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Effects of Tai Chi exercise on physical and psychological health of older people.

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Abstract

Tai Chi is a traditional Chinese form of conditioning exercise derived from martial arts and rooted in eastern philosophy and Chinese Medicine. Based on the inter-relatedness of mind, body and spirit this form of exercise focuses on producing an inner calmness which is thought to have both physical and psychological therapeutic value. This article provides a brief overview of selected current evidence examining the relationship between Tai Chi and physical, neurocognitive and psychosocial outcomes in older people. This is an emerging and growing area of research and improvements have often been reported in health functioning, physical and emotional health, reducing falls, fear of falling and risk of falls, and possibly enhancing cardiovascular functioning in older adults although the effects on bone density, cognitive and immunological functioning are less clear. Results overall are inconsistent and health improvements have not been evident in all studies. Tai Chi is becoming increasingly popular in practice, and more recent evidence is emerging which is based on experimental and longitudinal designs, although many of the proposed benefits of Tai Chi are yet to be validated in large, randomised controlled trials.

Keywords: Tai chi, older people, physical and psychological well-being, exercise interventions

Background

Improving health in older age is becoming an important goal to reduce age-related mortality and morbidity. Promoting physical activity in particular is known to improve general health, reduce cardiovascular risk factors and associated mortality [3-6]. Indeed, for over a decade, there has been increased focus on the health and health promotional needs of older people, which has led to the development of policy and guidance and a national strategy in the UK for improving the health and wellbeing of older people, and this includes the promotion of physical activity in this group [7-12]. However, inactivity has been shown to increase with ageing and only 30% of those aged 65 years and over report any regular exercise [13]. Exercise is a generic intervention which has demonstrated physiological and psychosocial benefits for all age groups including older adults. The American College of Sports Medicine (ACSM) position stand (July, 2009) states that exercise for healthy aging should include a combination of aerobic, strengthening, and flexibility exercises. Coordination exercise such as Tai Chi, with low velocity, low impact, and a high interest level, which also provides a good training effect, is viewed as appropriate for most older people [14].

This paper provides an overview of the health benefits of Tai Chi for older people. Articles were located using CINAHL, Medline and Embase. Studies were included that were reported in the English language with older people defined as individuals aged 65 years or over. A broad search strategy was developed under the following key terms: 'physical activity', 'older people', and 'Tai Chi', 'fitness', 'cardiovascular', 'immunity', 'cognitive function', 'mood', 'social', 'bone density', 'osteoporosis', 'strength', 'balance' and 'falls' . To maximize the search in the databases, various synonyms and combinations of the search terms were used.

Tai Chi is an exercise regimen, also referred to as Tai Chi Chuan (TCC) and Taijiquan, which is rooted in eastern philosophy and Chinese Medicine [15,16], and has been

practiced in China for centuries, with numerous anecdotal reports from practitioners declaring Tai Chi as a 'cure' for a diversity of health disorders [17,18]. Based on the inter-relatedness of mind, body and spirit, it combines physical movement, breathing techniques, and cognitive tools (both visualization and focused internal awareness) to focus on producing an inner calmness which has both physical and psychological therapeutic value [19]. There are typically five recognized styles of Tai Chi each with specific movement sequences or 'forms', resulting in countless variations dependent on functional ability and personal preference. Although the progression speed of Tai Chi is thought to be ten times slower than normal walking [20], these slow movements have been shown to be equivalent to moderate intensity exercise which is thought to convey aerobic benefits [21-23].

Tai Chi involves a series of slow, graceful, continuous movements shifting weight from one foot to the other, with rotational movements of the head, trunk and extremities [14,24] Practice involves a degree of flexion at the hips and knees which maintains a lower centre of gravity to promote strengthening of the lower extremities [25]. Tai Chi movements also promote strength and flexibility of the neck, trunk and upper extremities, improved postural alignment, coordination, tactile spatial acuity [26] and increased static and dynamic balance [27]. Controlled breathing and concentration can result in greater body awareness [23,28,29]. Improvements in perceived self-efficacy have been observed in both older populations [22,30] and clinical populations [31] and this is significant since self-efficacy may influence participation and exercise adherence [22].

Tai Chi is gaining popularity as an alternative form of exercise for older adults [32-35] and is proposed as a potentially beneficial and low-cost behavioural lifestyle intervention for older people which can be easily practiced and implemented in community settings. The safety and efficacy of Tai Chi has been investigated for a range of health concerns referred to by Wayne et al [36]. This article will present research findings in the areas of

physical fitness, aerobic capacity & cardiovascular risk factors, immune functioning, neurocognitive performance, bone density and osteoporosis, strength and balance, falls/fear of falling, mental health and psychological outcomes, and the social impact of Tai Chi.

Physical fitness & aerobic capacity

Non-randomised controlled studies have suggested that Tai Chi may enhance cardiorespiratory functioning in healthy older people [35,37,52] although there have been mixed findings [2]. Authors in the 1990s proposed that Tai Chi may delay the decline of cardiorespiratory function in older adults [52], and that older TCC practitioners had better cardiorespiratory fitness, muscular strength and flexibility than their sedentary counterparts [35]. A 2008 meta-analysis [54] concluded that Tai Chi exercise *is* effective in improving aerobic capacity (ES = 1.33) when practiced long term. This review showed that middle-aged and older women and men benefit most (≥ 55 years: ES = 1.07), with greater gains seen among those who were initially sedentary. It was concluded that Tai Chi *can* be recommended as an alternative aerobic exercise, particularly among sedentary adults $>$ or $= 55$ years old.

Research has demonstrated that long-term practice of Tai Chi can attenuate the age-related decline of aerobic capacity and also reduce the increase of body fat ratio in older individuals [32]. In this controlled cohort study (n=69), participants were either long-term practitioners of Tai Chi or non-exercising controls in the community. Age-related decline in aerobic capacity was assessed on a graded bicycle exercise testing at baseline and five years later. Triceps and subscapular skinfolds, and thoracolumbar flexibility were also measured. Participants who practiced Tai Chi showed over the five year period a smaller decrease in VO₂ peak, a smaller increase of body fat ratio and less decrease in flexibility than controls. This suggests that long-term practice of Tai Chi may have beneficial effects on aerobic capacity, body composition and flexibility, although at

baseline, the Tai Chi group displayed significantly higher VO₂peak and thoracolumbar spine flexibility, and lower fat ratio than the control group.

In clinical populations, [33] it has been suggested that Tai Chi may improve aerobic capacity in patients with coronary artery bypass surgery. In this small controlled study, graded exercise tests were performed before and after 1 yr of TCC training (n=9) and the TCC group increased 10.3% in VO₂peak and increased 11.9% in peak work rate compared with the non-tai chi home-exercising control group (n=11) who showed a slight decrease in both outcomes.

In summary, while there has been to date a lack of consensus over whether increasing levels of regular aerobic exercise in older adults conveys increased and marked health benefits, it has long been agreed that inactivity decreases longevity [64] and this together with positive findings of a recent meta-analysis [54] highlights the importance of continuing to promote physical activity in this group.

Blood pressure & cardiovascular risk factors

Randomised controlled trials have suggested that reductions in blood pressure with Tai Chi are evident in healthy older populations [39,40]. Regular practise of Tai Chi has been shown to be almost as effective as moderate intensity aerobic exercise in reducing elevated blood pressure in previously sedentary older individuals [39], although again these randomised trial findings are hampered by a lack of true control group.

A later prospective, treatment-control study measured vascular responses in a community sample of healthy middle-aged women [55]. In this study, 17 relatively sedentary but healthy normotensive women aged 33-55 years engaged in Tai Chi three times per week over 12 weeks, and were compared with 17 sedentary control subjects matched for age and body size. Significant decreases were observed in both mean systolic (9.71 mmHg) and diastolic (7.53 mmHg) blood pressure. Although this was a

middle-aged rather than elderly cohort, these authors argue that importance should be placed on the *process* of ageing rather than the outcome (the older person) since many health risks for women in older age have been attributed to a failure to maintain exercise earlier in life [56-58]. Further, decreases in systolic and diastolic blood pressure in Thornton et al's case-control study [55] were comparable or greater than those observed in early RCT studies [39, 40], suggesting benefits to the cardiovascular system. However, Thornton et al's [55] study was limited by a small sample and lacked an alternative exercise control group. Also, the Tai Chi was delivered in a cultural setting in Hong Kong where Tai Chi is a popular exercise and therefore 'subjective norms' may have played a role in the high adherence to the programme. This study was restricted to females and therefore it is not known whether the same findings would be evident in mixed gender study and different cultural settings. Without measurement of psychological outcomes it is unclear whether the vascular decreases observed were a consequence of the mental or physical relaxation, and whether perceived benefits from the Tai Chi could be attributed to the cardiovascular improvements.

Reductions in blood pressure have also been shown in patients recovering from acute myocardial infarction [41]. In this three-armed randomised controlled study (n=126), blood pressure fell in the Tai Chi and aerobic exercise groups, but a true comparator group was not available due to low rates of study completion in the non-exercise support group (8%) and thus there was risk of placebo effect.

Ageing is associated with progressive increases of sympathetic nervous system activity implicated in the onset of hypertension and cardiovascular disease [59,60]. Although it seems that Tai Chi may have benefits for cardiovascular outcomes, little research has been conducted evaluating the effects of Tai Chi on sympathetic nervous system activity [61]. One small study examined the acute effects of Tai Chi on sympathetic activity in healthy older adults [62]. Tai-Chi practitioners (n=17) were compared with Tai-Chi naive participants (n=13); measurements included pre-ejection period, blood pressure, and heart rate before and after a 20 minute period of Tai Chi or passive rest. No differences

were found in blood pressure or heart rate, though results showed that Tai Chi performance significantly decreased sympathetic activity as indexed by preejection period. However, participants were recruited from a larger randomised controlled trial (RCT) of Tai Chi, in a laboratory environment, and so findings may not be generalisable to older adult community samples [62].

The acute effects of Tai Chi exercise on the autonomic nervous system, in particular, cardiac vagal activity, has been examined in a small sample using heart rate variability (HRV) analysis [63]. These authors studied 29 men from Shanghai, China, HRV analysis from ambulatory electrocardiographic (ECG) recordings. Of these, 15 were elderly men with several years experience of Tai Chi exercises. The study showed positive effects of Tai Chi on the vagal cardiac autonomic activity in that brief (5 minute) Tai Chi exercise immediately increased HRV in both older and younger participants. For older participants, there was a five per cent increase in intervals between heartbeats. This is clinically significant in that reduced HRV has been associated mortality and a range of negative health outcomes (Bigger et al, 1992; Kleiger et al, 1987). However, these are exploratory findings and whether Tai Chi exerts any lasting effects on HRV or RRI is unknown.

The impact of Tai Chi on cardiovascular risk factors has been compared with resistance training exercises in elderly Chinese participants [2]. In this 12-month RCT study, 207 older adults were randomised to either Tai Chi exercise (one hour, 3x per week), resistance training exercises (one hour, 3x per week) or a usual activity level control group. Anthropometric measures, dual X-ray densitometry body composition, blood pressure, lipids, glycaemic and insulin sensitivity indices were measured at baseline and 12 months. Tai Chi had no significant effect on any anthropometric or metabolic parameter compared with controls, whereas resistance training improved the insulin sensitivity index.

Overall, studies have proposed that Tai Chi benefits cardiorespiratory function, although the impact of physical activity on cardiovascular risk factors in older adults is not well understood and there have been contradictory findings. Despite improvements in research designs, well-controlled trials assessing the effect of Tai Chi on cardiovascular risk factors are lacking [39,41].

Immune functioning

The immunological effect of Tai Chi exercise is still unclear with limited research evidence in this field from case-control studies and RCTs [45,46]. Specifically, there is very little published research reporting the outcomes of Tai Chi on virus-specific cell-mediated immunity (CMI).

Irwin et al [46] investigated the effects of Tai Chi as a behavioural intervention on VZV specific immunity and health functioning in community-dwelling older adults who on average have impaired health status and are at risk for shingles. It is known that the incidence and severity of herpes zoster (shingles) increases dramatically with age in association with a decline in varicella-zoster virus (VZV) specific cell-mediated immunity (CMI). In Irwin et al's [46] study, thirty-six men and women (age ≥ 60 years) were randomly assigned to either a 15-week program of Tai Chi instruction (three 45 minute classes per week; N = 18) or a wait list control condition (N=18). Tai Chi led to an increase in VZV-specific CMI compared with controls and was associated with improvements in physical health functioning, with greatest effects in those older adults who had impairments of physical status at entry into the study. Although these are preliminary findings based in a small sample, the increase of VZV-RCF in their sample appeared significant since the older adults in the study were in good health, not depressed, and had higher baseline levels of VZV-RCF than had been previously reported in this at-risk population [67]. Additionally, for the physical health functioning, the magnitude of change from baseline to post-intervention was large and comparable to

that reported for certain medical procedures, although long-term effects remain unknown. The comparison group were waiting list controls and it may be that nonspecific intervention factors, including instruction, attention, and social support during the group exercise classes, expectancy, and enthusiasm about assignment to the TCC group, could have influenced the results [46]. Nevertheless, despite design limitations of this study, the findings provide preliminary support for the value of Tai Chi for improving functional limitations in physical domains and for enhancing at least one clinically relevant measure of virus-specific cellular immunity [46]. This requires further investigation before conclusions can be drawn about the efficacy of Tai Chi as an intervention to support immune functioning.

Neurocognitive performance

Early cross-sectional studies showed that physically fit older adults perform better on simple cognitive tasks than their less-fit counterparts [68] and this has given rise to investigations into the effects of aerobic exercise on cognitive performance in ageing adults. Studies are limited and more recent RCTs with longitudinal outcomes based on healthy but sedentary older adults have yielded inconsistent results [69,70]. Meta-analysis has been conducted by Colcombe and Cramer [69] who found that fitness training increased performance 0.5 SD on average, regardless of the type of cognitive task, the training method, or participants' characteristics (ES for exercisers= 0.478). Physical fitness is known to benefit cognitive performance and indeed it has been suggested that improving cardiovascular fitness (CVF) can help to reduce the deleterious effects of age on cognition and brain structure [70].

Some researchers have focused on specific cognitive abilities such as perception and tactile acuity, which may have importance for balance. Tactile acuity is known to decline sharply with age, yet retention of tactile acuity at the fingertip in healthy older adults may improve the use of light touch for stabilization and thus assist in the prevention of falls in older age [71,72]. Attentional focus is known to increase the efficacy of auditory,

visual, and tactile perceptual training regimens through top-down cortical regulation [73]. Researchers have investigated whether long-term training in a sensory attentional practice carried out in the absence of a direct stimulus training regimen effects changes in a measure of low level sensory perception [26]. In this case-control study with healthy older adults, Tai Chi is described as 'a training programme that, while not engaging in a direct tactile stimulus training, elicits enhanced tactile acuity in long-term practitioners' through focusing mental attention on the body's extremities including the fingertips and hands as part of the slow-motion meditative exercising. Experienced adult Tai Chi practitioners (n=14) were compared with age-gender matched controls (n=14) on ability to discriminate between two different orientations (parallel and horizontal) across different grating widths at the fingertip [26]. Findings showed that Tai Chi practitioners' tactile spatial acuity was superior to that of the matched controls ($P < 0.04$) with a non-significant trend suggestive of an enhanced effect in older practitioners and the authors propose a slowing of age-related decline on this measure [26].

This study is based on a small sample and therefore exploratory, and it cannot be ascertained from these findings whether Tai Chi *initiates* or is simply *correlated* with perceptual changes or whether it elicits long-term plasticity in primary sensory cortical maps. These findings need replicating in a larger sample, and it may be beneficial to assess whether other mindful, attentional practices such as Qigong, meditation and Yoga yield similar results.

Bone density and osteoporosis

Weight-bearing exercise is known to be effective at building bone density and prevention of further bone loss although a recent systematic review by Lee et al [87] found that the evidence from controlled clinical trials of the use of Tai Chi for treating and preventing osteoporosis was inconclusive [87]. The review included three studies which examined Tai Chi and its effect in older adults specifically [88-90], but all were found only to be of moderate methodological quality. Amongst healthy but sedentary older adults Tai Chi was found to stimulate bone metabolism significantly more than resistance training [90].

However, amongst a similar population the evidence failed to show significant effects of Tai Chi on Bone Mineral Density (BMD) in the hip or the spine compared with resistance training [87]. Although, in frail institutionalised older adults it was found to increase bone density and reduce fracture rate [88]. Nonetheless, the studies included in the Lee et al [87] review measured bone mineral density in different ways, such as BMD [88,89] or bone metabolism [90] and therefore it is difficult to make direct comparisons between studies, with no further studies identified.

There are some indications that Tai Chi may have the potential to improve bone mineral density and reduce fracture rate particularly in frailer older adults, although more rigorously conducted research is required before satisfactory conclusions can be drawn. The indications are that Tai Chi is likely to have no more of an effect than weight-bearing exercise and strength training [87], although Tai Chi may be found to be more appealing to older adults than other forms of exercise.

Strength and Balance

It has been proposed that the slow concentrated movements in Tai Chi may positively impact on balance control and muscle strength and if so, this form of exercise would seem beneficial for the older population. Again, evidence is limited, with the majority of existing studies focusing on improved balance and less evidence examining the impact on muscle strength in older adults. Nevertheless, RCTs have suggested that, in a relatively short period, Tai Chi can help to maintain and improve functional balance and provide overall physical gains [25,91-93].

An early RCT by Wolfson et al [25] examined the impact of Tai Chi on maintenance of improvements achieved by healthy older adults (n= 110) after three months of intensive balance and weight training. Tai Chi significantly improved both strength and balance for six months after the intensive training despite decrements over the intervention period. In a later RCT study, Li et al [91] primarily focused on prevention of falls, although secondary outcomes included functional balance and physical performance. In this study,

Tai Chi (n=125) intervention was compared with a stretching program control group (n=131) in inactive but healthy older adults. Each program consisted of a one hour class, three times per week for six months. Although there were high attrition rates, intention to treat analysis showed significant improvements in all Tai Chi participants ($p < .001$) in physical functioning and balance when compared with the control group. Intervention gains were also maintained at six-month post intervention follow-up. A further RCT by Zhang et al investigated the effects of an intensive eight week Tai Chi program on balance, flexibility and fear of falling in community dwelling older adults [92]. The intervention consisted of one hour of Tai Chi exercise on seven days of the week (n=25) compared with a no-exercise control group who participated only in their usual level of physical activity (n=24). The Tai Chi intervention group showed significant improvements in balance and flexibility (measured through one leg stance (OLS) and trunk flexion) (< 0.001) when compared with the control group. However, validity of measures used may have been affected by translation into Chinese and the impact of this is not clear [92].

Voukelatos et al [93] used a randomised trial to determine the effectiveness of a 16-week, community based Tai Chi program in improving balance and reducing falls amongst fairly healthy older adults (n=702). This programme was longer in duration than Zhang's previous intervention [92] although less intense as participants exercised once per week rather than seven days per week. Statistically significant improvements were shown in the Tai Chi group across five of the six balance tests (including sway on floor and lateral stability). More recently, Au-Yeung et al [94] used an RCT to examine the effects of a short-form of Tai Chi on balance in people who had suffered from a stroke (n=136). They found that a 12-week intensive Tai Chi programme (1 hour group plus 4 hours home exercise) showed improved balance through a number of measures (standing balance and standing equilibrium). However, the 'Timed up and Go' measure showed no significant improvement in either control (practicing general exercises) or intervention group. This supports previous work demonstrating a positive effect of Tai

Chi on balance in healthy older adults [95-98]. Both Voukelatos et al and Au-Yeung et al's studies were found to be of good methodological quality and the results are therefore relatively robust [93-94].

An earlier review by Wu et al examining the effects of Tai Chi on balance [28] had found scattered and inconsistent results due to variations in outcome measures and forms of Tai Chi used for intervention. Although recent studies have provided some additional evidence supporting the positive effect of Tai Chi on balance with physically-able community-based older adults and also frail older adults, there is scope for further research in this field examining the effects of Tai Chi for older adults in institutional settings, such as care homes.

Falls/Fear of falling

Tai Chi is increasingly associated with falls prevention due to the suggested link with improvements in strength and balance, and reductions in fear of falling in older people. Whilst the research evidences demonstrates the potential of Tai Chi for improving balance, it is important to explore whether this translates into a reduction in falls risk in the aged population. Specifically, authors have found that Tai Chi has been associated with a decrease in *number* of falls (particularly multiple falls), the *risk* for falling, and in *fear* of falling, particularly in frailer, higher risk older adults [40,91,99].

Wolf et al [40] conducted a prospective RCT with three intervention arms (Tai Chi, Balance training and education) for healthy community living older adults (n=200). The intervention period was 15 weeks with a four month follow-up. Fear of falling was found to be reduced after the Tai Chi intervention compared with the education-only control group. Tai Chi was also found to reduce the risk of multiple falls by almost half (47.5%). However, participants in the study were not blinded and were informed about all arms of the intervention, further, it is not clear as to whether randomisation was conducted by a researcher blind to group allocation. These positive findings may also have been

influenced by the wide definition of falls in this trial, which also included 'stumbles' and 'trips'. Li et al's [91] RCT study, with Tai Chi intervention showed a significant reduction in falls after 6 months ($p < 0.007$) with healthy but in-active older adults, there were also less fallers ($p < 0.01$) and fewer injurious falls ($p < 0.03$). There was also a significant reduction in fear of falling ($p < 0.001$), supporting earlier findings [40]. A recent RCT by Logghe et al [102] examining community living older adults in which the intervention group received 1 hour of Tai Chi twice a week for 13 weeks compared with a control group who received usual care (information and advice), found that after 12 months, there was no lower falls risk in the Tai Chi group than in the control group (adjusted hazard ratio=1.16; 95% confidence interval=0.84-1.60). There were also no significant differences in balance or fear of falling [102]. However, although this study was carried out with a high-risk population, the participants had only minor balance problems and low fear of falling at the outset which may have influenced the study findings. More recent work by Voukelatos et al amongst fairly healthy older adults has suggested that falls can be reduced with Tai Chi compared with controls, in those who have had two or more falls, but not those who had one or more [93].

Wolf et al's [100] well-designed RCT study examined the outcomes of a 48 week, twice a week Tai Chi intervention compared with education-only on fall occurrences in older, transitionally frail adults ($n=311$) in care homes. The study showed only a non-significant trend towards reduction in rates of falling. No significant reduction in falls has been found to date for older adults in long term care [103,104].

It has already been demonstrated that Tai Chi can significantly reduce fear of falling in healthy older adults [40, 91]. Sattin et al [99] assessed fear of falling in a randomised trial ($n=311$) comparing a 48-week Tai Chi intervention with an education programme amongst transitionally frail adults. Tai Chi led to a significantly greater reduction in fear of falling when compared to the education program and this reduction increased over the 48 week time period.

However, the evidence has been contradictory and some studies have found no significant effect in this population [101,102]. A systematic review found limited evidence for the effectiveness of Tai Chi in reducing falls [101]. The most recent Cochrane review examining interventions for preventing falls in community dwelling older adults found Tai Chi to reduce rate of falls and also falls risk [105]. Sherrington et al's [106] systematic review and meta-analysis of effective exercise for the prevention of falls also concluded that Tai Chi was an 'effective program' in the reduction of falls rates (17% reduction; 44 trials with 9,603 participants) [106]. There have also been several recent reviews of RCTs for Tai Chi and falls prevention, with a specific focus on reduction in falls [107,108]. These reviews show evidence for the benefits of Tai Chi in reducing falls although both argue that larger randomised studies are required, particularly in the UK where there is currently less evidence. Again, methodological issues with many of the studies reviewed make firm conclusions difficult to reach, since studies vary in type and format of Tai Chi and there is a lack of standardisation in the measures used to collect data. The majority of available studies have accessed community dwelling populations, and there is still a need for more research with frail older adults and 'younger' ageing adults, and studies in alternative settings, such as care homes, where there seems to be a paucity of research evidence.

Mental health and psychological outcomes

Many studies of Tai Chi focus on the impacts of this exercise form on physical health, however, randomised studies are emerging which focus on the potential benefits for psychological wellbeing in healthy older adults, such as relaxation and reduction in emotional stress [51,74].

In addition to stress reduction, studies have suggested that physical activity interventions in older age can improve mood state. Depression is often common and

recurrent in older age and is a significant risk factor which contributes to poor physical functioning and reduced quality of life [78]. A recent systematic review showed that physical exercise programmes obtain clinically relevant outcomes in the treatment of depressive symptoms in depressed older people [79]. These authors showed that exercise, though not appropriate for all in this population, may improve mood in older adults (short-term positive outcomes found in nine out of eleven RCTs), although further research is needed to establish medium- to long-term effects and cost-effectiveness [79].

Tai Chi specifically has been purported to improve mood state [49-51,81]. Chou et al [48] conducted a small RCT comparing psychological outcomes in depressed older adults attending either a Tai Chi training group or in a waiting list control group. Participants in the Tai Chi group were instructed to engage in three 45-minute sessions per week of Tai Chi practice, for the entire three-month intervention period. Each session consisted of a 10-minute warm-up, a 25-minute Tai Chi session (18-form of Yang's style), and a 10-minute cool-down and all sessions were led by an experienced Tai Chi practitioner. This investigative study demonstrated that Tai Chi has a positive effect in reducing depressive symptoms compared with no treatment in older community-dwelling patients with depression. Indeed, the researchers found that, Tai Chi was equally effective in reducing all four categories of depressive symptoms including somatic symptoms, psychological symptoms, symptoms related to interpersonal relations, and symptoms associated with well-being. This provides preliminary support for the psychological benefits of Tai Chi in this group, although the study was limited by a small sample size and the lack of an attentional control group. More recent work has provided evidence for reductions in stress and improvements in mood state although this was based on quasi-experimental design rather than a randomised clinical trial [81]. Whilst Tai Chi shows promise for enhancing psychological outcomes there is a need for further controlled trials with larger samples before firm conclusions can be drawn.

Social impact

There have been few studies which have considered the social impact of Tai Chi for older adults. However, it is already known that one of the motivators for older adults to attend exercise classes is for social reasons [82,83]. Furthermore, group exercise such as Tai Chi can promote the development and maintenance of social networks and also group exercise can lead to group and social cohesion [84].

In a cross-sectional study, Ho et al [85] compared healthy adults who had practiced Tai Chi for a year, with those who had not (n=700, age 40-70 years) on the 'SF-36' as a measure of Social Functioning (a scale measuring the degree to which the individuals emotional or physical problems effect their ability to carry out normal social activity). The intervention group (n=140), who had national membership with the Tai Chi Chaun Association, had improved social functioning compared with the control group (n=560) and this finding was particularly significant for those in the oldest sub group (60-70 years).

Further support for the positive social outcomes of Tai Chi have been observed. Taylor-Piliae et al [81] carried out a quasi-experimental study with relatively healthy older adults (n=39; average age=66). After 12 weeks of Tai Chi exercise there were significant improvements in overall social support and perceived support from family and friends, although there was risk of self-selection bias in the study sampling. However, it is argued that Tai Chi is often delivered as part of a larger social group [85] which may explain these higher levels of perceived support and functioning. In group exercise such as Tai Chi, verbal and social persuasion is often provided by peers and the instructor, which itself may lead to increased social connectedness and confidence [81]. It has also been suggested that increased social support from family and peers can increase self-efficacy (belief in own ability to undertake the activity) by giving older adults the confidence to believe that they can carry out the movements [86].

Although evidence on the social benefits of Tai Chi mirrors the existing evidence on general exercise groups, research is limited and therefore a substantial link cannot be established.

Conclusion

Tai Chi exercise is a standardised series of exercise, usually light in intensity, which requires no special equipment and can be practised almost anywhere, indoors or outdoors, either in a group or alone. With reputed health benefits, this form of physical activity has apparent safety for people of all ages, including older adults and medically compromised populations, and irrespective of previous exercise experience. Growing in popularity Tai Chi is becoming more commonplace as a preventative and rehabilitative therapeutic tool within the Western medical community.

This is an emerging and growing area of research and improvements have often been reported in health functioning, physical and emotional health, reducing falls, fear of falling and risk of falls, and possibly enhancing cardiovascular functioning in older adults although the effects on bone density, cognitive and immunological functioning are less clear. Results overall are inconsistent and health improvements have not been evident in all studies [2,16,101]. Many of the existing studies are based on small samples, retrospective or cross-sectional designs, and non-controlled study designs from which it is difficult to make causal inferences. Case-control studies are hampered by their non-randomised and retrospective nature. Studies presenting comparison of experienced Tai Chi practitioners with unexperienced or non-exercising controls may be biased by person-specific confounding influences such as overall health status, or personality factors [16]. Furthermore, it has been suggested that there may have been bias in presentation of positive data and publication selection in this evidence-base [16]. More evidence is needed from longitudinal studies based on rigorous randomised controlled trial designs.

Also, the precise mechanisms of the benefits of practising Tai Chi are not yet well understood. It remains unclear as to whether the positive benefits may be due to the relaxation component of the activity itself, or whether participants simply gain pleasure and reward from engaging in this activity. Tai Chi practice varies in form and complexity and little is known about the impact of various forms of Tai Chi on health outcome. Investigation is needed to ascertain the overall appropriateness of Tai Chi in specific populations, such as the frail elderly in care homes, and those with poor balance and/or cognitive impairments. In summary, the literature is promising, and there is a rapidly increasing interest in Tai Chi practice for older adults. However, evidence should certainly be interpreted with caution due to study design limitations which include variations in study demographics, small sample sizes, heterogenous participants, differences in style or form of Tai Chi practice, differences in frequency, intensity and duration of the intervention, and variations in outcome measures. It is clear that more well-designed studies are needed to strengthen the evidence base and to investigate the medium to long-term effects of practice.

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