

# TAI CHI

## A therapeutic outline

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This therapeutic outline provides an introduction to what tai chi is and what it might be used for. The outline has been drafted by experts in the field, however it is not meant to be an exhaustive review of scientific evidence, such as a systematic review or meta-analysis, which is not its purpose. This outline provides a description of the therapy and a brief narrative review of the emerging evidence considered by the researchers at NICM Health Research Institute to be important science being undertaken in tai chi.

## What is tai chi?

Tai chi<sup>1</sup> is an ancient Chinese practise rooted in early traditional Chinese medicine, martial arts, and philosophy that became more formalised in the 17th-century,(1, 2) with the evolution of tai chi over the centuries leading to the evolution of different classical styles.(3) Since its development, tai chi has been widely practised in China as a self-defence method, art form, spiritual practise, relaxation technique, exercise, and as a holistic exercise to cultivate and maintain health and wellbeing.(4) As a multi-modal practise, tai chi is characterised by slow, flowing, rhythmic movements, breath work and focussed attention – often referred to as a meditation in motion - and is practised regularly in China with the intention of improving health. In the West where tai chi is seen as a form of low-impact mind-body exercise, tai chi is most commonly taught as a series of slow, gentle, low-impact movements that integrate the breath, mind, and physical activity to achieve greater awareness and a sense of inner peace and wellbeing.(5)

A growing body of research in Asia and the West has begun to elucidate some of the therapeutic elements of tai chi that may underlie its health benefits. These elements are described fully in *The Harvard Medical School Guide to Tai Chi: 12 Weeks to a Healthy Body, Strong Heart and Sharp Mind* but in brief are: awareness, intention, structural integration, active relaxation, strength and flexibility, natural freer breathing, social support, and embodied spirituality.(6)

## Why people practise tai chi

In Australia, estimates of prevalence of use of tai chi range from 1% to 6% of the population based on national representative samples.(7) (8) While popularity of tai chi is highest in older adults, it is still taught in many colleges in China and the USA and is increasingly being offered in academic medical centres such as those associated with Harvard Medical School.

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<sup>1</sup> Tai chi is also known as tai chi chuan/quan or taiji.

People practise tai chi for a variety of reasons, including generic health improvement through gentle exercise. The meditative movement of tai chi is designed to strengthen and stretch the body, improve the flow of blood and other fluids, improve balance, proprioception,<sup>2</sup> and awareness of how the body moves through space. The practise of tai chi is expected to elicit functional balance internally for healing, stress neutralization, longevity, and personal tranquillity.(9) The potential beneficial effects of tai chi, such as improved motor functions, pain perception, metabolic profile, cognitive functions, mental health and sleep quality have been linked to possible neural mechanisms.(10)

## Effectiveness of tai chi

The following evidence summary provides an overview of potential clinical areas of benefit from the use of tai chi as a therapeutic tool. An overview of reviews was undertaken, including a systematic search of Pubmed/Medline and Cochrane Collaboration publications to end 2020 limited to English language papers. However, this summary is not designed to serve as an exhaustive systematic review of all scientific evidence in the field, but rather provides a brief narrative review of the emerging evidence in key clinical areas as understood by expert researchers in the field.

An increasing number of clinical studies of tai chi interventions have been published for a variety of conditions since the early 2000's.(5) A 2015 review identified 507 studies published between 1958 and 2013, including 43 systematic reviews of clinical studies, 255 randomised controlled trials (RCTs), 90 non-randomised controlled clinical studies and 115 case series. The top 10 studied clinical conditions included hypertension, diabetes, osteoarthritis, osteoporosis or osteopenia, breast cancer, heart failure, chronic obstructive pulmonary disease, coronary heart disease, schizophrenia and depression.(5)

## Tai chi for falls prevention, balance and mobility

There is a large body of research in the area of tai chi for falls prevention focused on balance control and confidence, flexibility and minimising risk of falling in older adults.(11-17) A recent meta-analysis (MA) reported high-quality evidence that tai chi reduces the rate of falls and the rate of injury-related falls over the short-term (<12 months) in at risk adults and older adults (by 43 per cent and 50 per cent respectively). Moderate quality of evidence found there was no effect on time to first fall.(18) This finding was in line with the conclusions of another systematic review (SR) and MA published that year that concluded tai chi is effective in preventing falls in older adults with the preventative effect likely to increase with exercise frequency.(19) Earlier SRs found that tai chi practise improves balance and balance confidence in older people,(14) with individuals at both low and high risk of falling showing improved balance after 3-months practise although the effect was smaller in those at high risk of falling.(20) A subsequent RCT involving 670 people aged 70 years or older at high risk of falling assessed whether tai chi was clinically more effective in reducing falls in this group than stretching or a standard multimodal exercise intervention.(21) Each intervention lasted for 6-months

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<sup>2</sup> Proprioception is the sense of the relative position of one's own parts of the body.

and participants had two 60-minute sessions per week; the primary outcome measure was falls in that 6-month period. The study found tai chi effectively reduced falls by 58 per cent compared with the stretching exercise (control intervention) and by 31 per cent compared with a multimodal exercise intervention.

A meta-analysis of clinical trials (22, 23) demonstrated significant improvement in aerobic capacity in both women and men aged 55 years or older practising tai chi compared to sedentary subjects. One study with 40 elderly individuals demonstrated that the tai chi group after 16-weeks of practise showed a 19.9 per cent increase in muscle strength of the knee flexors ( $P < 0.01$ ) (24), indicating the beneficial effects of tai chi in improving postural stability and proprioception<sup>3</sup> of knee and ankle in older people. Similar findings have been reported in a 48-week, single-blind, RCT (25) involving 269 women aged 70 years or older. It demonstrated that compared with a wellness education group, the tai chi group reported significant improvements in their physical and ambulatory dimensions.

Furthermore, women with osteopenia have experienced improvements in balance and flexibility, a reduction in pain related to less joint stiffness or postural imbalances, an increase in energy and endurance for daily activities and strength, fewer headaches and improved sleep, an increase in mental alertness, and being calmer and more relaxed mentally.(26)

## Tai chi for neurological conditions

Aside from research into the effect of tai chi ostensibly on healthy older people, there is also a body of research on the impact of tai chi on balance, mobility and falls in people with neurological conditions such as Parkinson's Disease or stroke.(27)

[Tai chi for Parkinson's disease \(PD\)](#) - A MA published in 2019 which included five RCTs with 355 patients with PD assessed the effects of tai chi on falls and balance performance compared to no intervention or other physical training.(28) This MA found tai chi significantly decreased fall rates<sup>4</sup> and significantly improved balance and functional mobility<sup>5</sup> in people with PD. The methodological quality of the included RCTs was rated as moderate to high-quality. This finding was in line with that of a SR and MA published in 2014 which also concluded that satisfaction and safety of this intervention type was high.(29)

[Tai chi for stroke](#) - With regard to the effects of tai chi practise on the balance and mobility of people having suffered stroke, a 2018 SR concluded tai chi has an overall benefit on balance, limb motor function and walking ability among stroke survivors, as well as on activities of daily living,(10) findings in line with the findings of previous reviews.(30, 31) This form of exercise is safe for stroke survivors and has been found to reduce fall rates as well as improving physical function.(32)

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<sup>3</sup> Proprioception is perception or awareness of the position and movement of the body.

<sup>4</sup> The odds ratio = 0.47 with a 95% confidence interval (CI) 0.30 to 0.74 ( $p = 0.00$ ).

<sup>5</sup> Berg Balance Scale mean difference = 3.47, 95% CI 2.11 to 4.80, and  $p < 0.001$ ; Functional Reach mean difference = 3.55 cm, 95% CI 1.88 to 5.23, and  $p < 0.001$ ; Timed Up and Go Test mean difference = -1.06 s, 95% CI -1.61 to -0.51, and  $p < 0.001$ .

## Tai chi for mental health disorders

Tai chi has been evaluated in clinical trials to determine its effectiveness as either a stand-alone treatment or an adjunctive treatment for mental health disorders. Research to date is promising, indicating a variety of benefits of tai chi practise in individuals suffering depression/major depression(33, 34) and drug dependency,(35) together with benefits in the area of stress management.(36) However, clinical trials in this area are marred by methodological weaknesses which limits the strength of recommendations flowing from this research.(37)

A MA of RCTs on tai chi for depression including four trials comparing tai chi with a wait list control group (n=203 participants) found tai chi significantly reduced depression symptoms as compared with wait-list controls.<sup>6</sup>(33) This conclusion was supported by the finding of another SR and MA published the following year.(38) Aside from positively impacting mood in depressed patients, there is evidence that tai chi training also improves sleep quality in depressed individuals.

Further to this, the effect of tai chi used adjunctively with regular medication on inflammatory markers and C-reactive protein (CRP) in people with major depression was studied in a clinical trial of 73 older adults with this condition.(34) [Elevated levels of inflammatory markers and CRP have been associated with increased risk for psychological distress and depression (39)]. The tai chi plus medication group showed greater reduction of depressive symptoms and significantly greater improvements in quality of life (QOL) and cognitive function, as well as a significantly greater decline in inflammatory markers and CRP compared to the group receiving education and medication. Reduction in inflammatory markers and CRP might be part of the underlying mechanisms of how tai chi improved psychological distress and depression.

Further to this, there is accumulating evidence that tai chi can relieve depressive symptoms in patients with fibromyalgia, arthritis, multiple-sclerosis, heart failure, mild dementia, and cerebrovascular disorder.(40)

In the area of drug dependence, a controlled clinical trial investigating the effects of tai chi in 38 hospitalised, alcohol-dependent patients in Korea(35) found that patients practising tai chi for 8-weeks experienced significantly increased blood serotonin levels ( $p=0.001$ ) and reduced nicotine dependency, and reduced symptoms of depression and anger, when compared with the control group who participated in the routine hospital rehabilitation program. It suggests that alternation of blood serotonin level might be involved in the mechanism behind tai chi induced depression management.

With regard to stress management, a MA examining the effects of tai chi on stress and mood disorders/disturbance including RCTs and non-randomised studies found that regular practise of tai chi positively affected stress management in both healthy individuals and individuals with chronic conditions.<sup>7</sup>(36) Heterogeneity of included studies was high ( $I^2 = 82\%$ ) but the result remained significant after the study with the largest effect was excluded. Since the publication of this MA, a controlled trial of 26 lonely older adults randomised to tai chi or a stress and health education

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<sup>6</sup> Depression was measured using a self-report depression rating scale and the pooled standard mean difference for these studies was -0.27 (95% CI -0.52 to -0.02, P = 0.03).

<sup>7</sup> Effect score 0.66 with a 95% CI 0.23 to 1.09.

intervention found the tai chi group had significantly decreased levels of stress and increased nuclear factor-kappa B (NF- $\kappa$ B) levels,(41) which is an important mediator of stress and depressive behaviours.(42) Change in psychological stress was correlated with change in NF- $\kappa$ B activation compared to the control group.

## Tai chi for neurocognitive disorders

Tai chi shows promise as an alternative multi-modal exercise for attenuating age-related cognitive decline – both in healthy older adults and in individuals with mild cognitive impairment through to dementia. A 2014 meta-analysis found small to moderate but clinically relevant improvements in executive function in cognitively healthy adults after 10-weeks to one year of tai chi training, with the effect size larger when tai chi was compared with non-intervention controls than when tai chi was compared with an active control.<sup>8</sup>(43) When data relating to cognitively impaired adults was examined, smaller but statistically significant effects were found in favour of tai chi compared to a non-intervention control.<sup>9</sup> These findings are supported by the findings of a second SR published in 2015 which found healthy adults practising tai chi on a regular basis showed better performance on several cognitive tasks compared to those doing usual physical activity.(44) However, this SR reported methodological weaknesses of the included clinical studies which limits the strength of the conclusions and recommendations.

## Cardiovascular disease and related risk factors

There is a growing body of research related to the effect of tai chi on cardiovascular disease (CVD) and related risk factors to determine its effectiveness as either a stand-alone or adjunctive treatment. Research to date has focused on cardiovascular function, specifically blood pressure (45-49), and there is a body of work on related to people with chronic heart failure and therefore with or at risk of CVD; this work has primarily been focused on functional status with a little on psychological wellbeing and QOL. (50-52)

[Tai chi for high blood pressure](#) – While there is encouraging evidence that tai chi may be beneficial in high blood pressure, the methodological quality of current studies is weak. A 2008 systematic review concluded tai chi may have beneficial effects on blood pressure.(47) The eight studies included in the review reported a statistically significant within-group reduction in mean blood pressure after tai chi exercise, however these studies were of low quality. A more recent systematic review published in 2013 assessed the effectiveness of tai chi for essential hypertension.(49) This review found tai chi compared to routine care improved both systolic blood pressure (SBP)<sup>10</sup> and diastolic blood pressure (DSP).<sup>11</sup> Tai chi was effective in reducing SBP and DBP in one RCT when

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<sup>8</sup> Effect size when tai chi was compared with non-intervention controls (Hedges'  $g$  = 0.90;  $P$  = .04); effect size when tai chi was compared with an active control (Hedges'  $g$  = 0.51;  $P$  = .003). The active controls were Western exercise, cognitive behaviour therapy or Mah-jong.

<sup>9</sup> Hedges'  $g$  = 0.346,  $P$  = .004,  $I^2$  = 0%

<sup>10</sup> Weighted Mean Difference (in systolic blood pressure) = -12.43, 95% CI: -12.62 to -12.24,  $P$  < 0.00001 (10 trials).

<sup>11</sup> Weighted Mean Difference (in diastolic pressure) = -6.03, 95% CI -6.16 to -5.90,  $P$  < 0.00001 (10 trials)

compared to antihypertensive drugs<sup>12</sup>, but adjunctive treatment of antihypertensive medication with tai chi exercise saw no difference in blood pressure when compared to antihypertensive medication treatment alone. However, the poor methodology of these studies was also noted. A third SR of four clinical trials assessing the effectiveness of tai chi in reducing resting blood pressure in the elderly concluded the evidence for tai chi in reducing BP was limited.(48) Finally, a 2014 Cochrane review assessing the effectiveness of tai chi for primary prevention of CVD found that while there was some evidence of beneficial effect of tai chi on CVD risk factors such as high blood pressure, this effect was not consistent across all studies and the main studies were small and of short duration.(53)

One recent clinical trial,(54) involving women aged 35 to 50 years at increased risk of CVD, demonstrated that compared with waitlist group, an 8-week tai chi intervention decreased granulocyte colony-stimulating factor (G-CSF), which was also observed 2-months post intervention, indicating that tai chi may help down-regulate pro-inflammatory cytokines associated with underlying cardiovascular risks.

Oxidative stress contributes to cellular damage and affects several signalling pathways (55) associated with CVD development via endothelial dysfunction (56-58). A quasi-randomised controlled study with 55 elderly Mexican individuals (59) found that after 6-months of daily training in tai chi, this group exhibited a statistically significant decrease in glucose levels, total cholesterol, LDL cholesterol and systolic blood pressure, as well as an increase in superoxide dismutase and glutathione peroxidase activity and total antioxidant status compared with the control group. Reducing oxidative stress might be involved in the underlying mechanism of tai chi.

Endothelin-1 (ET-1)<sup>13</sup> and circulating hormones play important roles in maintaining cardiovascular function. A study with 44 subjects demonstrated that the change in ET-1 and triglyceride was significant after 3-months of tai chi training (60, 61). It was also reported in a 3-arm study involving patients with essential hypertension that 12-weeks of tai chi practise significantly increased the plasma nitric oxide, carbon monoxide and hydrogen sulphide levels (62) and lowered blood pressure. Correlations were observed in this study between changes of blood pressure and changes in these gaseous signalling molecules.

[\*Tai chi for chronic heart failure\*](#) – A MA of 13 RCTs published in 2017 examined the effectiveness of tai chi in improving physical performance in people with chronic heart failure. The primary outcomes of interest specified were 6-minute mean walking distance (6MWD) and QOL. The 10 trials included in the MA showed that tai chi could significantly improve 6MWD.<sup>14</sup> The eight studies that reported on QOL showed that tai chi practise resulted in improved QOL as measured by the Minnesota Living with Heart Failure Questionnaire (MLHFQ): those practicing tai chi showed significantly lower MLHFQ scores than those not practising tai chi.<sup>15</sup>(63)

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<sup>12</sup> The antihypertensive drugs were reserpine or compound rutin tablets.

<sup>13</sup> Endothelin-1 is a vasoconstrictor secreted by endothelial cells which acts as the natural counterpart of the vasodilator nitric oxide, and therefore contributes to vascular tone.

<sup>14</sup> Random-effects model: weight mean difference = 51.01 m, 95% CI 30.49 to 71.53, P < 0.00001.

<sup>15</sup> Random-effects model: weight mean difference = -10.37 points, 95% CI -14.43 to -6.32, P < 0.00001.

## Cardiorespiratory disease

[\*Tai chi for chronic obstructive pulmonary disorder \(COPD\)\*](#) – A Cochrane review with results from 12 RCTs (n=984 participants) was published in 2016 and explored the effect of tai chi on dyspnoea (shortness of breath), exercise capacity, pulmonary function and psychosocial status among people with mild to severe forms of COPD.(64) The authors concluded there was low to moderate quality evidence that those who practised tai chi (when compared to usual care) showed better functional capacity (as reflected by a lengthened six minute walking distance) and pulmonary function (as reflected by the level of forced expiratory volume in one second), but that shortness of breath between the two groups did not differ and there was no change in QOL. There was no evidence that tai chi used adjunctively to other interventions, such as breathing exercise or exercise, provided additional benefit in terms of shortness of breath or functional and psychosocial wellbeing.

A MA published in 2014 which assessed the effects of tai chi on health-related QOL as well as exercise capacity in individuals with COPD reached the same conclusion as the Cochrane review of Ngai SPC and colleagues(64) with regard to tai chi improving exercise capacity, but concluded tai chi practise may improve health-related QOL.(65)

[\*Tai chi for asthma\*](#) – Some primary studies show that tai chi may be helpful for asthmatics, both children and adults. A study involving 30 asthmatic children in Taiwan saw half allocated to 12-weeks of tai chi training and half acting as controls. Tai chi training improved the lung function of the children with asthma allocated to this arm of the study.(66) A follow up study by the same group which saw 20 asthmatic and 18 non-asthmatic children participate in a weekly tai chi training session for 3-months investigated if tai chi exercise of low-to-moderate intensity modified lung function, airway inflammation and quality of life of asthmatic children. The authors concluded that tai chi practise improved pulmonary function and decreased airway inflammation in both children with mild asthma and those without asthma. Furthermore, tai chi practise improved the QOL in mild asthmatic children.(67)

Regarding adults, a small study from Thailand suggests adult asthma sufferers may be able to better control their breathing and improve their exercise performance using tai chi training. After 6-weeks of tai chi training, the patients said they felt more comfortable during a 6-minute walk and increased their maximum work rate and maximum oxygen consumption.(68)

## Musculoskeletal conditions and chronic pain

A large number of studies have been designed to assess effectiveness of tai chi for musculoskeletal conditions and chronic pain including that associated with osteoarthritis and other rheumatoid diseases, but recommendations arising from this body of research are hampered by the poor methodological quality of the trials. They are briefly summarised as follows:

- [\*Tai chi for osteoarthritis\*](#) – Systematic reviews and meta-analyses have consistently found that tai chi has a positive effect in the short-term on pain and disability in people with arthritis, particularly knee osteoarthritis.(69-72) Importantly, a number of studies have found that tai

chi is non-inferior to the gold standard treatment for knee osteoarthritis, which is physical therapy. One example is a study by Wang and colleagues(73) which compared the effectiveness of a 12-week tai chi intervention with 12-week physical therapy regimen among a sample of 204 adults aged 40 years or older with symptomatic and radiographic knee osteoarthritis. They found that the tai chi intervention produced beneficial effects similar to those of a standard course of physical therapy in the treatment of knee osteoarthritis.

- [\*Tai chi for neck pain\*](#) - There is emerging evidence that tai chi is as effective as conventional neck exercises for the treatment of non-specific neck pain. A recent study testing the efficacy of tai chi for treating chronic neck pain randomised the 114 participants to 12-weeks of tai chi or conventional neck exercises or to wait-list controls.(74) After 12-weeks, tai chi participants reported significantly less pain compared with the wait list group (average difference in mm on the visual analogue scale: -10.5; 95 confidence interval, -20.3 to -.9; P = .033). Group differences were also found for pain on movement, functional disability, and quality of life compared with the wait list group. No differences were found for tai chi compared with neck exercises.
- [\*Tai chi for low back pain\*](#) - A systematic review and meta-analysis published in 2017 assessed the effectiveness of tai chi for chronic musculoskeletal pain conditions and included two RCTs specifically on tai chi for low back pain.(69) The review authors found that there was low quality evidence that tai chi was more effective than no treatment, with regard to short-term pain [SMD-1.58 [95% CI: 3.45, 0.25]]. However, the difference was not statistically significant. Only one of the two RCTs assessed medium-term pain as an outcome and tai chi was found to be effective but evidence was of low-quality.
- [\*Tai chi for fibromyalgia\*](#) - There is emerging evidence that tai chi is as effective as aerobic exercise for a variety of outcomes in patients with fibromyalgia.(4) This study randomised the 226 adults to either supervised aerobic exercise (24-weeks, twice weekly) or one of four classic Yang style supervised tai chi interventions (12 or 24-weeks, once or twice weekly) and participants were followed for 52-weeks. The primary outcome was change in the revised fibromyalgia impact questionnaire (FIQR) scores at 24-weeks compared with baseline. While FIQR scores improved in all five treatment groups, the combined tai chi groups improved statistically significantly more than the aerobic exercise group in FIQR scores at 24-weeks (difference between groups=5.5 points, 95% confidence interval 0.6 to 10.4, P=0.03).
- [\*Tai chi for people with rheumatoid arthritis\*](#) - Relatively few clinical trials have been done to date to assess the effect of tai chi on health outcomes in people with rheumatoid arthritis. A Cochrane review published in 2004,(75) which did not review pain outcomes, found that tai chi had statistically significant benefits on lower extremity range of motion, in particular ankle range of motion. Furthermore, the authors concluded that tai chi did not exacerbate symptoms of rheumatoid arthritis. A 2007 systematic review of two RCTs and three non-randomised controlled clinical trials found that there was no significant pain reduction in those practising tai chi compared with those doing education plus stretching or usual activity.(76)
- [\*Tai chi for osteopenia and osteoporosis\*](#) - A meta-analysis of 15 RCTs published in 2019 with 857 patients found that tai chi (compared to no treatment or standard treatment) may be

beneficial in improving BMD of patients with osteopenia and primary osteoporosis.(77) The authors of the meta-analysis note, however, the quality of included trials was low.

## Cancer symptoms

A meta-analysis published in 2018 investigated the effectiveness of tai chi on cancer-related fatigue.(78) This study, which included six RCTs (n=373 patients), found that tai chi practised for more than 8-weeks has short-term ameliorative effects on cancer-related fatigue, especially among patients with breast and lung cancer, and the beneficial effects are superior to physical exercise and psychological support; whether there are longer term effects is unclear.

A systematic review published in 2014 assessing the health benefits of tai chi and qi gong for cancer patients found that tai chi/qi gong had a positive effect on cancer specific QOL, fatigue, immune function and cortisol level of cancer patients. The authors noted the high risk of bias in the studies and hence the findings need to be treated with some caution.(79) A more recent (2018) meta-analysis of 15 RCTs and seven non-randomised studies critically evaluated the effects of tai chi and qi gong mind-body exercises on symptoms and QOL in cancer survivors.(80) Tai chi and qi gong was associated with significant improvement in fatigue, sleep difficulty, depression, and overall QOL in cancer survivors. The authors noted that larger and methodologically sound trials with longer follow-up periods and appropriate comparison groups are needed before definitive conclusions can be drawn.

Several small RCTs (sample size < 100) with a duration of 12 to 16-weeks have found benefits of tai chi on physical and psychological outcomes in cancer survivors(81-86), such as reducing cancer-related fatigue (66-67), systolic blood pressure (64), cellular inflammatory responses (68-69), and enhancing proliferative activity (65). In addition, as cancer survivors are at risk of chronic diseases/conditions such as cardiovascular disease, a tai chi intervention may help reduce associated risk factors.

## Safety of tai chi

There exists minimal reporting of adverse events in tai chi. When reported they are typically minor and primarily musculoskeletal related, for example knee or back pain.(87, 88) To our knowledge no serious adverse events have been reported.

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