STATE OF THE ART
REVIEWS

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Clinical Implications of Tai Chi Interventions: A Review

Abstract: *Tai Chi, a Chinese body-mind exercise, has been used in China for thousands of years for both prevention and therapeutic purposes. In the 1990s, the Western research community started to examine the effectiveness of Tai Chi interventions using scientific research design and standardized outcome measures. A number of reviews of these studies have been published. Based on an extensive literature search, this state-of-the-art review identified 25 such reviews published since 2000, provides a description of them, and summarizes what was learned from these reviews. Although there is still a need to understand more about Tai Chi interventions, especially Tai Chi's mechanism, it is concluded that Tai Chi is a very useful exercise format that can be used for a variety of chronic disease conditions. It requires no equipment and little space, and it can be practiced anytime, anywhere, and by older adults and individuals with chronic diseases. Since short forms (eg, 10 or 24 forms) have been shown to have similar benefits as longer ones, beginners should start using simple, short forms first. Like other exercise interventions, regular practice is a must to be able to gain maximal benefits. Tai Chi can be used safely as a complementary addition to conventional medical treatment, physical therapy, and rehabilitation, as well as with other exercise interventions.*

Keywords: Tai Chi; effectiveness of intervention; health outcomes; disease conditions; evidence-based reviews

Tai Chi, or more correctly Tai Chi Chuan (or *Tai Ji Quan*, using the current Chinese spelling system), is a Chinese body-mind exercise with a long and rich history. The *Tai Chi* characters in Chinese represent the Taoism or Tao philosophy, which believes that while the world is full of contrast or conflicts, it can reach harmony by balancing these contrasts or conflicts. The nature forces or rules that lead to harmony are the Tao or "way." The Tao and Tai Chi are often symbolized by a circle with 2 semicircular teardrop shapes, half white representing Yang (sun, male, fire, etc) and half black representing Ying (moon, female, water, etc; see Figure 1). Note that there is a black spot inside of the white shape and, similarly, there is a white spot inside of the black shape, which means that Yin and Yang are not absolute and they can change toward each other's direction. Together, the symbol represents the balance and change within the universe, nature, or even society. *Chuan* in Chinese means "fist," or boxing in this context. Thus, Tai Chi Chuan is in fact a boxing or martial art originally developed for self-defense. It is, however, unique because it integrates a Taoist philosophy in its principles and movements; for example, body weight is concentrated on one leg when Tai Chi Chuan practice begins, but it constantly transfers from one leg to the other.[1] To be consistent with the terms used in the literature, *Tai Chi* will be used throughout the text to represent "Tai Chi Chuan."

> "...the interest in Tai Chi and its health benefits has grown and continues to grow rapidly."

Although there are many different theories or beliefs about how Tai Chi was invented, it is generally believed that it was developed by Mr Wang-Ting Chen (17th century), a military officer during the later part of the Ming Dynasty (1368-1644 AD). Thereafter, it was passed

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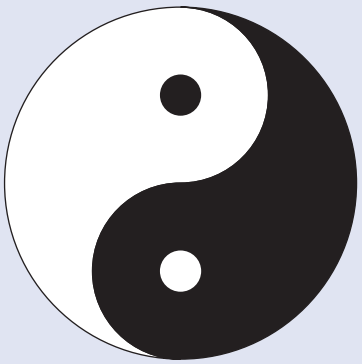
Figure 1.
Tai Chi Symbol.



within the Chen family for many generations in the Chen Village in He Nan Province in China until Mr Chang-Xing Chen (1771-1853 AD), a 14th-generation Chen, taught Tai Chi to Mr Lu-Chan Yang, a person outside of the Chen family.[1] Eventually, through Mr Yang and his students' teaching and promotion, Tai Chi became popular in China, and other styles of Tai Chi, namely, Yang, Sun, and Wu(s), gradually developed. More importantly, people started to practice it for health purposes rather than fighting or self-defense. In 1956, in a major national effort, the Chinese government promoted Tai Chi by simplifying the long form of Yang style into a short 24 forms/movements, resulting in making it the most popular exercise format in China. Today, millions of people in China practice Tai Chi in parks or other open spaces every morning.

Tai Chi was introduced to the United States in the 1970s, when it was practiced by only a very small group of individuals until the publication of a study in 1996 by Dr Steven L. Wolf and his colleagues at the Emory University School of Medicine, Atlanta, Georgia. In that seminal study, they divided 162 women and 38 men with an average age of 76 years, who were free of debilitating conditions such as crippling arthritis, Parkinson disease (PD), or stroke, into 3 groups. One group was given a simplified, 10-form version of Tai Chi's more than 100 movements, one group got biofeedback-based training in balance on a movable platform, and one group received education about falls but no physical training. The Tai Chi and biofeedback groups were given 15 weeks of training, and researchers kept track of participant-reported incidences of falling over 4 months. It was found that after the intervention, participants in the Tai Chi group reduced their falling risk an average 47.5% more than the other groups. Since the publication of this study, the interest in Tai Chi and its health benefits has grown and continues to grow rapidly. Hundreds of studies have been published, and interest has extended to many other health areas, such as the impact of Tai Chi on physical function, quality of life, and reducing risks of falling, cardiovascular diseases (CVDs), and so forth. In addition, many Tai Chi–related books have been published, including a few with a research focus.[2] The purpose of this article is to provide a state-of-the-art review on the clinical implications of Tai Chi interventions. Instead of conducting another scientifically meticulous review, which has been already well reported in the literature, this article focuses on a summary of these well-done reviews published since 2000.

How the Reviews Were Identified and Selected

The reviews reported in this study were identified through extensive searches in a number of major medical and exercise science research literature search engines (eg, Academic Onefile, CINAHL, EBSCO, ERIC, Health Source, Medline, PsycINFO, Science Direct, Sportdiscus, Scopus, Web of Science, as well as Google Scholar). The keywords used included *Tai Chi*, *Tai Chi Chuan*, *Tai Ji*, *Tai Ji Chuan*, and so forth. Only reviews published in the year 2000 or later were included and examined. Based on the articles found, additional cross-reference searches were conducted. A total of 32 reviews were identified. To ensure that the findings were evidence based, only the reviews based on some type of scientific procedures, in which randomized clinical trials or controlled clinical trials were the focus of the review, were selected for this review. As a result of this culling, 25 reviews were included, described, and summarized in this study.

What We Have Learned From These Reviews

Summaries of these included reviews[3-27] are illustrated in Tables 1 and 2, respectively, by author, publication year, type of review, databases searched, studies finally reviewed, subjects studied, quality rating (Table 1), review focus, Tai Chi intervention dose, outcome measures, and major findings (Table 2). It should be pointed out that although most of these reviews had a focused interest, many studies were cross-reviewed in these reviews.

In the follow sections, these reviews will be described in a little more detail according to their health focuses. After providing a description of these reviews with a focus on overall health, the reviews will further be described according to diseases. Those with strong evidence will be described first including overall health, balance and control, falling, PD, osteoarthritis, rheumatoid arthritis, and psychological benefits. Then, diseases with moderate evidence, including blood pressure, cancer, CVD, and diabetes, will be described. Note that strong or moderate evidence is operationally defined by the authors based on the number of studies employed in the review and the quality of research articles used in the review. Thereafter, 2 meta-analyses on the effectiveness of Tai Chi interventions on aerobic capacity will be described. Finally, a recent review on clinical trials of both Tai Chi and Qigong for older adults will be described.

Overall Health

Klein and Adams[7] critically reviewed the overall benefits of Tai Chi interventions. Seventeen studies that were either randomized controlled trials or controlled clinical trials judged to be of high rigor were selected for review, and the results produced many possible benefits from practicing Tai Chi. Seven studies produced results, indicating Tai Chi's beneficial effects on quality of life, mood, and/or stress. Other studies produced

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Table 1.

Summary of Characteristics of Reviews Included

Authors (year)	Type of Review	Databases Searched			Studies Finally Reviewed			Subjects Studied			Quality Rating
		No.	Language(s)	Studies Identified	No.	Year Range	Type	No.	Age Range	Health Status	
Chan et al (2000)[3]	Meta-analysis	4	English	NR	7	1992-1997	Mixed	481	20-80 y	Mostly healthy	Yes, 18-item rating scale
Wu (2002)[4]	Systematic review	1	English	24	Total = 16; intervention = 11; cross-section = 3; other = 2	1982-2000	Mixed	Intervention = 293; cross-section = 104; other = 111	20-92 y; 65-86 y; >75 y	Faller/mild balance disorder/ healthy; healthy; faller/ healthy	No
Komagata and Newton (2003)[5]	Systematic review and meta-analysis	4	English	40	11	1992-2000	Mixed	358 (without meta-analysis)	NR	NR	Yes, 25-item checklist
Han et al (2004)[6]	Meta-analysis	5	English and Chinese	4	4	1987-1999	RCT/CCT	206	Adult	RA	Yes, a quality scale
Klein and Adams (2004)[7]	Critical review	2	English	>200	17	1990-2003	CCT	1035	Adults and older adults	>80% were nonclinical populations	Yes
Taylor-Piliae and Froelicher (2004)[8]	Meta-analysis	7	English	15 (of 441 citations)	7	1991-1999	Mixed	344	30-69.5 y	Sedentary and healthy	Yes
Verhagen et al (2004)[9]	Systematic review	3	English	31	7	1996-2001	CCT, RCT	505	53-96 y	Except for 27, all were healthy seniors	Yes

(continued)

Table 1. (continued)

Authors (year)	Type of Review	Databases Searched			Studies Finally Reviewed			Subjects Studied			Quality Rating
		No.	Language(s)	Studies Identified	No.	Year Range	Type	No.	Age Range	Health Status	
Wang et al (2004)[10]	Systematic review	11	English and Chinese	64 (from 743 abst)	47	1979-2001	Mixed	2762	7-80 y	Healthy and patients	Yes
Wayne et al (2004)[11]	General review	2	English	24	24	1966-2002	Mixed	1141	20-86 y	Healthy, osteoarthritis, RA, balance disorder, multiple sclerosis	NR
Mansky et al (2006)[12]	General review	4	English	62	20	1995-2006	RCT	2119	Older adults 60-97 y	Healthy and patients	Only RCTs were included
Dechamps et al (2007)[13]	Systematic review	6	English	NR	14	1990-2006	Mixed	829	12-96 y	Mostly healthy	Yes
Lee et al (2007)[14]	Systematic review	14	No restriction	27	4	2003-2006	RCT/CCT	115	30-78 y	Breast cancer (stage 0-IV)	Yes
Lee et al (2007)[15]	Systematic review	22	No restriction	45	5	1991-2006	RCT/CCT	217	NR	RA patients	Yes
Lee et al (2007)[16]	Systematic review	11	No restriction	164	9	1996-2006	RCT	866	Adult	Patients with hypertension, stroke, type 2 diabetes	Yes
Wayne et al (2007)[17]	Systematic review	4	English	9	6	2002-2005	Mixed	425	43.9-67 y	Postmenopausal and community-dwelling women	Yes

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Table 1. (continued)

Authors (year)	Type of Review	Databases Searched			Studies Finally Reviewed			Subjects Studied			Quality Rating
		No.	Language(s)	Studies Identified	No.	Year Range	Type	No.	Age Range	Health Status	
Harling and Simpson (2008)[18]	Systematic review	7	English	97	7	1996-2006	RCT	1146	70.4-84 y	Healthy and with fall risks	Yes
Lee et al (2008)[19]	Systematic review	21	No restriction	11	7	1997-2007	Mixed	130	NR	Parkinson disease	Yes
Lee et al (2008)[20]	Systematic review	18	No restriction	181	12	2000-2007	RCT/CCT	1186	NR	Osteoarthritis	Yes
Lee et al (2008)[21]	Systematic review	>10	No restriction	471	5	2003-2007	RCT/CCT	539	NR	Type 2 diabetes	Yes
Lee et al (2008)[22]	Systematic review	20	No restriction	31	7	2004-2007	RCT/CCT	1071	49-79.4 y	Postmenopausal women and older adults	Yes
Taylor-Piliae (2008)[23]	Meta-analysis	7	English	41	14	1993-2006	Mixed	645	30-73.5 y	Mostly healthy, community-dwelling adults	Yes
Yeh et al (2008)[24]	Systematic review	10	English and Chinese	829 in English; 859 in Chinese	26	1985-2006	Mixed	1935	20-81 y	Hypertension, coronary artery disease, and healthy	Yes
Low et al (2009)[25]	Systematic review	5	English	345	7	1996-2007	RCT	1972	68.2-84.9 y	Mostly healthy older adults	Yes
Yeh et al (2009)[26]	Systematic review	11	English and Chinese	841 in English; 859 in Chinese	29	1981-2007	Mixed	1652	40-80 y	Coronary heart disease, heart failure, CVD, CVDRF	Yes, a quality-grading system
Rogers et al (2009)[27]	Systematic review	4	English	NR	36	1993-2007	RCT	3749	60-82 y	Sedentary, with diseases and healthy	No

Abbreviations: CCT, controlled clinical trial; CVD, cardiovascular disease; CVDRF, cardiovascular disease with risk factors; NR, not reported; RA, rheumatoid arthritis; RCT, randomized clinical trial.

Table 2.

A Summary of Tai Chi Interventions and Findings

Authors (year)	Focus	Tai Chi Dose				Outcome Measures	Major Findings
		Style	Frequency, time/wk	Duration	Length		
Chan et al (2000)[3]	Balance and postural control	NR	NR	NR	NR	Static conditions; internal perturbations; external perturbations	Tai Chi is more effective to internal perturbations than external perturbations or static conditions; research-based evidence = moderate; no optimal dose can be determined
Wu (2002)[4]	Balance/fall	Most used Yang, but different forms/ modifications	Intervention: 1-7; cross-section = NR; other = 1-7	NR	Intervention: 8-24 wk; cross-section = 0-35 y; other = 24 wk to 2.5 y	Self-report; functional measures; lab-based balance measures	Tai Chi has a positive effect on reduction of risk and fear of falling, even with 15-wk intervention; people with mild balance problems benefited more from Tai Chi intervention; there is modest evidence to support that Tai Chi may help improve general health and physical function; length (8-16 wk) of most interventions may be too short
Komagata and Newton (2003)[5]	Balance in older adults	NR	NR	NR	NR	Static balance; internal perturbations balance; external perturbations balance	Tai Chi could improve balance, especially on internal balance perturbations; effectiveness for fall reduction to be determined; compliance and randomizing the assignments are concerns
Han et al (2004)[6]	Effectiveness and side effects of Tai Chi for treating RA	Yang short form	1-7	60-90 min	8-10 wk	Function; tender and swollen joints; range of motion; strength; exercise enjoyment; adherence	Tai Chi does not exacerbate symptoms of RA; significant benefits on lower extremity range of motion, especially ankle range of motion; effect on pain should be examined in the future
Klein and Adams (2004)[7]	Comprehensive therapeutic benefits	Most used simplified Yang	1-3	<15 min to >1 h	6 wk to 12 mo	QOL; physical function; pain; blood pressure; balance; immune response; flexibility; strength; kinesthetic sense	Controlled research evidence confirmed therapeutic benefits of Tai Chi practice on all major outcomes examined; Tai Chi intervention is feasible for a variety of clinical populations

(continued)

Table 2. (continued)

Authors (year)	Focus	Tai Chi Dose				Outcome Measures	Major Findings
		Style	Frequency, time/wk	Duration	Length		
Taylor-Piliae and Froelicher (2004)[8]	Aerobic capacity	Yang 108 form or simplified Yang	3-5	45-60 min	12-52 wk/ cross-sectional	VO_2 max	Tai Chi is an aerobic exercise; long form and 1-y intervention brought greatest benefits
Verhagen et al (2004)[9]	Older adults' fall prevention, balance, and CR functions	Most used modified Yang (10 to 24 forms)	1-7	30-60 min	10-52 wk	Balance; BP; QOL; CR function; physical function; psychological well-being; ROM	Tai Chi is effective in reducing falls and blood pressure; evidence is still limited
Wang et al (2004)[10]	Balance; hypertension; musculoskeletal condition; CR condition; psychological measures	Most used Yang; a few used Wu	1-7	5-90 min	8 wk to 20 y cross-sectional	Balance, stability, strength; arthritis scale, clinical symptoms; BP; VO_2 max, HR, ECG; depression, anxiety, stress, mood, story telling; testosterone, T-cell; physical function, skin blood flow	Tai Chi could bring physiological and psychological benefits; it is safe and effective in promoting balance control, flexibility, and CR fitness; mechanism of the benefits was still not understood
Wayne et al (2004)[11]	Postural control	Most used Yang	1-7	30-90 min	8 wk to 28 mo for intervention; 1-20 y for cross-section	Occurrence of falls; physical fitness; ROM; balance; ADLs/ IADLs; fear of falls	Tai Chi is useful for various nonvestibulopathy etiologic balance disorders; safe and has few side effects; a moderate aerobic, low-impact dynamic postural control intervention; most studied are need for the impact on peripheral vestibulopathy
Mansky et al (2006)[12]	CR disease; chronic disease and immunity; psychological benefits; possible impact on cancer survivors	NR	2-3	50-90 min	6 wk to 12 mo	CR fitness; lipid profiles; QOL; psychological well-being; pain; physical function; immune function; fall risk	Tai Chi may reduce fall risk, improve balance, cardiovascular conditions, physical function; may reduce pain in patients; may be beneficial for immune function; need more studies for patients with chronic illness; could be used to help cancer survivors

(continued)

Table 2. (continued)

Authors (year)	Focus	Tai Chi Dose				Outcome Measures	Major Findings
		Style	Frequency, time/wk	Duration	Length		
Dechamps et al (2007)[13]	Self-efficacy and psychological health	Most used Yang short forms	2-7	30-60 min	5-8 wk	Psychological measures (eg, POMS, STAI-Y, STAXI, etc); self-esteem; function (eg, ADL); lipid profile; QOL (eg, SF-36)	Tai Chi enhanced overall psychological well-being; improved self-efficacy and mood; more tangible for adults and healthy older adults; need more study for clinical populations
Lee et al (2007)[14]	Tai Chi as a supportive therapy for cancer patients	NR	1-3	50-60 min	6-12 wk	Fatigue; function measure; physical fitness/ROM; depression; QOL	Positive effect on self-esteem, walking distance, strength; insufficient evidence to support Tai Chi as an effective supportive treatment for cancer
Lee et al (2007)[15]	Effectiveness of Tai Chi for treating RA	NR	1-2	50-60 min	6-12 wk	Fatigue; ROM; depression and mood; function index; QOL	Tai Chi is effective in improving physical function, QOL, depression, and mood; collectively, the evidence of treating RA is not convincing
Lee et al (2007)[16]	CR disease and risk factors	NR	NR	NR	NR	BP; HR; lipid profile; VO_2 max/speed or distance walking; balance/gait speed/ mobility	Tai Chi led to a reduction in blood pressure; has some benefit in preventing or treating CVD; no adverse effects
Wayne et al (2007)[17]	BMD in postmenopausal women	NR	5/NR	45 min/NR	Intervention = 8-12 mo; cross-section = 3-5 y	BMD with DXA or pQCT; bone formation and resorption markers; strength; balance	May be an effective, safe, and practical intervention for BMD; positive impact on risk factors related to BMD; no adverse effects
Harling and Simpson (2008)[18]	Reducing falls and fear of falling in older adults	Yang or modified, or NS	1-7	60-90 min	8-104 wk	Number of falls; fear of falling; fitness; IADL; depression	Strong evidence of reducing fear of falling; weak evidence in reducing the incidence of falls; beneficial to older people without major fall risks; more study is need for clinical subpopulation

(continued)

Table 2. (continued)

Authors (year)	Focus	Tai Chi Dose				Outcome Measures	Major Findings
		Style	Frequency, time/wk	Duration	Length		
Lee et al (2008)[19]	Effective of Tai Chi on Parkinson disease	NR	2-3	45-90 min	5 d to 16 wk	UPDRS; balance measures/fall frequency; fitness; QOL	One study reported the improvement in UPDRS; overall, the evidence is insufficient to suggest Tai Chi is an effective intervention for Parkinson disease
Lee et al (2008)[20]	Tai Chi's effectiveness on osteoarthritis	NR	1-5	40-120 min	6 wk to 12 mo	Pain; function; balance; flexibility; QOL	Encouraging evidence that Tai Chi may be effective for pain control; although Tai Chi is helpful, evidence is not convincing for pain reduction and improvement of physical function
Lee et al (2008)[21]	Tai Chi for type 2 diabetes	NR	2-7	40-60 min	10 wk to 6 mo	Insulin resistance; HbA1c; FBG; QOL	Evidence of Tai Chi reducing FBG and HbA1c is not convincing; more trials are needed
Lee et al (2008)[22]	Tai Chi's effect on osteoarthritis	NR	2-7	40-60 min	6 wk to 12 mo	BMD; fracture rate; strength; bone formation	One RCT found that Tai Chi helps prevent loss of BMD; overall, evidence for Tai Chi for prevention or treatment of osteoporosis is not convincing
Taylor-Piliae (2008)[23]	Tai Chi on aerobic capacity	Most used Yang	NR	NR	12-52 wk	VO_2 max	Large, significant Tai Chi effects on aerobic capacity in cross-sectional studies; small/moderate effects in experimental studies; Tai Chi is effective when practiced long term; middle-aged or older adults benefit most; Tai Chi can be recommended, particularly for sedentary adults ≥55 y
Yeh et al (2008)[24]	Tai Chi on BP	Most used Yang	NR	NR	8 wk to 3 yr	BP	Most studies (85%) reported reductions in BP with Tai Chi; no adverse effects were reported; more RCTs are needed; need to better characterize the intervention; examine role in both primary and secondary prevention

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Table 2. (continued)

Authors (year)	Focus	Tai Chi Dose				Outcome Measures	Major Findings
		Style	Frequency, time/wk	Duration	Length		
Low et al (2009)[25]	Fall prevention among older adults	Most used Yang	1-3	45-90 min	15 wk to 1 yr	Fall counts; risk of falls	Tai Chi could reduce falls or fall risks among older adults; effective especially for relatively young and nonfrail individuals; studies in other languages should be examined
Yeh et al (2009)[26]	Cardiovascular conditions and risk factors	Most used Yang; a few used Chen and Wu; different forms and modifications	NR	NR	8 wk to 3 y	BP, HR, peak expiratory flow rate, pulmonary function, etc	Most studies reported improvements, including BP reduction and increase in exercise capacity; no report of adverse effect
Rogers et al (2009)[27]	Tai Chi on older adults' health	Most used Yang	1-7	35-90	3 wk to 12 mo	Fall and balance; physical function; CR disease; psychological; disease	Tai Chi could help older adults improve physical function and reduce BP, fall risk, depression, and anxiety

Abbreviations: ADL, activity of daily living; BMD, bone mineral density; BP, blood pressure; CR, cardiorespiratory functions; CVD, cardiovascular disease; DXA, dual-energy x-ray absorptiometry; ECG, electrocardiogram; FBG, fasting blood glucose; HR, heart rate; IADL, instrumental activity of daily living; NR, not reported; NS, not specified; pQCT, peripheral quantitative computed tomography; QOL, quality of life; RA, rheumatoid arthritis; RCT, randomized clinical trial; ROM, range of motion; UPDRS, Unified Parkinson's Disease Rating Scale.

reliable results concerning increasing overall physical function and decreasing factors such as pain and blood pressure. This review highlights the wide range of benefits that practicing Tai Chi may achieve when used as an intervention tool.

The review by Wang et al[10] covered a wide variety of chronic conditions and the influence that practicing Tai Chi may have on them. Balance, musculoskeletal conditions, hypertension, cardiorespiratory conditions, psychological conditions, endocrine and immune functions, and miscellaneous other conditions were all examined separately. Overall, 9 randomized controlled trials, 23 nonrandomized controlled trials, and 15 observational studies up to April 2002 were included in the review. According to the review, Tai Chi has the potential to improve many of the physiological and psychological aspects of chronic conditions, and it is also to promote a safe and effective intervention balance, cardiovascular fitness, and flexibility in older adults. However, according to the authors, further research should be conducted to increase the knowledge base of the subject.

Verhagen et al[9] conducted a literature search dating through July 2001 on the effects of Tai Chi in older adults. Seven studies were selected, but a total of 9 publications are described because 3 publications were based on the results of 1 study. Three of the studies were randomized controlled trials, and the other 4 studies were controlled clinical trials. Tai Chi was shown to be effective as an aerobic exercise in reducing blood pressure, reducing the risk of falls, and increasing function in older adults. However, based on the low levels of evidence available for Tai Chi in this subgroup, the review states that no substantial claims can be made for Tai Chi practice in older adults. The review also indicates that it excluded any possible studies published in Chinese due to a language barrier, so a substantial bulk of the literature on Tai Chi may have been overlooked.

Balance and Control

Chan and Bartlett[3] reviewed the literature on the efficacy of Tai Chi on balance and postural improvements dating through 1998. Seven articles were selected, including 3 randomized controlled trials, 3 nonrandomized controlled trials, and 1 with a group pretest/posttest study design. The studies reviewed generally support the use of Tai Chi in improving balance and postural control. Chan also included a meta-analysis, which showed that studies with more methodological rigor produced larger effect sizes in balance improvements. The authors of the review conclude that moderate evidence in support of using Tai Chi to improve balance and postural stability is available, indicating that it is a reasonable intervention for clinical use.

The review by Komagata and Newton[5] focused on the efficacy of Tai Chi for improving balance and reducing falls in older adults. Eleven studies were selected for review and were evaluated for methodological quality. While many types of studies were used, all of the selected studies met the standards of methodological quality according to their quality index and methodological rigor scores. In the end, the authors found that Tai Chi improved balance in older adults but was not shown to be effective at reducing the rate of falls in older populations.[5]

The review by Wayne et al[11] analyzed the literature through June 2002 on the effects of Tai Chi on vestibulopathic postural control. Although no study was found specifically relating to vestibulopathic postural control, all studies were relevant to outcome measures associated with postural control, such as balance and falls. A total of 24 studies were selected, 10 being randomized controlled trials and 14 being nonrandomized controlled trials. Twenty of the studies produced evidence favorable to using Tai Chi to improve postural control, indicating sufficient support for Tai Chi. Support for the reduction of falls was especially strong since 8 of 10 randomized controlled trials reported fall reduction. While there are a number of methodological concerns with the studies and any conclusions should be approached carefully, the results are promising for the use of Tai Chi for elderly individuals experiencing vestibulopathic postural control.

Falling

Wu[4] reviewed the existing literature on Tai Chi for improving balance and reducing falls in older adults. Overall, 24 articles of various levels of evidence were found on this topic. The review indicates that the results of the studies were inconsistent, making it difficult to tease out the effects of Tai Chi practice. The study indicated that factors such as duration of treatment, sample size, and age span have all been variables in Tai Chi studies related to balance and falls, but there is some evidence that supports its use. The study emphasizes the need for further research.

Harling and Simpson[18] systematically reviewed the effects of Tai Chi practice on reducing the fear of falls and falls in those aged 60 years and older. In all, 7 randomized controlled trials were selected. The review showed that only 2 trials produced clinically significant reductions in the rate of falls, indicating weak support for Tai Chi in fall prevention; however, the study also found strong support for using Tai Chi to reduce the fear of falling. Five of the 7 studies produced clinically significant reductions in fear of falling, meaning that interventions aimed at improving an older person's self-efficacy about falls could use Tai Chi interventions.

Low et al[25] reviewed the literature on Tai Chi and its influence on falls in elderly persons. Seven randomized controlled trials dating through August 2007 were selected, and all studies had outcome measures of fall occurrence. In the end, the data for the efficacy of Tai Chi as well as data for its noneffectiveness were almost equivalent. However, the study noted that the most rigorous studies selected in the review were in support of Tai Chi for reducing the risk of falling, although a variety of other methodological qualities of the studies may have had other unseen effects on the results. While the study asserts that more research should be conducted in this area, it does support the use of Tai Chi to prevent falls in younger, prefrail elderly individuals.

Parkinson Disease

The review by Lee et al[19] focused on the influence of Tai Chi practice in individuals

with PD. The authors located 7 studies dating up to January 2008, including 3 randomized clinical trials, 1 nonrandomized controlled clinical trial, and 3 uncontrolled clinical trials were selected. While the overall consensus of the review was that more rigorous studies need to be completed to make any assertions about the use of Tai Chi for PD patients, the study did note that there is favorable evidence in support of Tai Chi with the PD population. Tai Chi improved the prevention of falls and scores on the Unified Parkinson's Disease Rating Scale compared with the exercise control group in 1 trial, but almost all other studies showed mixed or null effects of Tai Chi interventions. The review highlights the flawed designs of the current literature on the subject and recommends better designed studies be conducted in the future.

Osteoarthritis

The systematic review by Lee et al[20] determined the efficacy of Tai Chi for those with osteoarthritis. Twelve studies were included in the study, with 5 randomized controlled clinical trials and 7 nonrandomized controlled clinical trials dating up to June 2007. The review showed promising evidence in support of using Tai Chi to reduce pain associated with osteoarthritis and even reported larger effect sizes in pain reduction from Tai Chi than from other popular interventions, such as using nonsteroidal anti-inflammatory drugs. Also, the review showed that Tai Chi may be beneficial for improving balance and physical function, but the authors assert that further research needs to be conducted to support the reliability of all of the results reported in the review.

Rheumatoid Arthritis

The Cochrane review by Han et al[6] examined the effects of a Tai Chi intervention on people with rheumatoid arthritis (RA). The authors of the review located a total of 4 randomized controlled trials or clinical trials dating up to 2002 or 2003. The review mainly showed that Tai Chi statistically improved ankle plantar flexion in those with RA, but most other measures such as activities of daily living and swollen joints showed no improvements after Tai Chi interventions. None of the studies indicated any harmful effects of Tai Chi practice, and the review reported that adherence rates in the Tai Chi interventions were higher than in the controls, indicating that subjects may enjoy participating in Tai Chi over other exercises.

Lee et al[15] systematically reviewed the effects of Tai Chi in those with rheumatoid arthritis. In all, 5 studies dating up to January 2007 were selected, including 2 randomized clinical trials and 3 nonrandomized controlled clinical trials. The review indicated that all of the included trials were of low quality, which significantly affects the results they obtained. However, some studies did show improvements in pain, fatigue, mood, depression, vitality, and disability index. It should be noted, however, that in the areas of pain and mood, other selected studies found no such improvements compared with usual activity controls.

Bone Mineral Density

The review by Wayne et al[17] examined 6 trials dating through April 2006 to determine if Tai Chi influenced bone mineral density in postmenopausal women. Two randomized controlled trials, 2 nonrandomized prospective parallel cohort studies, and 2 cross-sectional studies met inclusion criteria, but they all were classified as having low methodological quality. This being noted, the review showed that Tai Chi is a promising intervention for maintaining postmenopausal women's bone mineral density. No significant adverse effects of practicing Tai Chi were reported, and research also indicates that Tai Chi may improve other risk factors associated with low bone mineral density. Therefore, more research needs to be conducted.

Lee et al[22] reviewed the literature on the effectiveness of Tai Chi for osteoporosis and selected 7 articles: 5 randomized clinical trials and 2 controlled clinical trials. The published data were from studies dating through March 2007. The review mainly showed mixed results in favor of Tai Chi approaches to osteoporosis, stating that there are currently insufficient data on the subject. While a meta-analysis included in the study did show that Tai Chi interventions do increase bone mineral density compared with a no-treatment control in postmenopausal women, the results were not statistically significant.

Psychological Benefits

A literature review of the psychological effects of practicing Tai Chi was conducted by Dechamps et al[13] within the literature from January 1990 to June 2006. Overall, 14 studies were selected, with 8 randomized controlled trials and 6 nonrandomized trials in total. The review showed that Tai Chi is useful for increasing well-being and self-efficacy, as well as improving overall mood. While the study used trials including participants aged 12 to 96 years, intervention effects were most notable in those 55 years and older, including frail older adults and healthy adults. On the other hand, the review indicated that Tai Chi was no more effective than other exercises at the same intensity, but Tai Chi was a safer exercise choice for those who may be deconditioned or have exercise intolerance.

Blood Pressure

The effects of Tai Chi on blood pressure were systematically reviewed in the literature through January 2007 by Yeh et al.[24] They located 26 relevant studies including 9 randomized controlled trials, 13 nonrandomized controlled studies, and 4 observational studies. Among the studied reviewed, 85% reported reductions in blood pressure in those who practiced Tai Chi, but the study quality varied, and 2 of the most rigorous studies showed that blood pressure was not affected by Tai Chi practice. In all of the studies, Tai Chi was shown to be safe, with no studies reporting adverse effects. Since study quality varied, solid statements cannot be made with regard to Tai Chi practice for those with high blood pressure, but the results indicate some potential for the use of Tai Chi in the future.

Cancer

A systematic review was conducted by Lee et al[14] to determine the efficacy of

Tai Chi treatment in those with breast cancer as a complement to traditional cancer treatment. Four studies were selected, with 3 randomized controlled trials and 1 nonrandomized controlled trial dating up to October 2006. Various findings were noted among the studies, including improved self-esteem and health-related quality of life, improved functions in activities of daily life, and increased shoulder range of motion. While these findings are promising, the review authors suggest using caution when evaluating such results because of the paucity of the available literature (only 4 studies were included) and the flaws (such as small sample size, inadequate study design, and poor reporting) within the available studies.

The review by Mansky et al[12] examined the effects of Tai Chi on various populations including elderly patients, cancer survivors, and those with CVD; 20 randomized controlled trials were selected. Once the studies were further subdivided into their respective categories (eg, elderly patients, cancer survivors, and patients with CVD), the review noted the limited evidence with respect to each category but also highlighted the future potential of Tai Chi in such populations. The review particularly focuses on the possible benefits of Tai Chi for cancer survivors since Tai Chi has been shown to increase immune response as well as psychological function, but only 2 randomized controlled studies have been conducted with cancer survivors. Both studies show improvements in either quality of life or functional capacity, but further research should be undertaken before any solid conclusions can be made about the usefulness of Tai Chi for cancer patients.

Cardiovascular Disease

The review by Lee et al[16] examined the effects of Tai Chi on CVD and associated risk factors in the literature through March 2007. Nine randomized controlled studies were selected, and support for the use of Tai Chi to reduce blood pressure was found. Four randomized controlled trials found that blood pressure was significantly reduced compared with no-treatment controls, while 2 other studies found no difference between Tai Chi and aerobic exercise interventions. The review indicates that the evidence is inconclusive because of the small number of trials but also notes that evidence is encouraging in support of using Tai Chi for reduction of hypertension.

Very recently, Yeh et al[26] conducted a review of Tai Chi for patients with cardiovascular conditions and risk factors. A total of 29 studies met inclusion criteria, including 9 randomized controlled trials, 14 nonrandomized studies, and 6 observational trials. The study subjects included patients with coronary heart disease, heart failure, CVD, and CVDRF (hypertension, dyslipidemia, impaired glucose metabolism). Tai Chi interventions ranged from 8 weeks to 3 years, and the sample size ranged from 5 to 207. Most studies reported improvement with Tai Chi intervention, such as reduction in blood pressure and increase in exercise capacity. In addition, no adverse effects were reported. The authors concluded that Tai Chi may be a beneficial adjunctive therapy for patients with CVD and CVDRF.

Diabetes

The review by Lee et al[21] attempted to determine the effects of Tai Chi on type 2 diabetes by examining the literature through May 2007. A total of 5 studies were included: 2 randomized controlled trials and 3 nonrandomized clinical trials. The results of the studies were mixed and conflicting, with some showing greater improvements in blood glucose levels compared with exercise, and others showing no effects from Tai Chi interventions. Overall, the review states that there is insufficient evidence in support of Tai Chi for type 2 diabetes. Note, however, that only the abstract of this review was published.

Aerobic Capacity

Taylor-Piliae and Froelicher[8] conducted a meta-analysis of the efficacy of Tai Chi in improving aerobic capacity, locating 7 qualified studies for analysis, with 2 randomized controlled trials, 2 quasi-experimental studies, and 3 cross-sectional studies. Large and significant effect sizes were noted in the cross-sectional studies, while nonsignificant effect sizes were found in the randomized controlled trials and quasi-experimental studies. Studies comparing sedentary people to Tai Chi participants also noted larger effects when Tai Chi was practiced for at least 1 year. The authors of the review concluded that Tai Chi could be used as an alternative form of aerobic exercise and recommends further inquiry into this area.

Taylor-Piliae[23] recently performed a follow-up study to update the above meta-analysis.[8] The study added an additional 7 studies to the analysis through June 2007, including 3 experimental studies (randomized controlled trials and quasi-experimental studies), 3 cross-sectional studies, and 1 prospective cohort study (14 studies in total). Much like the original meta-analysis, statistically significant and large effect sizes were noted in the cross-section studies (effect size = 1.33), meaning that subjects experienced significant aerobic improvements from practicing Tai Chi in the studies. On the other hand, small effect sizes were found within the experimental studies (effect size = 0.38). The review concludes that Tai Chi is an effective aerobic exercise to use in interventions.

Tai Chi and Older Adults

Rogers et al[27] recently reviewed both Tai Chi and Qigong, which is another form of Chinese body-mind exercise, clinical trials in older adults. Among 36 studies reviewed, 31 were Tai Chi studies. The authors focused their reviews on the outcomes of Tai Chi interventions on balance and falls, physical function, cardiovascular health, psychological outcomes, and disease outcomes and concluded that a Tai Chi intervention may help older adults improve physical function and reduce blood pressure, fall risk, depression, and anxiety. The authors called for more research on potential benefits of meditative aspects of Tai Chi and their possible contribution to successful aging.

Limitations of Tai Chi Research and Reviews

While these reviews provide rich and updated information on the benefits and

potential of Tai Chi interventions, several limitations, both in the original research and reviews, were noticed. For the original research, the most significant limitation is the control of the dose. The dose of the Tai Chi intervention includes Tai Chi style employed, frequency, and duration and length of the intervention. As illustrated in Table 2, although most of the interventions used the Yang style, the forms varied greatly from study to study, ranging from only a few forms to 108 forms. In addition, many studies did not even mention the key information concerning the intervention's Tai Chi dose, rather simply stating that Tai Chi exercises were employed. Reported frequency, duration, and length of the interventions also greatly varied (see Table 2). While a variation in any exercise intervention is expected, variation to such a large degree makes it hard to generalize in practice, especially in therapeutic settings.

The second limitation related to Tai Chi studies is that few studies explore the mechanism of Tai Chi. Why did Tai Chi sometimes work better than a typical exercise intervention? How could Tai Chi lead to the improvement of disease conditions? Will one specific form of a style of Tai Chi be more effective than another? How important is the sequence of a set of forms? Without understanding these basic questions, it will be very difficult to use Tai Chi in a quantitative way in clinical application or an intervention.

For the conducted reviews, the variation is also a problem: while some used meta-analysis, others employed systematic or general reviews; some used 1 database, and others used more than 20 databases; some included only randomized clinical trials, and others employed several types of interventions. Inclusion and exclusion of the studies are also not consistent. In fact, some of the selection criteria have been questioned. For example, Yeh et al[24] questioned the methodological quality of the review by Han et al,[6] which provided one of the most solid pieces of evidence about Tai Chi benefits for those with rheumatoid arthritis. Yeh et al[24] believed that the selection criteria (mixed intervention methods were included) in that study were not appropriate and that the use of the Jadad rating scale for this type of intervention was also a poor indicator of study quality within complementary medicine. Another limitation in these reviews is that, except for a few, most of the reviews were limited to only publications in English. As already pointed out by some of the authors (eg, Verhagen et al[9]), most Tai Chi research has been conducted in China and other parts of Asia and published in non-English journals. Without including this research and those publications, some important information on Tai Chi research and its clinical applications may be missing.

How We Can Use the Information From These Reviews

Based on the things we learned from these reviews, it seems that we can reasonably derive the following general implications regarding Tai Chi and its applications to clinical practice:

1. Tai Chi is a very useful exercise format that can be used for a variety chronic disease conditions. It requires no equipment and little space, and it can be practiced anytime and anywhere;
2. Because of its low- to moderate-intensity characteristics and slow and relaxed nature, Tai Chi can be practiced by anyone, including both older adults and individuals with chronic diseases.
3. Start simple. Learning some long forms of Tai Chi could be challenging, especially for older adults without any previous experience. Since short forms have shown similar benefits as the longer forms, beginners should begin with short forms first.
4. Practice daily if possible. Like other exercise interventions, practicing regularly is a must to be able to gain maximal benefits. In fact, people in China practice Tai Chi every day for both therapeutic and prevention purposes.
5. Use Tai Chi as a complementary addition to both conventional medical treatment and physical therapy or rehabilitation, as well as with other exercise intervention methods (eg, walking).

Conclusion

Tai Chi has a long and rich history of being used as an effective therapy and for prevention purposes. Since the 1990s, researchers in Western medical communities have examined the effectiveness of Tai Chi interventions in clinical applications. The reviews described in this article provide a summary of the latest cumulative evidence on Tai Chi interventions. While some of the findings are not consistent and more research is needed, especially concerning the mechanism and dose-response issues of Tai Chi interventions, clinical practitioners should take advantage of the information learned thus far and start to integrate this simple, yet effective, means of exercise into both their therapeutic and prevention applications.

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