and Froelicher¹¹ did a meta-analysis of several studies to estimate the effect of Tai Chi exercise on aerobic capacity. A computerized search of 7 databases was done using key words and all languages, with a result of 441 citations obtained. Only 7 focused on aerobic capacity in response to Tai Chi exercise (4 experimental and 3 cross-sectional). Older adults, including those with heart disease, participated ($n=344$ subjects); on average men were aged 55.7 years and women 60.7 years. Average effect size for the cross-sectional studies was large and statistically significant, while in

the experimental studies the average size was small and not significant. Aerobic capacity in women was greater than those for men, though not statistically significant. Aerobic capacity was higher in subjects performing a 52-week Tai Chi exercise intervention, compared with sedentary subjects. This meta-analysis suggests that Tai Chi may be an additional form of aerobic exercise.

The research team at the Division for Research Education in Complementary and Integrative Medical Therapies at Harvard Medical School examined the effects of a Tai Chi program on the quality of life and exercise capacity in patients with heart failure.¹² Thirty patients with chronic stable heart failure and left ventricular ejection fraction were randomly assigned to receive usual care, which included pharmacologic therapy and dietary and exercise counseling, or 12 weeks of Tai Chi training in addition to usual care. Tai Chi training consisted of a 1-hour class held twice weekly. Patients in the Tai Chi group showed improved quality of life scores, increased distance walked in 6 minutes, and decreased serum B-type natriuretic peptide levels compared with patients in the control group. No differences were detected in catecholamine levels.

BLOOD PRESSURE REDUCTION

Channer and colleagues¹³ conducted a study on myocardial infarction patients and the changes in hemodynamic parameters following Tai Chi and aerobic exercise. Three weeks after they were discharged from the hospital, a sample of 126 patients (90 males, average age 56 years, range 39-80) were randomly divided into 3 groups: Tai Chi (38), aerobic exercise (41), and a non-exercise support group (47). Patients attended sessions twice weekly for 3 weeks, then weekly for an additional 5 weeks. Heart rate and blood pressure were recorded before and after each session. At 11 weeks post-discharge, diastolic blood pressure had decreased only in the Tai Chi group ($P<.01$). Significant reductions in systolic blood pressure occurred in both exercise groups (both $P<.05$) compared to a control support group.

IMPROVED QUALITY OF LIFE

In 2004, Klein and Adams¹⁴ did a literature review in physical rehabilitation regarding comprehensive therapeutic benefits of Tai Chi exercise. Over 200 published reports were examined, 17 controlled clinical trials were judged to meet a high standard of methodological rigor. Controlled research evidence was found to confirm therapeutic benefits of Tai Chi exercise with regard to improving quality of life, physical function including activity tolerance and cardiovascular function,

pain management, balance and risk of falls reduction, enhancing immune response, and improving flexibility, strength, and kinesthetic sense.

STRESS REDUCTION

Sandlund and Norlander¹⁵ reviewed research studies concerning the role of Tai Chi in stress management and well being, linking those studies to research on exercise, yoga, and relaxation with regard to physiological and psychological wellness. All studies reported in PsychLit and Medline between 1996 and 1999 were reviewed. These studies revealed that Tai Chi may enhance flexibility and overall psychological well-being. Cognitively, there are indications that Tai Chi exercise may lead to improvements in mood. However, it was not clear whether the positive effects of Tai Chi are due solely to its relaxation and meditation component, or whether they are the consequence of various peripheral factors, since it is known that stress reduction often occurs when we indulge in activities we find pleasurable and satisfying. An important finding is that all studies on the benefits of Tai Chi for senior adults have revealed positive results.

IMPROVED SLEEP QUALITY

A randomized controlled trial on 118 women and men aged 60-92 was conducted to determine the effectiveness of Tai Chi on self-rated sleep quality and daytime sleepiness in older adults. The participants were randomized into a Tai Chi or low impact exercise group for 1-hour sessions, 3 times per week over 6 months. Primary outcome measures were the 7 subscales of the Pittsburgh Sleep Quality Index (PSQI), PSQI global score, and Epworth Sleepiness Scale (ESS). Secondary outcome measures were physical performance (single leg stand, timed chair rise, 50-foot speed walk) and 12-item short form (SF-12) physical and mental summary scores. It was concluded that older adults with moderate sleep complaints can improve self-rated sleep quality through a 6-month, low to moderate intensity Tai Chi program.¹⁶ Tai Chi participants reported sleep onset latency of about 18 minutes less per night and sleep duration of about 48 minutes more per night than low impact exercise participants. Tai Chi participants also showed better scores in secondary outcome measures than low-impact exercise participants. Both groups reported improvements in SF-12 mental summary scores.

INCREASED STRENGTH

The University of Vermont Physical Therapy researchers designed a cross-sectional study to compare

isokinetic strength of leg muscles and foot center of pressure (COP) as a measure of sway between long-term Tai Chi practitioners and controls.¹⁷ Twenty subjects in the Tai Chi group had practiced Tai Chi for a minimum of 3 years and the 19 subjects in the control group (age >55 years) had no Tai Chi experience. The results showed that the Tai Chi group had significantly higher knee extensor strength at all speeds tested and smaller foot COP excursions for both eyes open and eyes closed conditions than the control group. These findings support the hypothesis that the maintenance of eccentric strength of postural muscles in the lower extremities is helped through the long-term practice of Tai Chi.

SUMMARY

The majority of studies on Tai Chi conducted between 1996 and 2004 had focused on health and well being of Tai Chi exercise for senior adults. The results show that Tai Chi may lead to improved balance,⁴⁻⁹ reduced fear of falling,^{7,10} increased strength,^{6,8,18} increased functional mobility,^{6,7,12,14} greater flexibility,^{4,7,15} and increased psychological well-being,^{11,15} sleep enhancement for sleep disturbed elderly individuals,¹⁶ and increased cardio functioning.^{4,10-12} Wang, Collet, and Lau⁴ did a systematic review on Tai Chi research and found some limitations or biases existing in some of the studies, and it was difficult to draw firm conclusions about the benefits reported. Therefore, more well-designed studies are needed in the future.

There need to be studies on the effects on younger and middle-aged people. More longitudinal studies are needed, since time is an important factor of physical and psychological interventions. Studies on the effects of Tai Chi on the immune system and bone loss reduction are still very exploratory and will be especially useful for arthritis patients and others with immune disorders. Future studies should investigate outcomes associated with Tai Chi training as a function of different instructional techniques, different Tai Chi styles, different diagnostic groups, and different age groups.

It is not yet clear which of the components in Tai Chi makes the exercise form especially effective for seniors. Tai Chi exercise is a relatively "low tech" approach to preventing disability and maintaining physical performance in older adults. The positive effects of Tai Chi may be due solely to its relaxing, meditative aspects. The current data suggest that Tai Chi can influence older individuals' functioning and well being and provide some appreciation for why this exercise form has been practiced by older Chinese for more than 3 centuries.

REFERENCES

1. Galante L. *Tai Chi The Supreme Ultimate*. York Beach, Maine: Samuel Weiser, Inc.;1990:13.
2. Cohen KS. *Qigong: The Art and Science of Chinese Energy Healing*. New York: Ballantine Books; 1997:3.
3. Kirsteins A, Dietz M, Hwang S. Evaluating the safety and potential use of weight-bearing exercise, tai-chi chuan, for rheumatoid arthritis patients. *Am J Phys Med Rehabil*. 1991;70(3):36-141.
4. Wang C, Collet JP, Lau J. The effect of Tai Chi on health outcomes in patients with chronic conditions: a systematic review. *Arch Intern Med*. 2004;164(5):493-501.
5. Lam P, Horstman J. *Overcoming Arthritis: How to Relieve Pain and Restore Mobility Through a Unique Tai Chi Program*. New York: DK Publishing, Inc.; 2002.
6. Song R, Lee EO, Lam P, Bae SC. Effects of tai chi exercise on pain, balance, muscle strength, and perceived difficulties in physical functioning in older women with osteoarthritis: a randomized clinical trial. *J Rheumatol*. 2003;30(9):2039-2044.
7. Wolf S, Barhard H, Kutner N, et al. Reducing frailty and falls in older persons: an investigation of Tai Chi and computerized balance training. *J Am Geriatr Soc*. 1996;44:489-497.
8. Wolfson L, Whipple R, Derby C, et al. Balance and strength training in older adults: intervention gains and Tai Chi maintenance. *J Am Geriatr Soc*. 1996;44:498-506.
9. Tsang WW, Hui-Chan CW. Effects of exercise on joint sense and balance in elderly men: Tai Chi versus golf. *Med Sci Sports Exerc*. 2004;36(4):658-667.
10. Li F, Harmer P, Fisher, et al. Tai Chi and fall reductions in older adults: a randomized controlled trial. *J Gerontol A Biol Sci Med Sci*. 2005;60(2):187-194.
11. Taylor-Piliae RE, Froelicher ES. Effectiveness of Tai Chi exercise in improving aerobic capacity: a meta-analysis. *J Cardiovas Nurs*. 2004;19(1):48-57.
12. Yeh GY, Wood MJ, Lorell BH, et al. Effects of Tai Chi mind-body movement therapy on functional status and exercise capacity in patients with chronic heart failure: a randomized controlled trial. *Am J Med*. 2004;117(8):611-612.
13. Channer KS, Barrow D, Barrow R, et al. Changes in hemodynamic parameters following Tai Chi chuan and aerobic exercise. *Postgrad Med J*. 1996;72:347-351.
14. Klein PJ, Adams WD. Comprehensive therapeutic benefits of Taiji: a critical review. *Am J Phys Med Rehabil*. 2004;83(9):735-745.
15. Sandlund E, Norlander T. The effects of Tai Chi chuan relaxation and exercise on stress responses and well-being: an overview of research. *Internat J Stress Manag*. 2000;7(2):1-18.
16. Li F, Harmer P, Fisher, et al. Tai Chi and self-rated quality of sleep and daytime sleepiness in older adults: a randomized controlled trial. *J Am Geriatr Soc*. 2004;52(6):892-900.
17. Wu G, Zhao F, Zhou X, Wei L. Improvement of isokinetic knee extensor strength and reduction of postural sway in the elderly from long-term Tai Chi exercise. *Arch Phys Med Rehabil*. 2002;83(10):1364-1369.

Wisconsin Medical Journal

The mission of the *Wisconsin Medical Journal* is to provide a vehicle for professional communication and continuing education of Wisconsin physicians.

The *Wisconsin Medical Journal* (ISSN 1098-1861) is the official publication of the Wisconsin Medical Society and is devoted to the interests of the medical profession and health care in Wisconsin. The managing editor is responsible for overseeing the production, business operation and contents of the *Wisconsin Medical Journal*. The editorial board, chaired by the medical editor, solicits and peer reviews all scientific articles; it does not screen public health, socioeconomic or organizational articles. Although letters to the editor are reviewed by the medical editor, all signed expressions of opinion belong to the author(s) for which neither the *Wisconsin Medical Journal* nor the Society take responsibility. The *Wisconsin Medical Journal* is indexed in Index Medicus, Hospital Literature Index and Cambridge Scientific Abstracts.

For reprints of this article, contact the *Wisconsin Medical Journal* at 866.442.3800 or e-mail wmj@wismed.org.

© 2006 Wisconsin Medical Society