Published in final edited form as:
Am J Health Promot. 2010 ; 24(6): e1–e25. doi:10.4278/ajhp.081013-LIT-248.

A Comprehensive Review of Health Benefits of Qigong and Tai Chi

Roger Jahnke, OMD[1], **Linda Larkey, PhD**[2], **Carol Rogers**[3], **Jennifer Etnier, PhD**[4], and **Fang Lin**[5]

Roger Jahnke: roger@healthaction.net; Linda Larkey: larkeylite@msn.com; Carol Rogers: carol.rogers@asu.edu; Jennifer Etnier: JLEtnier@uncg.edu; Fang Lin: fanglin60@hotmail.com

[1] The Institute of Integral Qigong and Tai Chi, 243 Pebble Beach Santa Barbara CA, 93117

[2] Arizona State University College of Nursing and Healthcare Innovation, 500 N. 3rd Street, Phoenix, AZ 85004

[3] Arizona State University College of Nursing and Healthcare Innovation, 500 N. 3rd Street, Phoenix, AZ 85004. Phone: (602) 677-0711, Fax (602) 496-0775

[4] University of North Carolina, Greensboro, Department of Exercise and Sport Science, P.O. Box 26170, Greensboro, NC 27140

[5] 13448 E Bloomfield Drive, Scottsdale AZ 85259

Abstract

Objective—Research examining psychological and physiological benefits of Qigong and Tai Chi is growing rapidly. The many practices described as Qigong or Tai Chi have similar theoretical roots, proposed mechanisms of action and expected benefits. Research trials and reviews, however, treat them as separate targets of examination. This review examines the evidence for achieving outcomes from randomized controlled trials (RCTs) of both.

Data Sources—The key words tai chi, taiji, and qigong were entered into electronic search engines for the Cumulative Index for Allied Health and Nursing (CINAHL), Psychological Literature (PsychInfo), PubMed, Cochrane database, and Google Scholar.

Study Inclusion Criteria—RCTs reporting on the results of Qigong or Tai Chi interventions and published in peer reviewed journals published from 1993–2007

Data Extraction—Country, type and duration of activity, number/type of subjects, control conditions, and reported outcomes were recorded for each study.

Synthesis—Outcomes related to Qigong and Tai Chi practice were identified and evaluated.

Results—Seventy-seven articles met the inclusion criteria. The 9 outcome category groupings that emerged were: bone density (n=4), cardiopulmonary effects (n=19), physical function (n=16), falls and related risk factors (n=23), Quality of Life (n=17), self-efficacy (n=8), patient reported outcomes (n=13), psychological symptoms (n=27), and immune function (n=6).

Conclusions—Research has demonstrated consistent, significant results for a number of health benefits in RCTs, evidencing progress toward recognizing the similarity and equivalence of Qigong and Tai Chi.

Keywords

tai chi; taiji; meditation; qigong; mind body practice; meditative movement; moderate exercise; breathing

A substantial body of published research has examined the health benefits of Tai Chi (also called Taiji) a traditional Chinese wellness practice. In addition, a strong body of research is also emerging for Qigong, an even more ancient traditional Chinese wellness practice that has similar characteristics to Tai Chi. Qigong and Tai Chi have been proposed, along with Yoga and Pranayama from India, to constitute a unique category or type of exercise referred to currently as meditative movement.[1] These two forms of meditative movement, Qigong and Tai Chi, are close relatives having shared theoretical roots, common operational components, and similar links to the wellness and health promoting aspects of traditional Chinese medicine. They are nearly identical in practical application in the health enhancement context and share much overlap in what traditional Chinese medicine describes as the "three regulations": body focus (posture and movement), breath focus, and mind focus (meditative components).[1, 2]

Due to the similarity of Qigong and Tai Chi, this review of the state of the science for these forms of meditative movement will investigate the benefits of both forms together. In presenting evidence for a variety of health benefits, many of which are attributable to both practices, we will point to the magnitude of the combined literature and suggest under what circumstances Qigong and Tai Chi may be considered as potentially equivalent interventions, with recommendations for standards and further research to clarify this potential.

Objectives

Previously published reviews have reported on specific outcomes of either Tai Chi or Qigong, mostly addressing only one of these practices, and rarely taking into account the similarity of the two forms and their similar outcomes. These reviews have covered a wide variety of outcomes, with many focused on specific diseases or symptoms including: hypertension;[3] cardiovascular disease;[4, 5] cancer;[6–8] arthritic disease;[9] stroke rehabilitation;[10] aerobic capacity;[11] falls and balance;[12, 13] bone mineral density;[14] and shingles-related immunity,[15] with varying degrees of support noted for outcomes in response to Qigong or Tai Chi.

Other reviews have addressed a broad spectrum of outcomes to demonstrate how Qigong[16–19] or Tai Chi[20–26] have demonstrated improvements for participants with a variety of chronic health problems or with vulnerable older adults. While many of these reviews have utilized selection criteria which restrict their focus to rigorous empirical studies, others have used less stringent criteria. The purpose of this review is to evaluate the current evidence for a broad range of health benefits for both Qigong and Tai Chi using only randomized controlled trials (RCTs), and to evaluate the potential of treating these two forms of meditative movement as equivalent forms. A complete description of Qigong and Tai Chi is presented and the equivalence of their theoretical roots and their common elements of practice are established. Then, the body of evidence for outcomes in response to Qigong and Tai Chi is reviewed to examine the range of health benefits. Finally, to more critically evaluate similarities across studies of the two practices we discuss the potential of treating them as equivalent interventions in research and the interpretation of results across studies.

Research Question 1: What health benefits are evidenced from RCTs of Qigong and Tai Chi?

Research Question 2: In examining the Qigong and Tai Chi practices incorporated in research, and the evidence for health benefits commensurate with each, what claims can be

made for equivalence of these two forms of practice/exercise that have typically been considered to be separate and different?

Overview of Qigong and Tai Chi

Qigong is, definitively, more ancient in origin than Tai Chi and it is the over-arching, more original discipline incorporating widely diverse practices designed to cultivate functional integrity and the enhancement of the life essence that the Chinese call Qi. Both Qigong and Tai Chi sessions incorporate a wide range of physical movements, including slow, meditative, flowing, dance-like motions. In addition, they both can include sitting or standing meditation postures as well as either gentle or vigorous body shaking. Most importantly, both incorporate the purposeful regulation of both breath and mind coordinated with the regulation of the body. Qigong and Tai Chi are both based on theoretical principles that are inherent to traditional Chinese medicine (TCM).[1] In the ancient teachings of health-oriented Qigong and Tai Chi, the instructions for attaining the state of enhanced Qi capacity and function point to the purposeful coordination of body, breath and mind (paraphrased here): “Mind the body and the breath, and then clear the mind to distill the Heavenly elixir within.” This combination of self-awareness with self-correction of the posture and movement of the body, the flow of breath, and stilling of the mind, are thought to comprise a state which activates the natural self-regulatory (self-healing) capacity, stimulating the balanced release of endogenous neurohormones and a wide array of natural health recovery mechanisms which are evoked by the intentful integration of body and mind.

Despite variations among the myriad forms, we assert that health oriented Tai Chi and Qigong emphasize the same principles and practice elements. Given these similar foundations and the fashion in which Tai Chi has typically been modified for implementation in clinical research, we suggest that the research literature for these two forms of meditative movement should be considered as one body of evidence.

Qigong

Qigong translates from Chinese to mean, roughly, to cultivate or enhance the inherent functional (energetic) essence of the human being. It is considered to be the contemporary offspring of some of the most ancient (before recorded history) healing and medical practices of Asia. Earliest forms of Qigong make up one of the historic roots of contemporary Traditional Chinese Medicine (TCM) theory and practice.[2] Many branches of Qigong have a health and medical focus and have been refined for well over 5000 years. Qigong purportedly allows individuals to cultivate the natural force or energy (“Qi”) in TCM that is associated with physiological and psychological functionality. Qi is the conceptual foundation of TCM in acupuncture, herbal medicine and Chinese physical therapy. It is considered to be a ubiquitous resource of nature that sustains human well-being and assists in healing disease as well as (according to TCM theory) having fundamental influence on all life and even the orderly function of celestial mechanics and the laws of physics. Qigong exercises consist of a series of orchestrated practices including body posture/movement, breath practice, and meditation, all designed to enhance Qi function (that is, drawing upon natural forces to optimize and balance energy within) through the attainment of deeply focused and relaxed states. From the perspective of Western thought and science, Qigong practices activate naturally occurring physiological and psychological mechanisms of self-repair and health recovery.

Also considered part of the overall domain of Qigong is “external Qigong” wherein a trained medical Qigong therapist diagnoses patients according to the principles of TCM and uses “emitted Qi” to foster healing. Both internal Qigong (personal practice) and external Qigong (clinician emitted Qi) are seen as affecting the balance and flow of energy and enhancing

functionality in the body and the mind. For the purposes of our review, we are focused only on the individual, internal Qigong practice of exercises performed with the intent of cultivating enhanced function, inner Qi that is ample and unrestrained. This is the aspect of Qigong that parallels what is typically investigated in Tai Chi research.

There are thousands of forms of Qigong practice that have developed in different regions of China during various historic periods and that have been created by many specific teachers and schools. Some of these forms were designed for general health enhancement purposes and some for specific TCM diagnostic categories. Some were originally developed as rituals for spiritual practice, and others to empower greater skill in the martial arts. An overview of the research literature pertaining to internal Qigong yields more than a dozen forms that have been studied as they relate to health outcomes (e.g., Guo-lin, ChunDoSunBup, Vitality or Bu Zheng Qigong, Eight Brocade, Medical Qigong).[2, 27–29]

The internal Qigong practices generally tested in health research (and that are addressed in this review), incorporate a range of simple movements (repeated and often flowing in nature), or postures (standing or sitting) and include a focused state of relaxed awareness and a variety of breathing techniques that accompany the movements or postures. A key underlying philosophy of the practice is that any form of Qigong has an effect on the cultivation of balance and harmony of Qi, positively influencing the human energy complex (Qi channels/pathways) which functions as a holistic, coherent and mutually interactive system.

Tai Chi

Tai Chi translates to mean, “Grand Ultimate”, and in the Chinese culture, it represents an expansive philosophical and theoretical notion which describes the natural world (i.e., the universe) in the spontaneous state of dynamic balance between mutually interactive phenomena including the balance of light and dark, movement and stillness, waves and particles. Tai Chi, the exercise, is named after this concept and was originally developed both as a martial art (Tai Chi Chuan or taijiquan) and as a form of meditative movement. The practice of Tai Chi as meditative movement is expected to elicit functional balance internally for healing, stress neutralization, longevity, and personal tranquility. This form of Tai Chi is the focus of this review.

For numerous, complex sociological and political reasons,[2] Tai Chi has become one of the best known forms of exercise or practice for refining Qi and is purported to enhance physiological and psychological function. The one factor that appears to differentiate Tai Chi from Qigong is that traditional Tai Chi is typically performed as a highly choreographed, lengthy, and complex series of movements, while health enhancement Qigong is typically a simpler, easy to learn, more repetitive practice. However, even the longer forms of Tai Chi incorporate many movements that are similar to Qigong exercises. Usually, the more complex Tai Chi routines include Qigong exercises as a warm-up, and emphasize the same basic principles for practice, that is, the three regulations of body focus, breath focus and mind focus. Therefore Qigong and Tai Chi, in the health promotion and wellness context, are operationally equivalent.

Tai Chi as Defined in the Research Literature

It is especially important to note that many of the RCTs investigating what is described as Tai Chi (for health enhancement), are actually not the traditional, lengthy, complex practices that match the formal definition of traditional Tai Chi. The Tai Chi used in research of both disease prevention and as a complement to medical intervention is often a “modified” Tai Chi (e.g., Tai Chi Easy, Tai Chi Chih, or “short forms” that greatly reduce the number of

movements to be learned). The modifications generally simplify the practice, making the movements more like most health oriented Qigong exercises that are simple and repetitive, rather than a lengthy choreographed series of Tai Chi movements that take much longer to learn (and, for many participants, reportedly delay the experience of "settling" into the relaxation response). A partial list of examples of modified Tai Chi forms from the RCTs in the review are: balance exercises inspired by Tai Chi,[30] Tai Chi for arthritis, 5 movements from Sun Tai Chi,[31] Tai Chi Six Form,[32] Yang Eight Form Easy,[3334] and Yang Five Core Movements.[34]

In 2003, a panel of Qigong and Tai Chi experts was convened by the University of Illinois and the Blueprint for Physical Activity to explore this very point.[35] The expert panel agreed that it is appropriate to modify (simplify) Tai Chi to more efficiently disseminate the benefits to populations in need of cost effective, safe and gentle methods of physical activity and stress reduction. These simplified forms of Tai Chi are very similar to the forms of Qigong used in health research.

For this reason, it is not only reasonable, but a critical contribution to the emerging research dialogue to review the RCTs that explore the health benefits resulting from both of these practices together, as one comprehensive evidence base for the meditative movement practices originating from China.

Methods

Data Sources

The following data bases were used to conduct literature searches for potentially relevant articles: Cumulative Index for Allied Health and Nursing (CINAHL), Psychological Literature (PsychInfo), PubMed, Google Scholar, and the Cochrane database. The key words included Tai Chi, Taiji, Tai Chi Chuan, and Qigong combined with RCT or with clinical research terms. Additional hand searches (based on word-of-mouth recommendations) completed the search for articles.

Study Inclusion Criteria

Criteria for inclusion of articles included that they: a) were published in a peer-reviewed English-language journal between 1993 and December, 2007; b) were cited in nursing, medical, or psychological literature; c) were designed to test the effects of Tai Chi or Qigong; and d) used a RCT research design. The literature search resulted in the identification of 576 articles to be considered for inclusion. The full texts of 158 articles appearing to meet initial criteria (a–d) were retrieved for further evaluation and to verify which ones were, in fact, RCTs, resulting in a final set of 77 articles meeting all of our inclusion criteria

Data Abstraction

Articles were read and results were entered into a table according to criteria established by the authors for categorization and evaluation of the studies and outcomes. Included in Table One for review and discussion are: country of study; type and number of patients randomized; duration and type of intervention and control condition; measured outcomes; and results. As the information was entered into the table it became apparent that some of the authors reported results from the same study in more than one article. Thus, the 77 articles selected actually represented 67 unique studies, with 1 study reporting a range of outcomes across 4 articles, and 5 other studies' results published in 2 articles each. An additional two articles were not entered into the table[36, 37] as the same results were reported in newer articles. Other than these two dropped articles, multiple articles are entered into the

table as representing one study (see Table One) so that the full range of outcomes reported across the articles can be reported without inflating the number of studies.

Synthesis

Three authors independently reviewed the articles selected for inclusion and considered categorizing studies by type of patient or disease outcome. Many of the studies drew participants from a general, healthy population (n=16), so a category schema based on patient type or disease would not have included all of the studies. The authors revisited the long list of health benefits and outcomes assessed across the studies and generated broad categories that combined related health outcomes into larger groups. These initial categories were defined based on identifying the most frequently measured primary outcomes, and then refining the groups to develop an investigation framework that accommodated all of the research outcomes into at least one of the categories. These categories of outcomes related to Qigong and Tai Chi practice were discussed and continually reworked until we had clear, non-overlapping boundaries for each category based on similar symptoms or health indicators related to a common function or common target organ system. These groupings are not intended to be conclusive taxonomies but rather are used for this review as convenient and meaningful tools for evaluating similar groups of outcomes. In this way, examining health outcomes across a variety of study designs and populations (including, healthy, diseased or at-risk patients) was possible.

Results

Study Description

A total of 6410 participants were included across these reported studies. While some of the studies compared Qigong or Tai Chi to other forms of exercise (n=13), many compared to a non-exercise treatment control group such as education or usual care (n=43) and some used both exercise and non-exercise comparison groups to evaluate effects of Qigong or Tai Chi interventions (n=11). Most studies included healthy adults (n=16 studies), but several studies included participants based on specific risk factors or diagnosis of disease including: arthritis (n=5); heart disease (n=6); hypertension (n=5); osteoporosis risk [e.g., peri-menopausal (n=3)]; fall risk determined by age and sedentary lifestyle or poor physical function and balance (n=18); breast cancer (n=1); depression (n=2); fibromyalgia (n=2); immune dysfunction including HIV/AIDS and varicella history or vaccine response (n=3); muscular dystrophy (n=1); Parkinson's disease (n=1); neck pain (n=1); sleep complaints (n=1); chronic disease (n=1); and traumatic brain injury (n=1). Some of the studies (n=9) monitored adverse effects during the interventions and none reported an adverse event.

The studies originated from 13 countries (USA, n=34; China (including Hong Kong), n=9; Korea, n=4; Australia and New Zealand, n=5; Sweden, n=4; Great Britain, n=3; Italy and Taiwan, each n=2; Netherlands, Israel, Poland, and Spain, each n=1).

Outcomes

From all of the studies, 163 different physiological and psychological health outcomes were identified. Many of the studies assessed outcomes across more than one category (e.g., physical function as well as a variety of psychosocial and fitness outcomes), so some studies are discussed in more than one section in the review of categories that follows.

The 9 outcome category groupings that emerged are: bone density (n=4), cardiopulmonary effects (n=19), physical function (n=16), falls, balance and related risk factors (n=23), quality of life (n=17), self-efficacy (n=8), patient reported outcomes (n=13), psychological

symptoms (n=27), and immune- and inflammation-related responses (n=6). Within each category of outcomes, there were both Qigong and Tai Chi interventions represented.

Bone Density

Resistance training and other weight bearing exercises are known to increase bone formation[38] and have been recommended for post-menopausal women for that purpose.[39] Interestingly, most Qigong and Tai Chi practices involve no resistance and only minimal weight bearing (such as gentle knee bends), yet the four RCTs (total sample size=427) included in this review reported positive effects on bone health. One study examined the effect of Qigong[40] and three examined Tai Chi.[41–43] Bone loss was retarded and numbers of fractures were less among post-menopausal women practicing Tai Chi compared to usual care.[41] In another study, bone loss was less pronounced for post-menopausal females practicing Tai Chi or resistance training compared to no-exercise controls, but this effect was not found in the older men participating in the study.[43] Shen and colleagues[42] compared Tai Chi to resistance training and reported significant changes in biomarkers of bone health in both groups. Bone mineral density increased for women following Qigong exercises as compared to no-exercise controls.[40] In summary, current research suggests a favorable effect on bone health for those practicing Tai Chi or Qigong.

Cardiopulmonary

Nineteen studies [Qigong (n=7) and Tai Chi (n=12)] reported favorable cardiovascular and/or pulmonary outcomes. Participants in this grouping of studies were generally older adults (mean age=61.02) and inclusion criteria varied from history of disease to reported sedentary behavior. Measures of cardiopulmonary function were representative of cardiopulmonary fitness and cardiovascular disease risk and included blood pressure, heart rate, ejection fraction rates, blood lipids, 6-minute walk distance, ventilatory function, and body mass index (BMI).

One of the most consistent findings was the significant reduction in blood pressure reported in multiple studies, especially when Qigong[44, 45] or Tai Chi[46, 47] were compared to inactive control groups such as usual care, educational classes, or wait-list controls. Even when compared to active control groups such as aerobic exercise or balance training, Tai Chi showed a significant reduction in blood pressure in two studies.[48, 49] Other studies, however, that utilized active control interventions (low to moderate levels of physical activity) expected to reduce blood pressure showed positive changes for both groups, but without significant differences between Qigong[28] or Tai Chi[50, 51] and the comparison group; thus, providing preliminary evidence that these meditative movement practices achieve similar results to conventional exercise.

Other indicators of cardiac health have been evaluated. Reduced heart rate is reported[49, 51, 52] as well as increases in heart rate variability.[53] These reported changes in blood pressure, heart rate, and heart rate variability suggest that one or several of the key components of Tai Chi and Qigong, that is body, breath, and mind, may affect sympathetic and parasympathetic balance and activity.

Biomarkers of heart-health have been shown to improve in response to Qigong or Tai Chi practice. Yeh and colleagues[34] reported significantly improved Serum B-type natriuretic peptide levels in response to Tai Chi compared to usual care controls, indicating improved left ventricular function. Lipid profiles improved in two studies[44, 46] comparing Qigong and Tai Chi to inactive controls while another study of Qigong[54] reported no change in cholesterol levels compared to inactive (wait-list) controls. Pippa and colleagues[54] also reported no change in ejection fraction rates following a 16-week study of Qigong among

participants with a history of chronic atrial fibrillation. Urine catecholamine levels were significantly decreased in participants practicing Tai Chi compared to wait-list controls[45] but a similar trend did not reach significance in another study with only 15 participants per treatment condition.[34]

A variety of cardiopulmonary fitness indicators have been examined for both Qigong and Tai Chi. Participants with a history of heart failure reported significant improvements in the incremental shuttle walk following a combined Tai Chi/Qigong intervention implemented in two studies incorporating inactive control groups.[34, 55] Women treated for breast cancer achieved significantly increased distances in the 6-minute walk test in response to Tai Chi compared to a psychosocial support control intervention[56] and $VO_{2\ max}$ increased significantly more following a Tai Chi intervention compared to resistance training and usual care control groups.[53] In contrast to these consistent findings for cardiopulmonary benefits, one study found no significant improvement in response to Qigong, while aerobic training did achieve significant changes. In this small (n=11 in each arm of study) cross-over study of patients with Parkinson's disease, participants practiced Qigong or aerobic training in random order for 7 weeks (with 8 weeks rest in between intervention periods), results on the 6-minute walk test, VO_{2peak} and $VO_{2/Kg}$ ratio were significantly improved for those who completed the aerobic exercise protocol, but no significant effects were found for those practicing Qigong.[57]

Most of the non-significant findings have been found in studies with participants with some form of chronic illness or recovery from cancer at study entry. For example, respiratory function improved clinically, but not significantly, for patients with chronic heart failure practicing Tai Chi compared to usual care,[34] and as described above, was relatively unchanged for the Qigong group with a history of Parkinson's disease compared to an aerobic training control group.[57] A group of patients with muscular dystrophy[58] showed a trend for improvement that did not reach significance compared to a wait-list control. Further, no change in cardiovascular function was reported for sedentary participants with a history of osteoarthritis.[59] Aerobic capacity was shown to improve with Tai Chi, though not significantly more so than with inactive controls in a small study of breast cancer survivors.[52, 53, 56] It is important to point out that of these five studies that failed to demonstrate significant improvements following Qigong or Tai Chi, four had 31 or fewer participants. It is difficult to discern if non-significant findings in cardiopulmonary fitness are due to some pattern of ineffectiveness with chronic and debilitating illness or if they are a result of the limited statistical power.

One of the key risk factors for cardiac disease is obesity. Qigong has demonstrated a greater reduction in BMI as compared to an exercise control group in two studies,[28, 47] but this difference was not significant. Another study demonstrated a marked but non-significant reduction in waist circumference with Tai Chi compared to usual care for older adults.[52] Conversely, one study using Qigong and two with Tai Chi (respectively)[48, 54, 59] reported no change in BMI compared to usual care and another implementing a Qigong intervention[60] failed to maintain weight loss, suggesting the data are inconclusive at this point as to whether or not these practices may consistently affect weight.

A few studies of both Qigong and Tai Chi have examined level of intensity, indicating that some forms of these practices fall within the moderate intensity level,[11, 61] but for the most part, level of exercise intensity is not reported. Cardiopulmonary benefits of Qigong and Tai Chi may partially be explained as a response to aerobic exercise, but with the wide range of speeds with which these exercises are executed, it would be important to assess this factor for a better understanding of the elements that contribute to outcomes. Regardless of the mechanisms, the preponderance of studies on cardiopulmonary outcomes show that Qigong

and Tai Chi are effective compared to inactive controls, or at least approximately equal to the expected benefits of conventional exercise.

Physical Function

Decreased physical activity is related to declining physical function in all populations and that decline is compounded by the natural process of aging.[62, 63] Changes in physical function were assessed in 16 studies (Qigong, n=2; Tai Chi, n=14). Most of the studies were conducted with older adults (i.e., studies in which mean age = 55 years or older, n=13) and several recruited specifically for participants with chronic pain (e.g., osteoarthritis, neck pain, or fibromyalgia, n = 5). A number of behavioral measures of physical function performance were included in this category of outcomes which also includes self-reported responses on scales representing physical function. Although fitness outcomes, such as the 6-minute walk test, might also be seen as assessing overall physical function, we did not include tests already discussed in the cardiopulmonary fitness category, but rather focused on functional tests that are usually used to assess capacity for daily living. Studies that assessed changes in overall physical activity levels are also included as an outcome pertaining to physical function.

Physical function measured with a wide variety of performance indicators, including chair rise, 50-ft walk, gait speed, muscle contraction strength, hand grip, flexibility, and function as measured on the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC, an osteoarthritis-specific assessment for function, stiffness, and pain), were variously found to be significantly improved in 5 studies comparing Tai Chi to minimal activity (usual or stretching activity, psychosocial support, or education) comparison groups[56, 64–66] and one study of Tai Chi compared to an exercise therapy control intervention.[64] One of these studies combined functional walking with Tai Chi to achieve significant improvements with pre-frail elders compared to usual care.[67]

In contrast, in 7 studies including participants with osteoarthritis or multiple co-morbidities, some of the physical function measures were not significantly different for Tai Chi or Qigong in comparison to inactive controls. This was the case for gait speed,[47] timed up and go, 50-ft. walk and stair climb[68] and 50-ft. walk and chair stand.[69, 70] In one study of 30 patients with osteoarthritis practicing Tai Chi twice per week[69] and another with 36 participants with fibromyalgia that utilized hand grip and chair stand to test a 20 minutes per week Qigong intervention,[71] neither achieved significant improvements compared to usual care. In one exception to this trend, one measure of functional performance, time to complete chair rise, was significantly improved in transitionally frail elders in the Tai Chi group compared to a wellness education control group.[47]

Studies using self-report measures consistently show positive results for Tai Chi. Self-reported improvement in physical function for sedentary older adults was demonstrated for Tai Chi compared to wait-list controls,[70, 72] and a stretching exercise control.[33]

Results in this category of outcomes are inconsistent, with a preponderance of studies recruiting sedentary, or chronically ill or frail elder participants. Even so, a handful of these studies successfully demonstrated potential for Qigong and Tai Chi to build performance, even with health compromised individuals. Further studies are needed to examine the factors that are important to more critically evaluate these interventions (such as power considerations or dose and frequency of the interventions), or learn if there are particular states of ill health that are less likely to respond to this form of exercise.

Falls and Balance

Another large grouping of studies focused primarily on falls prevention, balance, and physical function tests related to falls and balance (such as one-leg stance). Although there may be some crossover of implied benefits to the more general physical function measures reported above, this separate category was established to report on the studies of interventions primarily targeting falls and related measures. Fear of falling is reported with the psychological outcomes and fall self-efficacy is reported in the self-efficacy outcomes rather than in this category of falls and balance.

Outcomes related to falls such as balance, fall rates, and improved strength and flexibility were reported in 24 articles (Qigong, n=2, Tai Chi, n=20, and 2 studies that included both practices). Scores directly assessing balance (such as one-leg stance) or other closely related measures were consistently, significantly improved in 16 Tai Chi studies that only included participants who were sedentary or deemed at risk for falls at baseline.[33, 43, 49, 53, 59, 65, 73–83]

Qigong has been less studied in relationship to balance-related outcomes; however, results suggest that there was a trend to maintain balance using Qigong in a population of patients with muscular dystrophy.[58] In two studies that used both Qigong and Tai Chi, several measures of balance were significantly improved with sedentary women[84] and with elderly healthy adults (mean age 80.4 years) compared to wait list controls.[85]

Another set of studies shows the effect of Tai Chi on balance to be similar to conventional exercise or physical therapy control interventions aimed at improving physical function related to balance;[53, 74, 86] or vestibular rehabilitation.[87, 88] On the other hand, in a study of stroke survivors comparing Tai Chi to balance exercises, significant improvements in balance were achieved in the exercise control group, but not for Tai Chi.[89] While knee extension was significantly improved, balance was not improved significantly in a Tai Chi intervention with sedentary women compared to a flexibility training control group.[76]

Mechanisms of gait performance which are important to understanding how Tai Chi affects balance were also studied. Reported improvements were found in 4 studies.[82, 87, 88, 90] Strength and flexibility are also important to fall prevention. Four studies found significant improvements in these factors when Tai Chi was compared to an active control (brisk walking)[33, 53, 59, 75, 83] or inactive controls.[59, 75, 83]

Eight studies directly monitored fall rates. Studies that incorporate educational or less active control interventions (e.g., stretching), variously demonstrated significant falls reduction for Tai Chi[67, 77, 80, 81] or non-significant reductions compared to control.[43, 49] In a study comparing Tai Chi to an active physical therapy intervention designed to improve balance, results were similar (non-significant differences) between the two groups.[86] The results are difficult to interpret as some participants may fall more because their level of activity has increased and some interventions are not monitored long enough to detect changes in fall rates.[75]

This category of outcomes has a large body of research supporting the efficacy of Tai Chi on improving factors related to falls, and growing evidence that falls may be reduced. Longer term studies to examine fall rates, and parallel studies that utilize Qigong as the intervention may further clarify the potential of these forms of exercise to affect falls and balance.

Quality of Life

Quality of life (QOL) outcomes were reported in 17 articles (Qigong, n=4 and Tai Chi, n=13). QOL is a broad ranging concept derived in a complex process from measures of a

person's perceived physical health, psychological state, personal beliefs, social relationships and relationship to relevant features of one's environment.[91] In 13 studies of a wide range of participants (including healthy adults, patients with cancer, post-stroke, arthritis, etc.) at least one of the components of QOL was reported to be significantly improved by Tai Chi compared to inactive[34, 66, 69, 73, 92–95] or active controls,[89] and by Qigong compared to inactive[96, 97] or active control groups.[74] Qigong showed improvements in QOL compared to an exercise intervention, but not significantly so.[74]

Conversely, two studies reported no change in QOL, both with severely health-compromised individuals. One was of short duration (6 weeks) conducted with patients with traumatic brain injury.[98] Some improvement in coping was shown with muscular dystrophy patients in response to a Qigong intervention,[58] however, this finding was not significant, and direct QOL measures remained unchanged. One study reported no change in QOL when Tai Chi was compared to balance training and an education control among healthy older adults.[99]

With a few exceptions, the preponderance of studies indicate that Qigong and Tai Chi hold great potential for improving QOL in both healthy and chronically ill patients.

Self-efficacy

Self-efficacy is the confidence a person feels in performing one or several behaviors and the perceived ability to overcome the barriers associated with the performance of those behaviors.[100] Although this is not a health outcome itself, it is often associated directly with health behaviors and benefits (e.g., falls self-efficacy associated with reduced falls), or with psychological health. Significant improvements in this outcome were reported in 8 studies (Qigong, n=2 and Tai Chi, n=6). Self-efficacy was generally assessed in the RCTs as a secondary outcome and reflected the "problem" area under investigation, such as falls self-efficacy (i.e., feeling confident that one will not fall) or efficacy to manage a disease (arthritis, fibromyalgia) or symptom (pain). Self-efficacy for falls was significantly increased as a result of participation in Tai Chi in 3 studies with adults at risk for falls compared to wait-list or usual care, sedentary control groups.[70, 75, 101] In studies with clinical populations, persons with arthritis experienced improvements in arthritis self-efficacy[69] and fibromyalgia patients experienced improvements in the ability to manage pain[102] after participating in Tai chi as compared to inactive control groups that provided social interaction (telephone calls and relaxation therapy respectively). Lastly, the perceived ability to handle stress or novel experiences[97, 103] and exercise self-efficacy[99, 103] were enhanced relative to inactive control groups as a function of participation in Qigong and Tai Chi.

Patient Reported Outcomes

Patient reported outcomes (PROs) include reports of symptoms related to disease as perceived by the patient. The definition of PROs as "a measurement of any aspect of a patient's health status that comes directly from the patient, without the interpretation of the patient's responses by a physician or anyone else,"[104] has developed over the past decade as an important indicator of treatment outcomes that matter to the patient, including an array of symptoms such as pain, fatigue, and nausea. Although PRO lists often include factors such as anxiety and depression, these are not included here, but rather in a separate section to address a range of psychological effects.

Thirteen studies are included in this category (Qigong, n=3 and Tai Chi, n=10). Arthritic pain[68, 73, 105, 106] decreased significantly in response to Tai Chi compared to inactive (health education or usual care) controls. Self-reported neck pain and disability[64] improved to a similar degree for Qigong and an exercise comparison intervention, but the difference

between groups was not significant. Fibromyalgia symptoms improved significantly in one study comparing Tai Chi to a relaxation intervention,[102] while another study reported slight improvements in symptoms for both Qigong and a usual care control group with no significant difference between the groups.[71] Perceived symptoms of heart failure,[55] disability,[67] and sickness impact scores[107] decreased in response to Tai Chi interventions as compared to inactive controls (either usual care or educational interventions) and sleep quality improved for Tai Chi even as compared to an exercise intervention.[108] With Tai Chi, dissociative experiences and symptoms improved clinically, but were not statistically different from gains achieved by a support group among male veterans.[109] Parkinson's disease symptoms and disability were not significantly changed following a 7-week session of Qigong compared to aerobic training sessions.[57]

With the wide range of symptoms, and irregular outcomes of these PROs studies, it is difficult to draw meaningful conclusions about this category. Pain consistently responded to Tai Chi in four studies, while other symptoms were not uniformly assessed.

Psychological

Twenty-seven articles (Qigong, n=7 and Tai Chi, n=19 and one study using both Qigong and Tai Chi) reported on psychological factors such as anxiety, depression, stress, mood, fear of falling, and self-esteem. Most of these studies examined psychological factors as secondary goals of the study, and consequently, they often did not intentionally recruit participants with appreciable psychological distress. Nevertheless, a number of substantial findings dominate this category.

Anxiety decreased significantly for participants practicing Qigong compared to an active exercise group.[28, 46, 110] Depression was shown to improve significantly in studies comparing Qigong to an inactive control, newspaper reading[97] and for Tai Chi compared to usual care, psychosocial support or stretching/education controls.[56, 73, 111] General measures of mood (e.g, Profile of Mood States) were improved significantly for participants practicing Tai Chi compared to usual care controls.[66, 98, 103, 112]

Depression improved, but not significantly, for both Qigong and exercise comparison groups[28, 96] and for Tai Chi compared to an educational intervention.[113] One study reported improved depression, anxiety, and stress among patients with osteoarthritis for both Tai Chi and hydrotherapy groups compared to a wait-list control, but only significantly so for hydrotherapy.[68]

Non-significant changes in anxiety were reported in a study of Tai Chi compared to a relaxation intervention[102] and two other studies did not detect significant differences in depression in response to Tai Chi[55, 102] or Qigong[58] compared to usual care or inactive controls. Fear of falling decreased significantly in most studies[49, 82, 83, 101, 114] except for one that showed no change.[84] Reports of self-esteem significantly improved in tests of Tai Chi compared to usual care[93, 115] and psychosocial support,[95] but the increase in self-esteem compared to exercise and education controls was not significant.[99]

Jin[112] specifically created a stressful situation and measured the response in mood, self-reported stress levels, and BP, across 4 interventions, including Tai Chi, meditation, brisk walking and neutral reading. Significant improvements were shown in adrenaline, heart rate, and noradrenaline in Tai Chi compared to a neutral reading intervention, while all groups showed improvements in cortisol. In another study examining blood markers related to stress response, norepinephrine, epinephrine and cortisol blood levels were significantly decreased in response to Qigong compared to a wait-list control group.[110]

This category of symptoms, particularly anxiety and depression, shows fairly consistent responses to both Tai Chi and Qigong, especially when the control intervention does not include active interventions such as exercise. In particular, with a few studies indicating that there may be changes in biomarkers associated with anxiety and/or depression in response to the interventions, this category shows promise for examining potential mechanisms of action for the change in psychological state.

Immune Function and Inflammation

Immune-related responses have also been reported in response to Qigong (n=3) and Tai Chi (n=3) studies. Manzaneque et al.[116] reported improvements in a number of immune-related blood markers, including total number of leukocytes, number of eosinphils, and number and percentage of monocytes, as well as the complement C3 levels following a 1-month Qigong intervention compared to usual care. Antibody levels in response to flu vaccinations were significantly increased among a Qigong group compared to usual care.[117] Varicella zoster virus titers and T-cells increased in response to vaccine among Tai Chi practitioners.[113] An earlier study conducted by Irwin and colleagues[92] reported an increase in varicella zoster virus specific cell-mediated immunity among those practicing Tai Chi compared to wait-list controls.

Immune function and inflammation are closely related, and are often assessed using a variety of blood markers, particularly certain cytokines and C-reactive protein. Interleukin-6, an important marker of inflammation, was found to be significantly modulated in response to practicing Qigong, compared to a no-exercise control group.[40] On the other hand, C-reactive protein and erythrocyte sedimentation rates remained unchanged among a group of rheumatoid arthritic patients who participated in a Tai Chi class compared to stretching and wellness education.[73]

A number of studies not utilizing an RCT design have examined blood markers prior to and after Tai Chi or Qigong interventions, providing some indication of factors that might be important to explore in future RCTs (and not reported in the table). For example, improvements in thyroid-stimulating hormone, follicle-stimulating hormone, triiodothyronine,[118] and lymphocyte production[119] have been noted in response to Tai Chi compared to matched controls. Pre-post Tai Chi intervention designs have also shown an improvement in immunoglobulin G (IgG)[120] and natural killer (NK) cells[121] and similar non-RCTs have suggested that Qigong improves immune function and reduces inflammation profiles as indicated by cytokine and T-lymphocyte subset proportions.[122–124]

As with the category of psychological outcomes, these immune and inflammation related parameters fairly consistently respond to Tai Chi and Qigong, while also providing potential for examining mechanisms of action.

Discussion

In answering Research Question 1, we have identified 9 categories of health benefits related to Tai Chi and Qigong interventions, with varying levels of support. Six domains of health-related benefits have dominated the research with sixteen or more RCTs published for each of these outcomes: psychological effects (27), falls/balance (23), cardiopulmonary fitness (19), QOL (17), PROs (18), and physical function (16). These areas represent most of the RCTs reviewed, with many of the studies including multiple measured outcomes spanning across several categories (n=42). Substantially fewer RCTs have been completed in the other three categories, including bone density (4), self-efficacy (8), and studies examining markers of immune function or inflammation (6).

The preponderance of studies showed significant, positive results on the tested health outcomes, especially when comparisons were made with minimally active or inactive controls (n=52). For some of the outcomes addressed in this review, there were studies that did not demonstrate significant improvements for the Tai Chi or Qigong intervention as compared to the control condition. For the most part, however, these non-significant findings occurred in studies in which the control design was actually a treatment type of control expected to produce similar benefits, such as an educational control group intervention producing similar outcomes as Tai Chi for self-esteem,[99] aerobic exercise showing similar results to Qigong in reducing depression,[28, 57] an acupressure group successfully maintaining weight loss compared to no intervention effect for Qigong,[60] or resistance training producing similar (nonsignificant) effects as Tai Chi for muscle strength, balance, and falls.[43, 66] It is important to note that although the Tai Chi and Qigong interventions did not produce larger benefits than these active treatment controls, in most cases substantial improvements in the outcome were observed for both treatment groups.

Other studies in which the improvements did not significantly differ between the treatment group and the control group suffered from: (a) study designs of shorter duration (4 to 8 weeks, rather than the usual 12 or more weeks)[51, 98] although there were some exceptional studies with significant results after only 8 weeks;[44, 83, 103] (b) selection of very health-compromised participants or individuals with conditions that do not generally respond to other conventional treatments or medicines such as muscular dystrophy,[58] multiple morbidities,[47] fibromyalgia,[71] arthritis;[73] or (c) the outcome measured was not noted as particularly problematic nor set as an eligibility criteria for poor starting levels at baseline (n=5).[28, 96]

On the other hand, in the areas of research that address outcomes typically associated with physical exercise, such as cardiopulmonary health or physical function, results are fairly consistent in showing that positive, significantly larger effects are observed for both Tai Chi and Qigong when compared to no-exercise control groups and similar health outcomes are found when compared to exercise controls. Even with the very wide range of study design types, strength of control interventions, and the entry level of the health status of study participants, there remain a number of remarkable and persistent findings of health benefits in response to both Qigong and Tai Chi.

In response to Research Question 2, we have noted in earlier sections the ways in which Qigong and Tai Chi are considered equivalent, and now address how studies identifying similar outcomes in response to these practices may provide additional evidence for equivalence. On the surface, research that examines the effects of Qigong on health outcomes appears to be of lesser magnitude than the research on what is typically called Tai Chi. For each category of outcomes described above, we noted how many RCTs had been conducted for each, Tai Chi and Qigong, and for the most part, there were many fewer reports on Qigong than for what is named Tai Chi for any given outcome examined. Nevertheless, across the outcomes examined in RCTs, the findings are often similar, with no particular trends indicating that one has different effects than the other.

As noted earlier, however, it is not unusual for the intervention used in a study or trial to be named Tai Chi, but to actually apply a set of activities which is more a form of Qigong, that is, easy-to-learn movements that are simple and repeatable rather than the long complex sequences of traditional Tai Chi movements that can take a long time to learn. For example, a large number of studies examining Tai Chi effects on balance use a modified, repetitive form of Tai Chi which is more like Qigong. Thus, while it appears that fewer studies have been conducted to test what is called Qigong, it is also clear that when a practice called Tai

Chi is modified to focus, especially on balance enhancement, for example, it actually may be Tai Chi in name only.

Given the apparent similarity of practice forms utilized in research, the discussion of equivalence of Tai Chi and Qigong extends beyond the earlier observation that they are similar in practice and philosophy. Since research designs often incorporate blended aspects of both Qigong and Tai Chi, it is unreasonable to claim that the evidence is lacking for one or the other and it becomes inappropriate not to claim their equivalence. We suggest that the combined current research provides a wider base of growing evidence indicating that these two forms produce a wide range of health-related benefits.

The problem with claiming equivalence, then, does not lie within the smaller number of studies using a form called Qigong, but rather in the lack of detail reported across the studies regarding whether or not the interventions contain the key elements philosophically and operationally thought to define meditative movement practices such as Tai Chi and Qigong. In previous publications, and in this review, we note that the roots of both of these TCM-based wellness practices require that the key elements of meditative movement be implemented: focus on regulating the body (movement/posture); focus on regulating the breath; and focus on regulating the mind (consciousness) to achieve a meditative state. Given the equivalence noted in foundational principles and practice, the differences among interventions and resultant effects on outcomes would perhaps more purposefully be assessed for intervention fidelity (i.e., adherence to the criteria of meditative movement).

Beyond the meditative movement factors that tie the practices and expected outcomes together, other, more conventional factors would be important to assess, each potentially contributing to variations in outcomes achieved. For example, dosing (i.e., frequency, duration and level of intensity, including estimate of aerobic level or metabolic equivalents) may be important in whether or not benefits accrue. Or, a focus on particular muscle groups may be critical to understanding changes relative to certain goals (e.g., how many of the exercises chosen for a study protocol develop quadricep strength likely to produce results for specific physical function tests?). Beyond the important similarities of movement and a focus on breath and mind to achieve meditative states, there are other aspects that vary greatly within the wide variety of both Tai Chi and Qigong exercises, including speed of execution, muscle groups used and range of motion, all of which may provide differences in the physiologically-oriented outcomes (similar to the differences that could be noted in the wide variety of exercises considered under the aerobic “umbrella”).

The question of the equivalence Tai Chi and Qigong, then, may be helpful if the focus is on similarity in philosophy and practice. With consistent reporting on adherence to the above mentioned aspects of practice, not only could a level of standardization be implemented, but also measures that control for variation of interventions could be used to better understand differences and similarities in effects.[1]

Limitations

For purposes of this review, a study was selected if it was designed as an RCT and compared the effects of either Tai Chi or Qigong to those of a control condition on a physical or psychological health outcome. However, there was no further grading of the quality of the research design. As a result of this relatively broad inclusion criterion, the studies represent a wide variety in methods of controlling for balanced randomization and intent to treat analyses, in the specific methods of implementing Tai Chi and Qigong, in the outcomes assessed, in the measurement tools used to ascertain the outcomes, and in the populations being studied.

One difficulty in examining such a broad scope of studies is that the large number of studies required that we logically, but artificially, construct categories within which to discuss each group of outcomes. However, by choosing to categorize by health outcomes, rather than participant, patient or disease types, we have provided one particular view of the data, and may have obscured other aspects. For example, in a recently published review, the authors analyzed studies that were conducted with community-dwelling adults over the age of 55.[125] Results showed that interventions utilizing Tai Chi and Qigong may help older adults improve physical function and reduce blood pressure, fall risk, and depression and anxiety. Another view of these data may emerge if only studies of chronically ill participants are evaluated. Thus, there may be other ways to examine the RCTs reported in the current review such that specific diseases or selected study populations may reveal more consistent findings (positive or negative) for certain outcomes that are clearly tied to entry level values.

Conclusion

A compelling body of research emerges when Tai Chi studies and the growing body of Qigong studies are combined. The evidence suggests that a wide range of health benefits accrue in response to these meditative movement forms, some consistently so, and some with limitations in the findings thus far. This review has identified numerous outcomes with varying levels of evidence for the efficacy for Qigong and Tai Chi, including bone health, cardiopulmonary fitness and related biomarkers, physical function, falls prevention and balance, general quality of life and patient reported outcomes, immunity, and psychological factors such as anxiety, depression and self-efficacy. A substantial number RCTs have demonstrated consistent, positive results especially when the studies are designed with limited activity for controls. When both Tai Chi and Qigong are investigated together, as two approaches to a single category of practice, meditative movement, the magnitude of the body of research is quite impressive.

So What?

Application to research

The current state of research splinters these TCM-based wellness practices by identifying them with different names, and treating them as separate and different methodologies. Our intent has been to recognize the common critical elements of Qigong and Tai Chi, based on the similarities in philosophy and practice and the range of findings for similar health outcomes, and to treat the two as equivalent forms. Studies in the future should acknowledge these elements, and even test for intervention fidelity, to assure that the practices do, in fact, reflect the guiding principles of Tai Chi and Qigong. Beyond this we assert that it is critical to begin delineating the practice characteristics that actually do differ both between and within these practices, so that a more specific body of knowledge can begin to accumulate about the types of practices, the component features of the practices and their effects on health-related outcomes.

Some studies of these forms of meditative movement indicate that study participants with severe, chronic, progressive illnesses may be slower to respond or not respond at all to the practices. Interestingly, however, other studies suggest that these practices may improve or slow the progression of such illnesses. This may be especially likely when the practices are implemented early as an aspect of wellness, prevention or disease management in a proactive, risk reduction context. These findings suggest that continued research on these and other forms of meditative movement is warranted for a broad number of conditions and across populations.

The wide variations in populations and outcomes studied, descriptions of interventions (or the lack of such description), reports of dose, and the extreme variety in the sorts of tools used to assess outcomes, point to the need to develop more standardized protocols and trends in measurement for the field of meditative movement research. Application in health promotion

The preponderance of findings are positive for a wide range of health benefits in response to Tai Chi, and a growing evidence base for similar benefits for Qigong. As described, the foundational similarities and the often adapted Tai Chi protocols which more closely resemble forms of Qigong, allow us to suggest that outcomes can be counted across both types of studies, further supporting claims of equivalence.

In a recent review addressing Tai Chi and Qigong research among older adults, it was pointed out that no adverse events were reported across studies.[125] The substantial potential for achieving health benefits, the minimal cost incurred by this form of self-care, and the apparent safety of implementation across populations, points to the importance of wider implementation and dissemination. The health promotion challenge is that both Tai Chi and Qigong are still often considered novel forms of exercise and adopted by a small market segment of our population. On the positive side, however, there is a rapid increase of visibility of what is popularly referenced as Tai Chi which is known as an effective intervention for balance enhancement and falls prevention among the elderly, and there is a growing interest in safe, alternative forms of exercise across all age groups. Tai Chi and Qigong interventions provide an accessible alternative option for individuals who may prefer these activities over more conventional or vigorous forms of exercise. The growing interest in these forms of exercise that include a mindful focus on the breath and meditation provides an opportunity for changing the landscape of personal choice making and shifts the motivations that people have to exercise, while presenting an entirely new set of exercise research opportunities. This suggests that Tai Chi and Qigong (or more generally, meditative movement types of exercise) may provide an attractive and effective exercise alternatives for the large populations of people at risk for preventable disease, sedentary, and lacking the motivation to engage in more conventional exercise.

References

1. Larkey L, Jahnke R, Etnier J, Gonzalez J. Meditative movement as a category of exercise: Implications for research. Journal of Physical Activity & Health. 2009; 6:230–238. [PubMed: 19420401]
2. Jahnke, R. The Healing Promise of Qi: Creating Extraordinary Wellness through Qigong and Tai Chi. Chicago, Il: Contemporary Books; 2002.
3. Lee MS, Pittler MH, Guo R, Ernst E. Qigong for hypertension: A systematic review of randomized clinical trials. Journal of Hypertension. 2007; 25:1525–32. [PubMed: 17620944]
4. Lee MS, Pittler MH, Taylor-Piliae RE, Ernst E. Tai chi for cardiovascular disease and its risk factors: A systematic review. Journal of Hypertension. 2007; 25:1974–5. [PubMed: 17762664]
5. Cheng T. Tai chi: The Chinese ancient wisdom of an ideal exercise for cardiac patients. International Journal of Cardiology. 2006; 117:293–295. [PubMed: 16904211]
6. Lee MS, Chen KW, Sancier KM, Ernst E. Qigong for cancer treatment: A systematic review of controlled clinical trials. Acta Oncol. 2007; 46:717–22. [PubMed: 17653892]
7. Lee MS, Pittler MH, Ernst E. Is tai chi an effective adjunct in cancer care? A systematic review of controlled clinical trials. Supportive Care in Cancer. 2007; 15:597–601. [PubMed: 17318592]
8. Mansky P, Sannes T, Wallerstedt D, et al. Tai chi chuan: Mind-body practice or exercise intervention? studying the benefit for cancer survivors. Integrative Cancer Therapies. 2006; 5:192–201. [PubMed: 16880423]

9. Lee MS, Pittler MH, Ernst E. Tai chi for rheumatoid arthritis: Systematic review. Rheumatology. 2007; 46:1648–51. [PubMed: 17634188]
10. Taylor-Piliae RE, Haskell WL. Tai chi exercise and stroke rehabilitation. Topics in Stroke Rehabilitation. 2007; 14:9–22. [PubMed: 17698454]
11. Taylor-Piliae RE, Froelicher ES. The effectiveness of tai chi exercise in improving aerobic capacity: A meta-analysis. Journal of Cardiovascular Nursing. 2004; 19:48–57. [PubMed: 14994782]
12. Wayne PM, Krebs DE, Wolf SL, et al. Can tai chi improve vestibulopathic postural control? Archives of Physical and Medicine & Rehabilitation. 2004; 85:142–152.
13. Verhagen AP, Immink M, van der Meulen A, Bierma-Zeinstra SMA. The efficacy of tai chi chuan in older adults: A systematic review. Family Practice. 2004; 21:107–13. [PubMed: 14760055]
14. Wayne PM, Kiel DP, Krebs DE, et al. The effects of tai chi on bone mineral density in postmenopausal women: A systematic review. Archives of Physical Medicine & Rehabilitation. 2007; 88:673–80. [PubMed: 17466739]
15. Irwin M, Pike J, Oxman M. Shingles immunity and health functioning in the elderly: Tai chi chih as a behavioral treatment. Evidence-based Complementary and Alternative Medicine. 2004; 1:223–232. [PubMed: 15841255]
16. Lan C, Lai JS, Chen SY. Tai chi chuan: An ancient wisdom on exercise and health promotion. Sports Medicine. 2002; 32:217–224. [PubMed: 11929351]
17. Sancier KM. Medical applications of qigong. Alternative Therapies. 1996; 2:40–46.
18. Sancier KM. Therapeutic benefits of qigong exercises in combination with drugs. Journal of Alternative and Complementary Medicine. 1999; 5:383–389.
19. Sancier KM, Holtman D. Commentary: Multifaceted health benefits of medical qigong. The Journal of Alternative and Complementary Medicine. 2004; 10:163–165. [PubMed: 15025890]
20. Li JX, Hong Y, Chan KM. Tai chi: Physiological characteristics and beneficial effects on health. Br J Sports Med. 2001; 35:148–56. [PubMed: 11375872]
21. Adler PA, Roberts BL. The use of tai chi to improve health in older adults.[see comment]. Orthopaedic Nursing. 2006; 25:122–126. [PubMed: 16572030]
22. Hogan M. Physical and cognitive activity and exercise for older adults: A review. Int J Aging Hum Dev. 2005; 60:95–126. [PubMed: 15801385]
23. Kemp CA. Qigong as a therapeutic intervention with older adults. Journal of Holistic Nursing. 2004; 22:351–373. [PubMed: 15486154]
24. Wolf SL, Coogler C, Xu T. Exploring the basis for tai chi chuan as a therapeutic exercise approach. Arch Phys Med Rehabil. 1997; 78:886–92. [PubMed: 9344312]
25. Wang C, Collet JP, Lau J. The effect of tai chi on health outcomes in patients with chronic conditions: A systematic review.[see comment]. Archives of Internal Medicine. 2004; 164:493–501. [PubMed: 15006825]
26. Matsuda S, Martin D, Yu T. Ancient exercise for modern rehab: Tai chi promotes wellness and fitness among a wide range of patients. Rehab Manage. 2005; 18:24–27.
27. Chen K, Yeung R. A review of qigong therapy for cancer treatment. Journal of International Society of Life Information Science. 2002; 20:532–542.
28. Cheung BMY, Lo JLF, Fong DYT, et al. Randomised controlled trial of qigong in the treatment of mild essential hypertension. Journal of Human Hypertension. 2005; 19:697–704. [PubMed: 15905884]
29. Lee MS, Jeong SM, Kim YK, et al. Qi-training enhances respiratory burst function and adhesive capacity of neutrophils in young adults: A preliminary study. Am J Chin Med. 2003; 31:141–148. [PubMed: 12723764]
30. Faber MJ, Bosscher RJ, Chin A Paw MJ, van Wieringen PC. Effects of exercise programs on falls and mobility in frail and pre-frail older adults: A multicenter randomized controlled trial. Archives of Physical Medicine & Rehabilitation. 2006; 87:885–896. [PubMed: 16813773]
31. Fransen M, Nairn L, Winstanley J, Lam P, Edmonds J. Physical activity for osteoarthritis management: A randomized controlled clinical trial evaluating hydrotherapy or tai chi classes. Arthritis & Rheumatism. 2007; 57:407–414. [PubMed: 17443749]

32. Greenspan AI, Wolf SL, Kelley ME, O'Grady M. Tai chi and perceived health status in older adults who are transitionally frail: A randomized controlled trial. Phys Ther. 2007; 87:525–535. [PubMed: 17405808]
33. Li F, Fisher KJ, Harmer P, Shirai M. A simpler eight-form easy tai chi for elderly adults. J Aging Phys Activity. 2003; 11:206–18.
34. 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. [see comment]. American Journal of Medicine. 2004; 117:541–8. [PubMed: 15465501]
35. Chodzko-Zajko, W.; Jahnke, R. Working Group. National expert meeting on qi gong and tai chi: Concensus report. Urbana, Il: University of Illinois at Urbana-Champaign; November. 2005 Available from: http://healerwithinfoundation.org/National_Expert_Meeting/
36. Orr R, Tsang T, Lam P, Comino E, Singh MF. Mobility impairment in type 2 diabetes: Association with muscle power and effect of tai chi intervention. Diabetes Care. 2006; 29:2120–2. [PubMed: 16936164]
37. Li, F.; Harmer, P.; Fisher, KJ.; McAuley, E. Tai chi: Improving functional balance and predicting subsequent falls in older persons; Med Sci Sports Exerc. 2004. p. 2046-2052.Available from: http://www.cinahl.com/cgi-bin/refsvc?jid=1040&accno=2005073881
38. American College of Sports Medicine. Physical activity and bone health. Medicine & Science in Sports & Exercise. January 23.1996 2004 2008–1985.
39. Maddalozzo GF, Snow CM. High intensity resistance training: Effects on bone in older men and women. Calcified Tissue International. 2000; 66:399–404. [PubMed: 10821873]
40. Chen HH, Yeh ML, Lee FY. The effects of baduanjin qigong in the prevention of bone loss for middle-aged women. The American Journal of Chinese Medicine. 2006; 34:741–747. [PubMed: 17080541]
41. Chan K, Qin L, Lau M, et al. A randomized, prospective study of the effects of tai chi chun exercise on bone mineral density in postmenopausal women. Archives of Physical Medicine & Rehabilitation. 2004; 85:717–22. [PubMed: 15129394]
42. Shen C, Williams JS, Chyu M, et al. Comparison of the effects of tai chi and resistance training on bone metabolism in the elderly: A feasibility study. American Journal of Chinese Medicine. 2007; 35:369–81. [PubMed: 17597496]
43. Woo J, Hong A, Lau E, Lynn H. A randomised controlled trial of tai chi and resistance exercise on bone health, muscle strength and balance in community-living elderly people. Age & Ageing. 2007; 36:262–8. [PubMed: 17356003]
44. Lee MS, Lee MS, Kim HJ, Choi ES. Effects of qigong on blood pressure, high-density lipoprotein cholesterol and other lipid levels in essential hypertension patients. International Journal of Neuroscience. 2004; 114:777–786. [PubMed: 15204043]
45. Lee MS, Lee MS, Choi ES, Chung HT. Effects of qigong on blood pressure, blood pressure determinants and ventilatory function in middle-aged patients with essential hypertension. The American Journal of Chinese Medicine. 2003; 31:489–497. [PubMed: 12943180]
46. Tsai J, Wang W, Chan P, et al. The beneficial effects of tai chi chuan on blood pressure and lipid profile and anxiety in a randomized controlled trial. The Journal of Alternative and Complimentary Medicine. 2003; 9:747–754.
47. Wolf SL, O'Grady M, Easley KA, Guo Y, Kressig RW, Kutner M. The influence of intense tai chi training on physical performance and hemodynamic outcomes in transitionally frail, older adults. Journals of Gerontology Series A-Biological Sciences & Medical Sciences. 2006; 61:184–189.
48. Young DR, Appel LJ, Jee S, Miller ER 3rd. The effects of aerobic exercise and tai chi on blood pressure in older people: Results of a randomized trial. Journal of the American Geriatrics Society. 1999; 47:277–84. [PubMed: 10078888]
49. Wolf SL, Barnhart HX, Kutner NG, et al. Selected as the best paper in the 1990s: Reducing frailty and falls in older persons: An investigation of tai chi and computerized balance training. Journal of the American Geriatrics Society. 2003; 51:1794–803. [PubMed: 14687360]
50. Motivala SJ, Sollers J, Thayer J, Irwin MR. Tai chi chih acutely decreases sympathetic nervous system activity in older adults. Journals of Gerontology Series A-Biological Sciences & Medical Sciences. 2006; 61:1177–80.

51. Channer KS, Barrow D, Barrow R, Osborne M, Ives G. Changes in haemodynamic parameters following tai chi chuan and aerobic exercise in patients recovering from acute myocardial infarction. Postgraduate Medical Journal. 1996; 72:349–51. [PubMed: 8758013]
52. Thomas GN, Hong AWL, Tomlinson B, et al. Effects of tai chi and resistance training on cardiovascular risk factors in elderly Chinese subjects: A 12-month longitudinal, randomized, controlled intervention study. Clinical Endocrinology. 2005; 63:663–9. [PubMed: 16343101]
53. Audette JF, Jin YS, Newcomer R, Stein L, Duncan G, Frontera WR. Tai chi versus brisk walking in elderly women. Age & Ageing. 2006; 35:388–93. [PubMed: 16624847]
54. Pippa L, Manzoli L, Corti I, Congedo G, Romanazzi L, Parruti G. Functional capacity after traditional chinese medicine (qi gong) training in patients with chronic atrial fibrillation: A randomized controlled trial. Preventive Cardiology. 2007; 10:22–5. [PubMed: 17215629]
55. Barrow DE, Bedford A, Ives G, O'Toole L, Channer KS. An evaluation of the effects of tai chi chuan and chi kung training in patients with symptomatic heart failure: A randomised controlled pilot study. Postgraduate Medical Journal. 2007; 83:717–21. [PubMed: 17989272]
56. Mustian KM, Katula JA, Zhao H. A pilot study to assess the influence of tai chi chuan on functional capacity among breast cancer survivors. The Journal of Supportive Oncology. 2006; 4:139–45. [PubMed: 16553140]
57. Burini D, Farabollini B, Iacucci S, et al. A randomized controlled cross-over trial of aerobic training versus qigong in advanced Parkinson's disease. Europa Medicophysica. 2006; 42:231–8. [PubMed: 17039221]
58. Wenneberg S, Gunnarsson L, Ahlstrom G. Using a novel exercise programme for patients with muscular dystrophy. part II: A quantitative study. Disabil Rehabil. 2004; 26:595–602. [PubMed: 15204513]
59. Song R, Lee E, Lam P, Bae S. 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. Journal of Rheumatology. 2003; 30:2039–44. [PubMed: 12966613]
60. Elder C, Ritenbaugh C, Mist S, et al. Randomized trial of two mind-body interventions for weight-loss maintenance. Journal of Alternative & Complementary Medicine. 2007; 13:67–78.
61. Lan C, Chou S, Chen S, Lai J, Wong M. The aerobic capacity and ventilatory efficiency during exercise in qigong and tai chi chuan practitioners. American Journal of Chinese Medicine. 2004; 32:141–50. [PubMed: 15154293]
62. Freemont AJ, Hoyland JA. Morphology, mechanisms and pathology of musculoskeletal ageing. 2007; 211:252–259.
63. Spirduso, WW.; Francis, KL.; MacRae, PG. Physical Dimensions of Aging. 2. Champaign, IL: Human Kinetics; 2005.
64. Lansinger B, Larsson E, Persson LC, Carosson JY. Qigong and exercise therapy in patients with long-term neck pain: A prospective randomized trial. Spine. 2007; 32:2415–2422. [PubMed: 18090079]
65. Gatts SK, Woollacott MH. Neural mechanisms underlying balance improvement with short term tai chi training. Aging-Clinical & Experimental Research. 2006; 18:7–19. [PubMed: 16608131]
66. Galantino ML, Shepard K, Krafft L, et al. The effect of group aerobic exercise and t'ai chi on functional outcomes and quality of life for persons living with acquired immunodeficiency syndrome. Journal of Alternative & Complementary Medicine. 2005; 11:1085–92.
67. Faber MJ, Bosscher RJ, Chin A, Paw MJ, van Wieringen PC. Effects of exercise programs on falls and mobility in frail and pre-frail older adults: A multicenter randomized controlled trial. Archives of Physical Medicine & Rehabilitation. 2006; 87:885–96. [PubMed: 16813773]
68. Fransen M, Nairn L, Winstanley J, Lam P, Edmonds J. Physical activity for osteoarthritis management: A randomized controlled clinical trial evaluating hydrotherapy or tai chi classes. Arthritis & Rheumatism. 2007; 57:407–14. [PubMed: 17443749]
69. Hartman CA, Manos TM, Winter C, Hartman DM, Li B, Smith JC. Effects of T'ai chi training on function and quality of life indicators in older adults with osteoarthritis. Journal of the American Geriatrics Society. 2000; 48:1553–9. [PubMed: 11129742]
70. Li F, Harmer P, McAuley E, Fisher KJ, Duncan TE, Duncan SC. Tai chi, self-efficacy, and physical function in the elderly. Prevention Science. 2001; 2:229–39. [PubMed: 11833926]

71. Mannerkorpi K, Arndorw M, Mannerkorpi K, Arndorw M. Efficacy and feasibility of a combination of body awareness therapy and qigong in patients with fibromyalgia: A pilot study. Journal of Rehabilitation Medicine. 2004; 36:279–81. [PubMed: 15841606]
72. Li F, Harmer P, McAuley E, et al. An evaluation of the effects of tai chi exercise on physical function among older persons: A randomized controlled trial. Annals of Behavioral Medicine. 2001; 23:139–46. [PubMed: 11394556]
73. Wang C, Roubenoff R, Lau J, et al. Effect of tai chi in adults with rheumatoid arthritis. Rheumatology. 2005; 44:685–7. [PubMed: 15741197]
74. Tsang T, Orr R, Lam P, Comino EJ, Singh MF. Health benefits of tai chi for older patients with type 2 diabetes: The “move it for diabetes study”-A randomized controlled trial. Clinical Interventions in Aging. 2007; 2:429–439. [PubMed: 18044193]
75. Choi JH, Moon J, Song R. Effects of sun-style tai chi exercise on physical fitness and fall prevention in fall-prone older adults. Journal of Advanced Nursing. 2005; 51:150–7. [PubMed: 15963186]
76. Judge JO, Lindsey C, Underwood M, Winsemius D. Balance improvements in older women: Effects of exercise training. Physical Therapy. 1993; 73:254–265. [PubMed: 8456144]
77. Li, F.; Harmer, P.; Fisher, KJ., et al. Tai chi and fall reductions in older adults: A randomized controlled trial; J Gerontol A Biol Sci Med Sci. 2005. p. 187-194.Available from: http://www.cinahl.com/cgi-bin/refsvc?jid=1022&accno=2009070904
78. Maciaszek J, Osiski W, Szeklicki R, Stemplewski R. Effect of tai chi on body balance: Randomized controlled trial in men with osteopenia or osteoporosis. American Journal of Chinese Medicine. 2007; 35:1–9. [PubMed: 17265545]
79. Sattin, RW.; Easley, KA.; Wolf, SL.; Chen, Y.; Kutner, MH. Reduction in fear of falling through intense tai chi exercise training in older, transitionally frail adults; J Am Geriatr Soc. 2005. p. 1168-1178.Available from: http://www.cinahl.com/cgi-bin/refsvc?jid=748&accno=2009007318
80. Voukelatos A, Cumming RG, Lord SR, Rissel C. A randomized, controlled trial of tai chi for the prevention of falls: The central Sydney tai chi trial. Journal of the American Geriatrics Society. 2007; 55:1185–91. [PubMed: 17661956]
81. Wolf, SL.; Sattin, RW.; Kutner, M.; O’Grady, M.; Greenspan, AI.; Gregor, RJ. Intense tai chi exercise training and fall occurrences in older, transitionally frail adults: A randomized, controlled trial... includes commentary by Lavery L and Studenski S; J Am Geriatr Soc. 2003. p. 1693-701.p. 1804-5.Available from: http://www.cinahl.com/cgi-bin/refsvc?jid=748&accno=2004130497
82. Wolf SL, Barnhart HX, Ellison GL, Coogler CE. The effect of tai chi quan and computerized balance training on postural stability in older subjects. Atlanta FICSIT group. frailty and injuries: Cooperative studies on intervention techniques. Physical Therapy. 1997; 77:371–81. [PubMed: 9105340]
83. Zhang J, IshikawaTakata K, Yamazaki H, Morita T, Ohta T. The effects of tai chi chuan on physiological function and fear of falling in the less robust elderly: An intervention study for preventing falls. Arch Gerontol Geriatr. 2006; 42:107–116. [PubMed: 16125805]
84. Stenlund T, Lindstrom B, Granlund M, Burell G. Cardiac rehabilitation for the elderly: Qi gong and group discussions. European Journal of Cardiovascular Prevention & Rehabilitation. 2005; 12:5–11. [PubMed: 15703500]
85. Yang Y, Verkuilen JV, Rosengren KS, Grubisich SA, Reed MR, Hsiao-Wecksler ET. Effect of combined taiji and qigong training on balance mechanisms: A randomized controlled trial of older adults. Medical Science Monitor. 2007; 13:CR339–48. [PubMed: 17660722]
86. Nowalk MP, Prendergast JM, Bayles CM, D’Amico FJ, Colvin GC. A randomized trial of exercise programs among older individuals living in two long-term care facilities: The FallsFREE program. Journal of the American Geriatrics Society. 2001; 49:859–65. [PubMed: 11527475]
87. McGibbon CA, Krebs DE, Parker SW, Scarborough DM, Wayne PM, Wolf SL. Tai chi and vestibular rehabilitation improve vestibulopathic gait via different neuromuscular mechanisms: Preliminary report. BMC Neurology. 2005; 5:3. [PubMed: 15717934]
88. McGibbon CA, Krebs DE, Wolf SL, Wayne PM, Scarborough DM, Parker SW. Tai chi and vestibular rehabilitation effects on gaze and whole-body stability. Journal of Vestibular Research. 2004; 14:467–78. [PubMed: 15735329]

89. Hart J, Kanner H, Gilboa-Mayo R, Haroeh-Peer O, Rozenthul-Sorokin N, Eldar R. Tai chi chuan practice in community-dwelling persons after stroke. International Journal of Rehabilitation Research. 2004; 27:303–4. [PubMed: 15572994]

90. Hass, CJ.; Gregor, RJ.; Waddell, DE., et al. The influence of tai chi training on the center of pressure trajectory during gait initiation in older adults; Arch Phys Med Rehabil. 2004. p. 1593-1598.Available from: http://www.cinahl.com/cgi-bin/refsvc?jid=123&accno=2005029868

91. World Health Organization. Active ageing: A policy framework. 2002.

92. Irwin MR, Pike JL, Cole JC, Oxman MN. Effects of a behavioral intervention, tai chi chih, on varicella-zoster virus specific immunity and health functioning in older adults. Psychosomatic Medicine. 2003; 65:824–30. [PubMed: 14508027]

93. Lee LYK, Lee DTF, Woo J. Effect of tai chi on state self-esteem and health-related quality of life in older Chinese residential care home residents. Journal of Clinical Nursing. 2007; 16:1580–2. [PubMed: 17655547]

94. Li F, Fisher KJ, Harmer P, McAuley E. Delineating the impact of tai chi training on physical function among the elderly. American Journal of Preventive Medicine. 2002; 23:92–7. [PubMed: 12133743]

95. Mustian KM, Katula JA, Gill DL, Roscoe JA, Lang D, Murphy K. Tai chi chuan, health- related quality of life and self-esteem: A randomized trial with breast cancer survivors. Supportive Care in Cancer. 2004; 12:871–6. [PubMed: 15599776]

96. Tsang HWH, Mok CK, Yeung YTA, Chan SYC. The effect of qigong on general and psychosocial health of elderly with chronic physical illnesses: A randomized clinical trial. International Journal of Geriatric Psychiatry. 2003; 18:441–9. [PubMed: 12766922]

97. Tsang HWH, Fung KMT, Chan ASM, Lee G, Chan F. Effect of a qigong exercise programme on elderly with depression. International Journal of Geriatric Psychiatry. 2006; 21:890–7. [PubMed: 16955451]

98. Gemmell C, Leathem JM. A study investigating the effects of tai chi chuan: Individuals with traumatic brain injury compared to controls. Brain Injury. 2006; 20:151–156. [PubMed: 16421063]

99. Kutner NG, Barnhart H, Wolf SL, McNeely E, Xu T. Self-report benefits of tai chi practice by older adults. J Gerontol B Psychol Sci Soc Sci. 1997; 52B:P242–6. [PubMed: 9310093]

100. Baranowski, T.; Perry, CL.; Parcel, GS. How individuals, environments, and health behavior interact: Social cognitive theory. In: Glanz, K.; Rimer, BK.; Lewis, FM., editors. Health Behavior and Health Education: Theory, Research, and Practice. 3. San Francisco: John Wiley & Sons; 2002. p. 8

101. Li, F.; Fisher, KJ.; Harmer, P.; McAuley, E. Falls self-efficacy as a mediator of fear of falling in an exercise intervention for older adults; J Gerontol B Psychol Sci Soc Sci. 2005. p. P34-40.Available from: http://www.cinahl.com/cgi-bin/refsvc?jid=1173&accno=2009117775

102. Hammond A, Freeman K. Community patient education and exercise for people with fibromyalgia: A parallel group randomized controlled trial. Clinical Rehabilitation. 2006; 20:835–46. [PubMed: 17008336]

103. Lee MS, Lim HJ, Lee MS. Impact of qigong exercise on self-efficacy and other cognitive perceptual variables in patients with essential hypertension. The Journal of Alternative and Complimentary Medicine. 2004; 10:675–680.

104. United States Food and Drug Administration (FDA). Consumer updates. Available at: http://www.fda.gov.ezproxy1.lib.asu.edu/ForConsumers/ConsumerUpdates/default.htm

105. Brismee J, Paige RL, Chyu M, et al. Group and home-based tai chi in elderly subjects with knee osteoarthritis: A randomized controlled trial. Clinical Rehabilitation. 2007; 21:99–111. [PubMed: 17264104]

106. Song R, Lee E, Lam P, Bae S. Effects of a sun-style tai chi exercise on arthritic symptoms, motivation and the performance of health behaviors in women with osteoarthritis. Daehan Ganho Haghoeji. 2007; 37:249–56.

107. Greenspan AI, Wolf SL, Kelley ME, et al. Tai chi and perceived health status in older adults who are transitionally frail: A randomized controlled trial. Physical Therapy. 2007; 87:525–35. [PubMed: 17405808]

108. Li F, Fisher KJ, Harmer P, Irbe D, Tearse RG, Weimer C. Tai chi and self-rated quality of sleep and daytime sleepiness in older adults: A randomized controlled trial. Journal of the American Geriatrics Society. 2004; 52:892–900. [PubMed: 15161452]
109. Winsmann, F. Dissertation. Santa Barbara, CA: Fielding Graduate University; 2005. The effect of tai chi chuan meditation on dissociation in a group of veterans.
110. Lee M, Soo Lee M, Kim H, Moon S. Qigong reduced blood pressure and catecholamine levels of patients with essential hypertension. International Journal of Neuroscience. 2003; 113:1691. [PubMed: 14602541]
111. Chou K, Lee PWH, Yu ECS, et al. Effect of tai chi on depressive symptoms amongst Chinese older patients with depressive disorders: A randomized clinical trial. International Journal of Geriatric Psychiatry. 2004; 19:1105–7. [PubMed: 15497192]
112. Jin P. Efficacy of tai chi, brisk walking, meditation, and reading in reducing mental and emotional stress. Journal of Psychosomatic Research. 1992; 36:361–370. [PubMed: 1593511]
113. Irwin MR, Olmstead R, Oxman MN. Augmenting immune responses to varicella zoster virus in older adults: A randomized, controlled trial of tai chi. Journal of the American Geriatrics Society. 2007; 55:511–7. [PubMed: 17397428]
114. Sattin RW. Falls among older persons: A public health perspective. Annual Review of Public Health. 1992; 13:489–508.
115. Li F, Harmer P, Chaumeton NR, Duncan T, Duncan S. Tai chi as a means to enhance self-esteem: A randomized controlled trial. Journal of Applied Gerontology. 2002; 21:70–89.
116. Manzaneque JM, Vera FM, Maldonado EF, et al. Assessment of immunological parameters following a qigong training program. Medical Science Monitor. 2004; 10:CR264–70. [PubMed: 15173671]
117. Yang Y, Verkuilen J, Rosengren KS, et al. Effects of a taiji and qigong intervention on the antibody response to influenza vaccine in older adults. American Journal of Chinese Medicine. 2007; 35:597–607. [PubMed: 17708626]
118. Xu SW, Wang WJ. A study of the effects of tai ji quan on endocrinology. Chinese Journal of Sports Medicine. 1986; 5:150–151.
119. Sun XS, Xu YG, Xia YJ. Determination of e-rosette-forming lymphocyte in aged subjects with tai ji quan exercise. International Journal of Sports Medicine. 1989; 10:217–219. [PubMed: 2789200]
120. Zhang GD. The impacts of 48-form tai chi chuan and yi qi yang fei gong on the serum levels of IgG, gM, IgA, and IgE in human. Journal of Beijing Institute of Physical Education. 1990; 4:12–14.
121. Li ZQ, Shen Q. The impact of the performance of wu's tai chi chuan on the activity of natural killer cells in peripheral blood in the elderly. Chinese Journal of Sports Medicine. 1995:53–56.
122. Jones BM. Changes in cytokine production in healthy subjects practicing guolin qigong: A pilot study. BMC Complementary and Alternative Medicine. September 29.2008 2001:1.
123. Ryu H, Mo HY, Mo GD, et al. Delayed cutaneous hypersensitivity reactions in qigong (chun do sun bup) trainees by multitest cell mediated immunity. American Journal of Chinese. 1995; 23:139–144.
124. Ryu H, Jun CD, Lee BS, Choi BM, Kim HM, Chung HT. Effects of qigong training on proportions of T lymphocyte subsets in human peripheral blood. American Journal of Chinese Medicine. 1995; 23:27–36. [PubMed: 7598089]
125. Rogers CE, Larkey LK, Keller C. A review of clinical trials of tai chi and qigong in older adults. Western Journal of Nursing Research. 2009; 31:245–279. [PubMed: 19179544]

Table 1

Randomized Controlled Trials Testing Health Benefits of Qigong and Tai Chi

Source	No. of Subjects/ Mean Age Sex (Male/Femal e)	Exercise Duration (minutes × days per week)	Exercise Group	Control group	Reported Outcomes * P<.05
Audette Jin Newcomer Stein Duncan & Frontera, 2006 USA	27 Sedentary women 71.4 years 0/27	12 weeks (60 minutes × 3 days)	**T**ai **C**hi 10 movement Yang (n=11)	**B**risk **W**alking (n=8); Usual Care (**UC**) later recruited and not randomized (n=8)	Cardiopulmonary: $VO_{2\,max}$ ↑ in **TC** more than **BW** and **UC***; heart rate variability, high frequency ↑ and low frequency ↓ in **TC** only* no between Falls and Balance: Strength, hand grip and knee extension ↑ **TC** only* and left knee extension ↑ in **TC** more than **BW** *; flexibility, only toe touch flexibility ↑ in **TC** more than **BW***; and balance, only non-dominant one leg stance (OLS) with eyes closed ↑ in **TC** more than **BW***
Barrow Bedford Ives O'Toole & Channer, 2007 UK	52 Older adults history chronic heart failure 69.5 years 42/10	16 weeks (55 minutes × 2 days)	**TC** with Chi Kung (n=25)	**U**sual **C**are (n=27)	Cardiopulmonary: Incremental shuttle walk ↑ in **TC** more than **UC** ns Patient Reported Outcomes: Perceived symptoms of heart failure ↓ in **TC** more than **UC*** Psychological: Depression (SCL-90-R) ↓ in **TC** more than **UC** ns; anxiety ↓ in both groups ns
Brismee Paige Chyu Boatright Hagar McCaleb Quintela Feng Zu Shen, 2007 USA	41 History of knee osteoarthritis 70 years 7/34	12 week **TC** and 6 week no training (40 minutes × 3 days/ 6 weeks group training and 6 weeks home training; and 6 weeks detraining)	**TC** Yang 24-form simplified (n=18)	6 weeks of **H**ealth **L**ecture followed by no activity same as exercise group (n=13)	Physical Function: WOMAC ↑ in **TC** more than **HL*** with ↓ for detraining period Patient Reported Outcomes: Pain ↓ in **TC** more than **HL***; adverse outcomes ns
Burini Farabollini Ianucci, Rimatori Riccardi Capecci Provinciali & Ceravolo, 2006 Italy	26 History of Parkinson's disease 65 years 9/17	7 weeks each of Aerobics (45 min × 3 days) and Qigong (50 min × 3 days) 20 sessions each with 8 weeks between sessions	Qigong (QG) (n=11)	Aerobic Training (AT) sessions (n=11)	Cardiopulmonary: 6-minute walk and Borg scale for breathlessness ↑ and spirometry and cardiopulmonary exercise test ↓ for **AT** more than **QG*** Patient Reported Outcomes: Parkinson's Disease Questionnaire ns for both; Unified Parkinson's Disease Rating Scale ns; Brown's Disability Scale ns Psychological: Beck Depression Inventory ns

Source	No. of Subjects/ Mean Age Sex (Male/Femal e)	Exercise Duration (minutes × days per week)	Exercise Group	Control group	Reported Outcomes * P<.05
Chan Qin Lau Woo Au Choy Wingyee Lee & Lee, 2004 Hong Kong	132 History of post-menopausal and sedentary 54 years 0/132	12 months (45 min 5 × days)	Tai Chi Chuan Yang Style (n=54)	**UC** (n=54)	Bone Density: Fractures (1 **TC** and 3 **UC**) BMD measured by Dual energy x-ray absorptiometry in femoral neck, ↓ in **TC** less than **UC** ns and trochanter ↓ both ns; peripheral quantitative computed tomography of distal and ultradistal tibia ↓ less in **TC** than **UC***
Channer Barrow Barrow Osborne & Ives 1996 UK	126 History of MI 58.5 years ?/?	8 weeks (2 days × 3 weeks, then 1 day × 5 weeks)	**TC** Wu Chian-Ch'uan (n=38)	**A**erobic **E**xercise (n=41) or Cardiac **S**upport **G**roup (n=41) discussed risk factor modification and problems in rehab.	Cardiopulmonary: Immediate SBP and DBP ↓ **TC** and AE ns and HR ↑ in **AE** more than **TC** *; Over time, SBP ↓ both ns and DBP and resting HR↓ in **TC** more than **AE** *; **SG** too small for comparison
Chen Yeh & Lee 2006 Taiwan	87 History of BMD T ≥ −2.5 45 years 0/87	12 week (studied for 2 weeks, then 3 days/week)	QG Baduanjin (n=44)	**N**o **Q**igong (n=43)	Bone Density: BMD maintained in QG and ↓ in NQ*; Immune/Inflammation: Interleukin-6↓ in QG and ↑ in NQ*
Cheung Lo Fong Chan Wong Wong Lam Lau Karlberg 2005 Hong Kong	88 Older adults in community, history of hypertension 54.5 years 37/51	16 wk (120 min × 2 days × 4 weeks then monthly and encouraged to practice 60 min in AM and 15 min in PM × 7 days)	QG Guolin (n=37)	**E**xercise (n=39)	Cardiopulmonary: BP, HR, waist circumference, BMI, Total cholesterol, renin and 24 hour urinary protein excretion ↓ **QG** and **E** ns; ECG **QG** and **E** nc/ns QOL: SF-36 ↓ E ns Psychological: Beck Anxiety Inventory ↓ and Beck Depression Inventory ↑ QG and E ns
Choi Moon & Song 2005 South Korea	59 Living in care facility, ambulatory with history of at least 1 fall risk factor 77.8 years 15/44	12 weeks (35 min × 3 days)	Tai Chi Sun-style (n=29)	**UC** (n=30)	Falls and Balance: Falls ns, but falls efficacy for **TC** ↑ and ↓ **UC***; knee and ankle strength, OLS eyes open, and Toe reach ↑ and 6 meter walk ↓ more than **UC***; OLS eyes open nc Self-efficacy: Falls efficacy for **TC**↑ and ↓ **UC***
Chou Lee Yu Macfarlane Cheng Chan & Chi 2004 Hong Kong	14 Community dwelling Chinese, history of depression from a psycho-geriatric clinic 72.6 years 7/7	3 months(45 min × 3 days)	Tai Chi Yang Style18 form (n=7)	**W**aitlist (n=7)	Psychological: Center for Epidemiological Studies Depression Scale ↓ **TC** more than W*
Elder, Ritenbaugh Mist Aickin Schneider Zwickey & Elmer 2007 USA	92 History of completing 12 week wt loss intervention and loss of at least 3.5 kg 47.1 years 13/79	24 weeks (10 hours overall with 28 min qigong sessions)	Qigong Emie Zhen Gong (n=22)	**T**apas **A**cupressure **T**echnique (n=27) and **S**elf-**D**irected **S**upport (n=24)	Cardiopulmonary: Wt loss maintenance for **TAT** and ↑ QG and **SDS***

Source	No. of Subjects/ Mean Age Sex (Male/Femal e)	Exercise Duration (minutes × days per week)	Exercise Group	Control group	Reported Outcomes * P<.05
Faber Bosscher Chin Paw & vanWieringe n 2006 Netherlands	238 Frail (51%) or pre-frail (48.9%) older adults living in care facility 85 years 50/188	20 week (60 min exercise and 30 min social time × day × 4 weeks for socializatio n, then × 2 days for 16 weeks)	Tai Chi (balance exercises inspired by **TC**) (n=90)	**F**unctional **W**alking (n=66) or **UC** (92)	Falls and Balance: Falls lower for **TC** more than FW and **UC** ns; When FW and **TC** combined, Fall risk↓ and physical function (6 meter walk, Timed chair stand, TUG, and FICSIT-4) ↑ compared to **UC** in pre-frail*, frail ns, also **TC** compared to FW ns Patient Reported Outcomes: Performance Oriented Mobility Assessment ↑ for **TC** and FW and exercise groups combined more than **UC*** and pre-frail*, frail ns; Groningen Activity Restriction Scale ↓ for FW more than control* **TC** vs **UC** ns
Fransen Nairn Winstanley Lam & Edmons 2007 Austrailia	152 Older adults, history of chronic symptomatic hip or knee osteoarthritis 70.8 years 40/112	12 week (60 min × 2 days)	**TC** for Arthritis by Dr. Lam from Sun Style 24-forms (n=56)	**H**ydrotherapy (n=55) and **W**ait **L**ist control (n=41)	Physical Function: WOMAC: Pain and function ↓ **TC** and H ns with treatment effect for physical function moderate*; pain score ↓ for H compared to **WL***, **TC** ns; Physical performance: TUG, 50-foot walk, and stair climb ↓ more for H than **WL***; and timed stair climb for ↓ **TC** and H ns QOL: SF-12 Physical ↑ H more than **WL*** and **TC** more than **WL** borderline*; SF-12 Mental ns Patient Reported Outcomes: Pain and function ↓ **TC** and **H** ns Psychological: Depression Anxiety & Stress 21 ↓ in **H*** and **TC** ns
Galantino Shepard Krafft Laperriere Ducette Sorbello Barnish Condoluci & Farrar 2005 USA	38 History of long term care of HIV/ AIDS Between 20 and 60 38/0	8 weeks (60 minx 2 days)	**TC** (n=13)	**A**erobic **E**xercise (n=13) and **UC** (n=12)	Physical Function: FR, SR, Sit Up, and Physical Performance Test all improved more than **UC*** and **TC** compared to AE nc QOL: Medical Outcomes Short Form-HIV improved **TC** and AE more than control*; Spiritual Well Being improved **TC** AE and **UC** ns Psychological: Profile of Mood States improved **TC** and AE more than control*
Gatts and Woollacott 2006 USA	19 Balance impaired seniors 68–92 years 2/17	3 weeks (90 min × 5 days)	Tai Chi Twelve Classical Tai Chi Postures (n=11)	**TC B**ased and axial mobility program; same group practiced **TC** after control time (n=8)	Falls and Balance: TUG ↓ more for **TC** than control*; FR↑ for **TC** and control; OLS and tandem stance both legs ↑ more **TC** than control*; tibialis anterior more ↑ for **TC** than control*; gastrocnemius ↑ only **TC** after control time*

Source	No. of Subjects/ Mean Age Sex (Male/Femal e)	Exercise Duration (minutes × days per week)	Exercise Group	Control group	Reported Outcomes * P<.05
Gemmell & Leathem 2006 New Zealand	18 History of traumatic brain injury symptoms 45.7 years 9/9	6 weeks (45 min × 2 days)	**TC** Chen Style (n=9)	Waitlist **UC** (n=9)	QOL: SF-36 and Rosenberg Self-Esteem Scale no different ns except role emotional ↑ **TC** more than **UC*** Psychological: Visual Analogue Mood Scales improved **TC** more than **UC***; Rosenberg Self-Esteem Scale nc, ns
Greenspan Wolf Kelley O'Grady 2007 USA	269 Congregate independent living, transitionally frail with at least 1 fall in past year >70 years and 50% over 80 0/269	48 week (60 increasing to 90 min × 2 days)	**TC** 6 simplified forms (n=103)	**W**ellness **E**ducation (n=102)	Physical Function: Sickness Impact Profile for physical function and ambulation ↓ more **TC** than WE* Patient Reported Outcomes: Sickness Impact Profile and physical and ambulation perceived health status ↓ **TC** more than **WE*** and Self Reported Health nc **TC** and **WE** ns
Hammond & Freeman 2006 UK	133 History of fibromyalgia from a rheumatology outpatient department 48.53 years 13/120	10 weeks (45 min × 1 day)	Tai Chi for Arthritis (part of patient **E**ducation group including fibromyalg ia informatio n, postural training, stretching and weights) (n=52)	**R**elaxation **G**roup (n=49)	Self-efficacy: Arthritis Self-Efficacy Scale ↑ **TC** more than RG at 4 months* at 8 months ns Patient Reported Outcomes: Fibromyalgia Impact Questionnaire ↓ **TC** more than RG* at 4 months* at 8 months ns Psychological: Anxiety and depression **TC** and TG ns
Hart Kanner Gilboa-Mayo Haroeh-Peer Rozenthul-Sorokin Eldar 2004 Israel	18 History of stroke, community-dwelling 54.77 years 16/2	12 weeks (60 min × 2 days)	**TC**C (n=9)	**B**alance **E**xercises (n=9)	Falls and Balance: BBS, OLS, Emory Fractional Ambulation Profile, Romberg, TUG improved in **BE***, not **TC**C ns QOL: Duke Health Profile improved **TC***, not **BE** ns
Hartman Manos Winter Hartman Li & Smith 2000 USA	33 Community dwelling with lower extremity osteoarthritis 68 years 4/28	12 weeks (60 min × 2 days)	**TC** 9 form Yang (n=18)	**U**sual **C**are with phone calls every 2 weeks to discuss issues related to Osteoarthritis (n=15)	Physical Function: OLS, 50-ft walk, and chair rise **TC** and **UC** ns with small to moderate effect size for **TC** only QOL: Arthritis Impact Measurement Scale II(satisfaction with life) ↑ and tension ↓ more for **TC** than **UC*** Pain and mood both ns Self-efficacy: Arthritis self-efficacy ↑ **TC** more than **UC***
Hass Gregor Waddell Oliver Smith Fleming Wolf 2004 USA	28 Older adults transitioning to frailty 79.6 years ?/?	48 weeks(60 min × 2 days)	Tai Chi 8 of 24 simplified forms (n=14)	**W**ellness **E**ducation (n=14)	Falls and Balance: Center of pressure during S1 and S2 improved for **TC** more than **WE*** S3 for both ns
Irwin Olmstead & Oxman 2007 USA	112 Healthy older adults 70 years 41/71	16 weeks (40 min × 3 days)	Tai Chi Chih (n=59)	**H**ealth **E**ducation (n=53)	QOL: SF-36 improved for physical functioning, bodily pain, vitality and mental health for **TC** more than

Source	No. of Subjects/ Mean Age Sex (Male/Femal e)	Exercise Duration (minutes × days per week)	Exercise Group	Control group	Reported Outcomes * P<.05
					HE*; Role emotional ↓ for HE more than **TC***; Role physical, general health, and social functioning both groups ns Psychological: Beck Depression Score ↑ **TC** and **HE** ns Immune/Inflammation: Varicella zoster virus-Responder cell frequency ↑ **TC** more than **HE***
Irwin Pike Cole & Oxman 2003 USA	36 Healthy older adults 60 years 5/13	15 week (45 min × 3 days)	Tai chi Chih (n=14)	**W**ait **L**ist (n=17)	QOL: SF-36 only role-physical and physical functioning improved more for **TC** than **WL*** Immune/Inflammation: Varicella zoster virus-cell-mediated immunity ↑ more for **TC** than **WL***
Jin 1992 Australia	96 Tai Chi practitioners 36.2 years 48/48	History of **TC** 46.4 mo males/34 months females 2 sessions of exposure to stress followed by respective treatment	Tai Chi Long form or Yang Style (n=24)	**B**risk **W**alking (n=24), **TC** **M**editation (n=24), and **N**eutral **R**eading (n=24)	Psychological: Profile of Mood States improved all treatments* with state anxiety ↓ in **TC** more than reading*; BP and HR ↑ under stress for **TC** and BW more than M and NR*; Adrenaline ↓ more for **TC** than M*; noradrenaline ↑ more for **TC** than NR*; and salivary cortisol ↑ all groups*
Judge Lindser Underwook & Winsemius 1993 USA	21 Sedentary women 68 years 0/21	6 months(20 min walking plus other exercise × 3 days for **TC** and no exercise for 12 weeks, then 30 min x1 day for FT)	Tai Chi simple with strength training and walking (n=12)	**F**lexibility **T**raining (n=9)	Falls and Balance: OLS ↑ more for **TC** than FT ns; knee extension ↑ more for **TC** than **FT***; and sitting leg press improved **TC** and **FT** ns
Kutner, Barnhart, Wolf, McNeely, & Xu 1997 USA	130 **TC** Balance training and control mostly women/ Healthy older adults 76.2 years ?/?	15 weeks (45 min total × 2 days TC and 1 day BT and ED)	**TC** 10 modified forms from 108 (n=51)	**B**alance **T**raining (n=39) and **E**ducation **C**ontrol (n=40)	QOL: SF-36 all groups nc Self-efficacy: Self confidence ↑ more for **TC** and **BT** than **EC*** Psychological: Rosenberg self esteem ↑ more **TC** than **BT** or **EC** ns
Lansinger Larsson Persson & Carlsson 2007 Sweden	122 History of long term nonspecific neck pain 43.8 years 36/86	3 month (1 hour × 1–2 days/week × 10–12 sessions)	Qigong Biyun (n=60)	**E**xercise **T**herapy (n=62)	Physical Function: Grip strength and Cervical ROM ↑ both groups ns Patient Reported Outcomes: Neck pain and Neck Disability Index ↓ both groups ns
Lee Lee Kim & Choi 2004a AND Lee Lim & Lee 2004b Korea	36 History of hypertension 53.4 years 14/22	8 wk (30 min × 2 days)	Qigong Shuxinping xuegong (n=17)	**W**ait**L**ist (n=19)	Cardiopulmonary: (2004a)

Source	No. of Subjects/ Mean Age Sex (Male/Femal e)	Exercise Duration (minutes × days per week)	Exercise Group	Control group	Reported Outcomes * P<.05
					BP ↓ more in **QG** than **WL** *; HDL and APO-A1 ↑ more in QG than **WL** *; high-density lipoprotein and Apolipoprotein A1 ↑ and total cholesterol ↓ in **QG** pre-post *; Triglycerides ↓ in **QG** and ↑ in **WL** ns Self-efficacy: (2004b) Self efficacy and perceived benefits↑ in **QG** and ↓ in **WL** * Psychological: (2004b) Emotional state ↑ in **QG** and ↓ in **WL** *
Lee Lee Kim & Moon 2003a AND Lee Lee Choi & Chung 2003b Korea	58 History of hypertension 56.2 years	10 weeks (30 min × 3 days)	Qigong Shuxinping xuegong (n=29)	**UC** **W**ait**L**ist (n=29)	Cardiopulmonary: (2003a) HR ↓ more in **QG** than **WL** *; Epinephrine and norepinephrine ↓ for **QG** and ↑ for **WL** *; cortisol ↓ for QG and ↑ for **WL** ns Psychological: (2003a) Self report stress↓ QG more than **WL** *; Epinephrine and norepinephrine ↓ for QG and ↑ for **WL** *; cortisol ↓ for QG and ↑ for **WL** ns Cardiopulmonary: (2003b) BP and catecholamines ↓ for QG and ↑ for **UC** *; Ventilatory function ↑ more for **QG** than **UC** *
Lee Y. K. Lee & Woo 2007a Hong Kong	139 Resident of care facility, ambulatory, Chinese and 82.7 years 45/96	26 weeks (60 min × 3 days)	Tai Chi (n=66)	**UC** (n=73)	QOL: Health Related Quality of Life ↑ **TC** more than **UC** * Psychological Symptoms: Self Esteem ↑ **TC** more than **UC** *
Li Fisher Harmer & Shirai 2003 USA	48 Older adults 68.88 years	3 months (3 days/ wk)	Tai Chi Yang 8- form easy Tai Chi (n=26)	**S**tretching **C**ontrol (n=22)	Falls and Balance: OLS improved **TC** more than **SC** * Physical Function: SF-12 physical, instrumental activities of daily living, 50-ft walk, and chair rise all improved **TC** more than **SC** * Psychological: SF-12 mental ↑ more **TC** than **SC** *
Li Fisher Harmer Irbe Tearse & Weimer 2004 USA	118 History of moderate sleep complaints and community dwelling adults 75.4 years 22/96	24 week (60 min × 3 days)	Tai chi Yang (n=62)	**E**xercise **C**ontrol (n=56)	Physical Function: OLS and SF-12 physical ↑; and chair rise and 50-ft walk ↓ **TC** more than **EC** * Patient Reported Outcomes: Sleep duration and efficiency ↑ and sleep quality, latency, duration, and disturbances; Epworth Sleepiness Scale; and Pittsburg Sleep Quality Index ↓ more for **TC** than **EC** *; Sleep dysfunction both and medication ↓ **TC** only ns

Source	No. of Subjects/ Mean Age Sex (Male/Femal e)	Exercise Duration (minutes × days per week)	Exercise Group	Control group	Reported Outcomes * P<.05
					Psychological: SF-12 mental ↑ both ns
Li Harmer Fisher McAuley Chaumeton Eckstrom & Wilson 2005b AND Li Fisher Harmer & McAuley 2005a USA	256 Sedentary 77.48 years 77/179	6 month (60 min × 2 days)	**TC** Yang Style 24 forms (n=125)	**S**tretching **C**ontrol (n=131)	Falls and Balance: (2005b) Fewer falls and fewer injurious falls for **TC** than **SC***; and BBS, Dyamic Gait Index, FR and OLS ↑ and 50 ft walk and TUG ↓ more for **TC** than **SC*** all sustained at 6 month follow-up Falls and Balance: (2005a) Activities Specific Balance ↑ more for **TC** than **SC*** Self-efficacy: (2005a) Falls Self-efficacy↑ (mediator) and fear of falling (SAFFE) ↓ more for **TC** than **SC*** Psychological: Fear of falling (SAFFE) ↓ more for **TC** than **SC***
Li Harmer McAuley Duncan Duncan Chaumeton & Fisher 2001a USA	49 Sedentary and community dwelling 72.8 years 9/85	6 month (60 min × 2 days)	Tai Chi Yang style 24 forms (n=49)	**W**ait**L**ist (n=45)	Physical Function: SF-20 (physical function) ↑ more **TC** than **WL***
Li Harmer McAuley Fisher Duncan & Duncan 2001b AND Li Fisher Harmer & McAuley 2002 AND Li Harmer Chaumeton Duncan Duncan 2002 AND Li McAuley Harmer Duncan & Chaumeton 2001 USA	94 Sedentary 72.8 years 9/85	6 month (60 min × 2 days)	Tai Chi Yang style 24 forms (n=49)	**W**ait**L**ist (n=45)	Physical Function: (2001b) SF-20 physical Function ↑ among **TC** more than **WL** over time* r scores Self-efficacy: (2001b) Self-efficacy ↑ among **TC** more than **WL** over time* r scores QOL: (2002) SF −20 (General Health Survey) ↑ more for **TC** than **WL***; **TC** with lower levels of health perception, physical function, and high depression at baseline and Movement confidence ↑ = ↑ physical function * Psychological: (2002) Physical function self-esteem and Rosenberg self-esteem ↑ more for **TC** than **WL*** Self-efficacy: (2001) Barrier and performance Self-efficacy ↑ **TC** more than **WL***; exercise adherence ↑ **TC** than **WL***; and SE conditions related to adherence for **TC**
Maciaszek Osinski Szeklicki & Stemplewske 2007 Poland	49 Sedentary, history of osteopenia or osteoporosis 60 to 82.1 years 49/0	18 week (45 min × 2 days) 3 month (20 min × 1 day)	Tai Chi 24 form (n=25)	**UC** (n=24)	Falls and Balance: Posturographic Platform (time ↓; % task performance and total length of path ↑ for **TC***; and % task performance and total length of path ↑ more for **TC** than **UC***

Source	No. of Subjects/ Mean Age Sex (Male/Femal e)	Exercise Duration (minutes × days per week)	Exercise Group	Control group	Reported Outcomes * P<.05
Mannerkorpi & Arndorw 2004 Sweden	36 History of Fibromyalgia 45 years 0/36		Qigong with Body Awareness (n=19)	**UC** (n=17)	Physical Function: Chair stand and hand grip **TC** and **UC** ns Patient Reported Outcomes: Body Awareness ↑ **TC** more than **UC*** ; fibromyalgia symptoms **TC** and **UC** ns
Manzaneque Vera Maldonado Carranque et al. 2004 Spain	29 Healthy young adults 18–21 14/15	1 month (30min × 5 days)	Qigong Eight Pieces of Brocade (low intensity) (n=16)	**UC** (n=13)	Immune/Inflammation: Leukocytes, eosoinophils, monocytes, and C3 levels ↓ **TC** than **UC*** ; trend for neutrophils; and total lymphocytes, T lymphocytes, t helper lymphocytes, concentrations of complement C4 or immunoglobulins ns
McGibbon Krebs Parker Scarborough Wayne & Wolf 2005 USA	36 History of vestibulopath y 59.5 years 16/20	10 weeks (70 min × 1 day)	Tai Chi Yang (n=19)	**V**estibular **R**ehabilitation (n=12)	Falls and Balance: Gait speed ↑ **TC** more than VR* ; step length ↑ for **TC** and **VR*** ; stance duration ↓ VR* more than **TC**; Step width ↑ VR and **TC** ns: Mechanical energy expenditure (hip ↓ **TC** more than VR* ; ankle ↑ more for **TC** than **VR*** ; knee and leg both ns); Peak trunk forward velocity ↑ **TC** more than **VR*** ; forward velocity range and peak or range of lateral trunk velocity **TC** and VR ns; Peak trunk angular velocity ↑ more for VR than **TC*** ; and trunk angular velocity in frontal plane and change in peak and range **TC** and VR ns; Trunk velocity peak and range positively correlated with change in leg mechanical energy expenditure for **TC*** and **VR** negative relationship
McGibbon Krebs Wolf Wayne Scarborough & Parker 2004 USA	26 History of Vestibulopath y 56.2 years 11/15	10 weeks (70 min × 1 day)	Tai Chi Yang (n=13)	**V**estibular **R**ehabilitation (n=13)	Falls and Balance: Gaze stability ↑ more for VR than **TC*** ; Whole-body stability and foot fall stability ↑ more for **TC** than VR* ; Correlation between change in gaze stability and whole-body stability, and foot-fall stability and gaze stability for VR not **TC*** ; Correlation between foot-fall stability and whole-body stability for VR and **TC***
Motivala Sollers Thayer & Irwin 2006 USA	32 out of 63 who completed RCT for Herpes Zoster risk in aging study 68.5 years 14/18	37 week **TC** (? Min × 1 day)	**TC**C (n=19)	**P**assive-**R**est and slow moving physical movement (n=19)	Cardiopulmonary: Pre-ejection period ↑ post task more for **TC** than **PR*** ; BP and HR **TC** and **PR** ns
Mustian Katula Gill Roscoe Lang & Murphy 2004 AND Mustian Katula & Zhao 2006 USA	21 History of breast cancer 52 years 0/21	12 week (60 min × 3 days)	Tai Chi Yang and Chi Kung (n=11)	**P**sychosocial **S**upport (n=10)	Cardiopulmonary: (2006) 6-minute walk ↑ for **TC** and ↓ for **PS*** ; aerobic capacity ↑ for **TC** and ↓ for PS ns Physical Function: (2006)

Source	No. of Subjects/ Mean Age Sex (Male/Femal e)	Exercise Duration (minutes × days per week)	Exercise Group	Control group	Reported Outcomes * P<.05
					Muscle strength (hand grip ↑ for **TC** and ↓ for **PS**[*]); and flexibility (abduction ↑ **TC** and PS, flexion, extension, horizontal adduction and abduction ↑ more for **TC** than **PS**[*]; and body fat mass ↓ for **TC** and ↑ for **PS** ns QOL: (2004) Health Related Quality Of Life ↑ for **TC**[*] and ↓ **PS** ns Psychological: (2004) Self esteem ↑ for **TC** and ↓ for **PS**[*]
Nowalk Prendergast Bayles D'Amico & Colvin 2001 USA	110 Long term care residents 84 years 7/48	13 to 28 months (3 × week)	Tai Chi with behavioral component (n=38)	Physical therapy weight training (n=37) and **E**ducation **C**ontrol (n=35)	Falls and Balance: Falls No difference between groups
Pippa Manzoli Corti Congedo Romanazzi & Parruti 2007 Italy	43 History of stable chronic atrial fibrillation 68 years 30/13	16 week (90 minutes × 2 days)	Qigong (n=22)	**W**ait-**L**ist control (n=21)	Cardiopulmonary: 6-minute walk ↑ for **QG** and ↓ for **WL**[*]; Ejection fraction, BMI, cholesterol ns
Sattin Easley Wolf Chen & Kutner 2005 USA	217 Transitionally frail with history of 1 or more falls in past year (55 African Americans) 70–97 years 12/205	48 weeks (60–90 min × 2 days)	Tai Chi 6 of 24 Simplified (n=158)	**W**ellness **E**ducation (n=153)	Falls and Balance: Activities Specific Balance ↑ more among **TC** than **WE**[*] Psychological: Falls Efficacy Scale ↓ more among **TC** than **WE**[*]
Shen Williams Chyu Paige Stephens Chauncey Prabhu Ferris & Yeh 2007 USA	28 Sedentary from a senior living facility 79.1 years 7/21	24 week (40 min × 3 days)	**TC** Yang Style Simplified 24 forms (n=14)	**R**esistance **T**raining (n=14)	Bone Density: Sedentary older adults on bone metabolism (Serum Bone Specific alkaline phosphatase/ Urinary Pyridinoline ↑ more for **TC** than **RT** at 6 weeks[*] and **TC** returned to baseline and **RT** less than baseline[*]; Parathyroid hormone ↑ more for **TC** than **RT** at 12 weeks[*]; serum 1,25-vitamin D3 **TC** and **RT** ns; serum calcium ↑ more for **TC** than **RT** at 12 weeks compared to 6 weeks[*]; urinary calcium ↓ for **TC**[*] not **RT**; serum and urinary Pi **TC** and **RT** ns
Song Lee Lam & Bae 2003 AND Song Lee Lam & Bae 2007 Korea	72 History of osteoarthritis and no exercise for 1 year prior 63 years 0/72	12 week (60 min × 3 days for 2 weeks then × 1 day for 10 weeks)	Tai Chi Sun Style modified for arthritics (n=22)	**UC** (n=21)	Cardiopulmonary: (2003) BMI, 13 minute ergometer **TC** and **UC** ns Falls and Balance: (2003) OLS, trunk flexion and sit ups ↑ more for **TC** than **UC**[*]; Flexibility and knee strength **TC** and **UC** ns Patient Reported Outcomes: (2007) Pain and stiffness ↓ and perceived benefits ↑ more for **TC** than **UC**[*];**TC** performed more health behaviors than **UC**[*]

Source	No. of Subjects/ Mean Age Sex (Male/Femal e)	Exercise Duration (minutes × days per week)	Exercise Group	Control group	Reported Outcomes * P<.05
Stenlund Lindstrom Granlund & Burell 2005 Sweden	95 History of coronary artery disease 77.5 years 66/29	12 weeks (60 min QG and 120 min of discussion on various themes)	Qigong (**TC** & Medicinsk Qigong) (n=48)	**UC** (n=47)	Falls and Balance: Falls Efficacy Scale, tandem standing, OLS Left, Climb boxes Left **TC** and **UC** ns; OLS Right and climb boxes right ↑ more for **TC** than **UC***; and co-ordination ↓ more for **UC** than **TC***; and Self reported activity level ↑ for **TC** more than **UC*** Psychological: Fear of falling between **TC** and **UC** ns
Thomas Hong Tomlinson Lau Lam Sanderson & Woot 2005 Hong Kong	207 Healthy, community dwelling 68.8 years 113/94	12 months(60 min × 3 days)	Tai Chi Yang style 24 forms (n=64)	**R**esistance **T**raining (n=65) or **UC** (n=78)	Cardiopulmonary: Energy expenditure ↑ for **TC** and **RT** more than **UC** ns; Waist circumference and HR ↓ more **TC** and **RT** than **UC** ns; Insulin sensitivity ↓ more for **RT** than **UC*** and more for **TC** than **UC** ns; BMI, body fat, BP, Cholesterol, and glucose **TC**, **RT**, and **UC** ns
Tsai Wang Chan Lin Wang Tomlinson Hsieh Yang & Liu 2003 Taiwan	76 Sedentary with pre- hypertension or Stage I 52 years 38/38	12 wk (50 min × 3 days)	Tai Chi Yang (n=37)	**UC** (n=39)	Cardiopulmonary: BP& total cholesterol ↓ for **TC*** and ↑ for **UC** ns; BMI and HR **TC** and **UC** ns; Triglyceride ↓ **TC*** and ↑ **UC***; LDL ↓ **TC*** and ↑ **UC** ns; High-density lipoprotein ↑ **TC*** and ↓ **UC** ns Psychological: Trait and State anxiety ↓ **TC*** more than **UC** ns
Tsang H.W. Fung Chan Lee & Chan 2006 Hong Kong	82 history of depression and chronic illness 82.4 years 16/66	16 weeks (30–45 min × 3 days)	Qigong Baduanjin (n=48)	**N**ewspaper **R**eading group with same intensity (n=34)	QOL: Personal Well Being ↑ for **QG** and ↓ **NR** *; and General Health Questionnaire ↓ **QG** and ↑ **NR***; and Self-concept ↓ more **TC** than **NR*** Self-efficacy: Chinese General Self-efficacy and Perceived Benefits Questionnaire ↑ more for QG than **NR*** Psychological: Geriatric Depression Scale ↓ more for **QG** than **NR***
Tsang HW Mok Yeung & Chan 2003 Hong Kong	50 History of chronic disease 74.6 years 26/24	12 week (60 min × 2 days)	Qigong Eight- Section Brocades (n=24)	**B**asic **R**ehabilitation activities (n=26)	QOL: Physical health, activities of daily living psychological health and social relationships improved for **QG***; Self-concept and WHOQOL-BREF QG and **BR** ns Psychological: Geriatric Depression Scale ↓ **TC** and **BR** ns
Tsang T. Orr Lam Comino & Singh 2007 Australia	38 Sedentary, community dwelling, type 2	16 week (45 min × 2 days)	Tai Chi for diabetes (12 movement hybrid from Yang and Sun (n=17)	**S**ham **E**xercise (seated calisthenics and stretching) (n=20)	Physical Function: 6-minute walk, habitual and maximal gait speed, muscle strength and peak power ↑ **TC** more than

Source	No. of Subjects/ Mean Age Sex (Male/Femal e)	Exercise Duration (minutes × days per week)	Exercise Group	Control group	Reported Outcomes * P<.05
	diabetics 65.4 years 8/30				**SE** ns; Endurance ↓ more for SE than **TC** ns; and Habitual Physical Activity ↑ **TC** and ↓ **SE*** Falls and Balance: Balance index ↓ **TC** and SE ns; OLS open ↑ **TC** and nc **SE** ns; OLS closed and tandem walk ↓ **TC** and SE ns; Falls 0–2 **TC** and **SE** ns QOL: SF-36 (except Social Function ↑ for **TC** and ↓ **SE***) and Diabetes Integration Scale **TC** and **SE** ns
Voukelatos Cumming Lord & Rissel 2007 Australia	702 Community dwelling 69 years 112/589	16 weeks (60 min × 1 day)	Tai Chi 38 Programs mostly Sun-style (83%) Yang (3%) (n=271)	**W**ait-**L**ist (n=256)	Falls and Balance: Sway on floor and foam mat, lateral stability, coordinated stability, and choice stepping reaction time improved **TC** more than **WL** *; Maximal leaning balance range ↑ **TC** more than **WL** ns; Fall rates less for **TC** (n=347) than **WL** (n=337) *
Wang Roubenoff Lau Kalish Schmid Tighiouart Rones & Hibberd 2005 USA	20 Community dwelling with Rheumatoid Arthritic class I or II 49.5 years 5/15	12 week (60 min × 2 days)	Tai Chi Yang Style (n=10)	Stretching and **W**ellness **E**ducation (n=10)	Physical Function: Chair stand and 50-ft walk ↑ **TC** and WE ns; American College of Rheumatology 20 ↓ **TC** more than WE*; hand grip not reported; Health Assessment Questionnaire ↑ more **TC** than WE*; Erythrocyte sedimentation rate and C-Reactive protein ns QOL: SF-36 ↑ more **TC** than WE with only vitality * Patient Reported Outcomes: Pain ↓ **TC** and ↑ WE ns Psychological: Center for Epidemiological Studies Depression Scale ↑ more **TC** than WE* Immune/Inflammation: ESR and C-Reactive protein ns (note **TC** higher level at baseline)
Wennenberg Gunnarsson & Ahlstrom 2004 Sweden	36 History of Muscular Dystrophy 33–80 years 19/17	12wk (Weekend immersion, then 45–50 min × 1 day for 4 weeks, then every other week for 8 weeks)	Qigong (n=16)	**W**ait-**L**ist control (n=15)	Cardiopulmonary: Forced vital capacity and expiratory volume ↓ QG and **WL** ns Falls and Balance: BBS unchanged for QG and ↓ **WL** ns for intervention period; subgroup A QOL: SF-36 general health unchanged for QG and ↓ **WL** * and other dimensions ns; Ways of Coping: positive reappraisal coping ↓ for QG and unchanged for **WL** *, Confrontative coping ↑ QG and ↓ **WL** ns, and other dimensions ns Psychological:

Source	No. of Subjects/ Mean Age Sex (Male/Femal e)	Exercise Duration (minutes × days per week)	Exercise Group	Control group	Reported Outcomes * P<.05
					Montgomery Asberg Depression Rating Scale QG and **WL** ns
Winsmann 2006 USA	47 Veterans 49.55 years 47/0	4 weeks (75 min × 2 days)	Tai Chi Chuan Yang Style (n=23)	**UC** included group therapy (n=24)	Patient Reported Outcomes: Dissociative Experiences and Symptom Checklist 90 ↓ **TC** more than **UC** ns
Wolf O'Grady Easley Guo Kressig & Kutner 2006 USA	311 Transitionally frail with average of 5.6 comorbidities 80.9 years 20/291	48 weeks (60–90 min × 2 days)	Tai chi 6 of 24 simplified forms (n=158)	**W**ellness **E**ducation (n=153)	Cardiopulmonary: BMI ↓ **TC** and ↑ **WE***; SBP and HR ↓ **TC** and ↑ **WE***; DBP ↓ **TC** more than **WE*** Physical Function: Gait Speed and FR ↑ **TC** and **WE** ns; Chair stands ↓ 12.3% **TC** and ↑ 13.7% WE*; 360° turn and pick up object similar change **TC** and **WE** ns; and OLS nc
Wolf Sattin Kutner O'Grady Greenspan & Gregor 2003b USA	311 Transitionally frail with average of 5.6 comorbidities 80.9 years 20/291	48 weeks (60–90 min × 2 days)	Tai chi 6 of 24 simplified forms (n=145)	**W**ellness **E**ducation (n=141)	Falls and Balance: **TC** lower risk for falls from month 4 to 12; RR falls **TC** and **WE** 0.75 (CI=0.52–1.08) ns
Wolf Barnhart Ellison Coogler & Gorak 1997a USA	72 Sedentary 77.7 years 12/60	15 weeks (60 min × 2days **TC** group)	Tai Chi 108 forms simplified to 10 forms (n=19)	**B**alance **T**raining (n=16) and **E**ducation Control (n=19)	Falls and Balance: Balance: Dispersion for OLS (eyes open), toes up (eyes open and closed), Center of Balance X with toes up (eyes open) and Center of Balance Y (OLS eyes open and closed) ↓ more **BT** than **ED** and **TC***; Dispersion for toes up (eyes open), Center of Balance X OLS (eyes open and closed) and Toes up (eyes closed), and Center of Balance Y for toes up (eyes open and closed) **TC**, **BT**, and **ED** ns; Psychological: Fear of falling ↓ more for **TC** than **BT** and **ED***
Wolf Barnhart Kutner McNeelly Coogler & Xu 2003a USA	200 Community dwellling 76.2 years 58/242	15 weeks (45 minutes weekly in class plus 15 min 2 × daily)	Tai Chi (n=72)	Balance Training (n=64) and **E**ducation Control (n=64)	Cardiopulmonary: BP↓ more for **TC** than **BT** and **ED***; 12-minute walk ↑ 0.01 mile for **BT** and **ED** and ↓ 0.02 for **TC***; Body composition changes for **TC**, **BT** and **ED** ns Physical Function: Left hand grip strength ↓ more in **BT** and **ED** than **TC***; Strength of hip, knee and ankle via Nicholas MMT 0116 muscle tester, lower extremity ROM changes **TC**, **BT** and **ED** ns Falls and Balance: Intrusiveness↓ more for **TC** than **ED** ns; RR for falls in **TC** 0.632 (CI 0.45– 0.89)* using FICSIT fall definition and for **BT** and other fall definitions ns Psychological:

Source	No. of Subjects/ Mean Age Sex (Male/Femal e)	Exercise Duration (minutes × days per week)	Exercise Group	Control group	Reported Outcomes * P<.05
					Fear of falling ↓ more for **TC** than **BT** and **ED***
Woo Hong Lau & Lynn 2007 China	180 Community dwelling 68.91 years 90/90	12 months (?min × 3 days)	Tai Chi Yang style 24 forms (n=30)	**R**esistance **T**raining (n=29) and **UC** (n=29)	Falls and Balance: Muscle strength (grip strength and quadriceps) ns; Balance (SMART Balance Master, stance time, gait velocity, and bend reach); and falls for **TC**, **RT** and **UC** ns Bone Density: Women: BMD loss at hip less for **TC** and **RT** than **UC*** ; BMD loss at spine less for **TC** and **RT** than **UC** ns; Men: no difference in % change in BMD
Yang Verkuilen Rosengren Grubisich Reed & Hsiao-Wecksler 2007a USA	49 Healthy adults 80.4 years 10/39	6 months (60 min × 3 days)	Qigong (sitting and standing) and Taiji Chen style Essential 48 form (n=33)	**W**ait-**L**ist (n=16)	Falls and Balance: Sensory Organization Test vestibular ratios and Base of Support measures ↑ more for **TC** than **WL*** ↑; Sensory Organization Test visual ratios and feet opening angle for **TC** and **WL** nc
Yang Verkuilen Rosengren Mariani Reed Grubisich & Woods 2007b USA	50 History of received flu immunization and sedentary 77.2 years 13/37	20 weeks (60 min × 3 days)	Qigong (sitting and standing) and Taiji Chen style Essential 48 form (n=27)	**W**ait-**L**ist (n=23)	Immune/Inflammation: Hemagglutination Inhibition assay ↑ 109% for **QG** compared to ~10% for **WL***
Yeh Wood Lorell Stevenson Eisenberg Wayne et al. 2004 USA	30 History chronic stable heart failure 64 years 19/11	12 weeks (60 min × 2 days)	Tai chi Yang-style 5 core movements (n=15)	**UC** including pharmacologi c therapy, dietary and exercise counseling (n=15)	Cardiopulmonary: Peak O2 uptake↑ **TC** and ↓ **UC** ns; 6-minute walk ↑ **TC** and ↓ **UC*** ; Serum B-type natriuretic peptide ↓ **TC** and ↑ **UC*** ; Plasma norepinephrine ↑ **TC** more than **UC** ns; and no differences in incidence of arrhythmia between groups QOL: Minnesota Living with Heart Failure ↓ **TC** and ↑**UC***
Young Appel Jee & Miller 1999 USA	62 History of BP between 130 and 159 and not taking medications for hypertension or insulin (45.2% black) 66.7 years 13/49	12 weeks (60 min × 2 days class with goal of 30–45 min/4–5 days/ week)	**TC** Yang Style 13 movements (n=31)	**A**erobic **E**xercise class at 40 to 60% HR reserve (n=31)	Cardiopulmonary: BP↓ **TC** and **AE** * ; BMI ↑ slightly **TC** and **AE** ns; and time in moderate activity, weekly energy expenditure, and leisurely walking ↑ for **AE** more than **TC** ns
Zhang Ishikawa- Takata Yamazaki Morita & Ohta 2006 China	47 History of poor balance 70.4 years 25/22	8 weeks (60 min × 7 days)	**TC** simplified 24 forms Zhou (n=24)	**UC** (n=23)	Falls and Balance: OLS, trunk and flexion more **TC** than **UC*** ; 10 minute walk ↓ **TC** and **UC** ns Psychological Symptoms: Falls Efficacy Scale ↑ more **TC** than **UC***

[†]BBS, Berg Balance Scale; BMD, Bone Marrow Density; FR, Functional Reach; nc, no change in scores; ns, scores not significantly different between groups; OLS, One leg stance; SR, Sit and Reach; TUG, Timed Up & Go; WOMAC, Western Ontario and McMaster Universities Osteoarthritis Index; ↑, increase in score; ↓, decrease in score.

[*]$p \leq .05$ between groups