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A Review of Tai-Chi and its Potential Benefits for Older Community Dwelling Adults with Osteoarthritis in the Context of Covid-19

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Abstract

Osteoarthritis, a chronic condition resulting in considerable disability, particularly in later life, not only impacts life quality significantly and severely, but is also strongly associated with the health conditions most often found in older coronavirus [COVID-19] patients. This review aimed to synthesize whether Tai Chi as applied to aging adults with this condition, in likely to be highly efficacious, in general, and especially during this current pandemic of isolation and social distancing. A second aim was to provide directives for professionals serving or likely to serve this population at this time and in the near future in the event no effective COVID-19 vaccine or treatment is forthcoming. The article specifically focuses on examining the efficacy of various forms of Tai Chi as intervention strategies for minimising the disability of older adults living in the community diagnosed as having osteoarthritis. To this end, the author attempted to include a broad overview of all relevant articles published in the English language on the topic, rather than any systematic review. Collectively, these data reveal that while more research may be helpful, Tai Chi—practiced widely in China for many centuries as an art form, as well as a religious ritual, relaxation technique, exercise, and self-defense method—may be a very useful intervention strategy for older adults in the community diagnosed as having osteoarthritis, as well as for reducing associated health problems that heighten COVID-19 risk. They specifically suggest health educators and others working with people diagnosed as having osteoarthritis can safely recommend this form of exercise to most people with this condition with the expectation that consistent Tai Chi practices will be protective in multiple ways, as well as heightening their life quality and overall health status.

Keywords: *aging, COVID-19, disability, exercise, intervention, life quality, osteoarthritis, pain, Tai Chi.*

Introduction

Osteoarthritis, a term used to describe the most common form of arthritis is a highly disabling chronic health condition affecting one or more of the freely moving joints of the body. Known to be a highly prevalent condition among older adults worldwide, the condition, which commonly affects the joints of the lower limb, spine, and hands, is an immense burden to society as well as the individual due to its generally progressive, and its tendency to advance from being a disease of a single joint to a disease of multiple joints over time. Consistently associated with varying degrees of intractable pain, joint stiffness and swelling as a result of associated damage to affected joint structure, the associated factors of obesity, and cardiovascular comorbidities that often accompany this disease [1, 2] render this group of older adults not only at heightened risk for premature morbidity and mortality in its own right, but also potentially for an increased risk of being affected by the novel and deadly corona virus [3]. In addition, those osteoarthritis cases who desire to resist or overcome the highly infectious corona virus may be especially challenged in various ways in the face of this 2020 unanticipated pandemic when they want to carry out safety precautions and others [4]. They may recover more slowly than desirable, even if data on this

possibility are not robust [5]. They may also struggle in their isolation-a strategy to enforce social distancing' - to manage their symptoms effectively during this pandemic lock down state that still prevails for many elderly in the US and Canada and elsewhere, if they are fearful, depressed, and feel unconfident to do this. In turn, they may be especially prone to pain, and sleep challenges, and to acquiring some form of metabolic disease, a corona virus risk factor, if they don't already have hypertension, or diabetes, especially if they are sedentary and remain symptomatic with no relief in sight [4].

On the other hand, intervention efforts designed to minimize symptomatic, osteoarthritis and reduce its debilitating impacts as a result of any unremitting pain may help overcome any associated unwillingness to exercise, which is of special significance in the context of ameliorating pain and its associated symptoms in osteoarthritis [6]. Appropriately designed interventions may also help to improve the overall health status of older adults with osteoarthritis, who are commonly in poor health, and are known to suffer from multiple health issues, including poor endurance, obesity, and fatigue that can further affect overall function and health status negatively and significantly [6-8]. As well, an inexpensive intervention approach that is simple to apply and can be carried out in the community, especially in the face of many 2020 travel restrictions as well as outdoor or indoor gatherings, and clinic visits, may yet help to reduce the burden or the perceived burden of the demands of managing the disease, as well as new tasks such as masking, hand washing, careful food preparation and home cleaning requirements, in the face of limited visits from home visiting nurses, and family members, among others [9-11].

A practical form of intervention with proven results is also desirable to minimize the mental health burden and other burdens commonly found among older community dwelling persons currently affected by osteoarthritis [7, 12] (See Box 1). Those that involve little financial investments that are safe and found to especially help the affected individual to carry out his/her normal functions of daily living without undue compromise, excess effort and excessive physical stress [11, 13, 14], are especially indicated in the context of this disease among the older population, and efforts to foster self-management, motivation for this, as well as for reducing the extent of any prevailing disability [6].

Box1. *Selected Problems Commonly Faced by People with Osteoarthritis of One or More Joints [*=factors that increase mobility limitation as per Lamb et al. (7); ** =factors that could be exacerbated as a result of COVID-19 issues]*

Physical	
	Chronic pain*
	Frailty*
	Joint inflammation and swelling*
	Muscle weakness**
	Increased risk for falling
	Joint instability
	Limited joint flexibility and joint stiffness
	Limited mobility and function*
	Obesity*
	Poor bone health*
	Poor endurance capacity*
	Poor posture
	Reduced balance capacity
Mental	
	Stress**, fatigue, sleep disturbances and lack of energy
	Sleep disturbances**
	Depression and anxiety**
	Lack of confidence in prevailing abilities to function, control pain**
	Feelings of helplessness**
Social	
	Reduced ability to work**
	Social isolation**
Other	
	High levels of comorbid health conditions.[1, 2, 15, 16]**

Unfortunately, despite the numerous and considerable challenges associated with osteoarthritis among the older population shown in Box 1, plus decades of related research, there is as yet, no effective safe pharmacologic remedy to limit or eliminate the symptoms of this condition [1, 2, 8]. Moreover, some medications may not only be injurious to joint tissues and others, but may inadvertently increase the risk for succumbing to COVID-19 [5]. In addition, while useful in restoring function and ameliorating pain in severe cases of the disease, not all cases of osteoarthritis can undergo artificial joint-replacement surgery, for example if the individual has severe osteoporosis and/or respiratory problems or obesity and cannot tolerate anaesthesia [15, 16]. In the case of the 2020 COVID-19 pandemic, elective surgery is also often restricted and not being offered in some cases due to infection related issues. Rest too, does not bring as many benefits as once expected, and can increase debility and joint destruction processes, whereby pain produces sleeplessness, and a perpetual cycle of fatigue. Finally, since no drug reverses or delays the progression of osteoarthritis, their long-term efficacy has been challenged [17]. As a result, adjunctive methods other than medications, or surgery, that might reduce the pain and disability associated with osteoarthritis, have been advocated for some time [18].

In this regard, physical activity is emerging as a crucially important intervention for promoting the general health status and well-being of older people with osteoarthritis. Indeed, specific evidence shows that aerobic exercise can improve cardio-respiratory function, and exercise endurance among people with arthritis [19], as well as assisting in weight reduction [20] that can decrease disease symptoms [21] and possibly their heightened COVID-19 risk and infection susceptibility [23, 24]. Along with improvements in joint flexibility and muscle strength [21], participation in regular exercise may decrease the severity of anxiety and depression found among people with osteoarthritis [22], while heightening immunity [25], improving blood pressure, coronary artery disease, diabetes, lipid profile, osteoporosis, neurocognitive function, and overall morbidity and mortality, in addition to osteoarthritis [19].

However, when even the shortest exercise bout may cause pain and leave the osteoarthritis patient with more, rather than less pain [21], and many adults with osteoarthritis also suffer from osteoporosis, and poor bone health, exercises that may overexert this patient group or cause undue fatigue, as well as injurious impacts on their already damaged joints is something patients as well as their practitioners may want to actively avoid. As well, certain exercises that increase the risk of injuries such as falls, due to fatigue, proprioceptive deficits, and poor balance issues, need to be avoided at all costs.

On the other hand, exercises that are gentle, as well as those that can currently be done indoors, as well as outdoors, with no equipment and independently of a gym or trainer, if required, would appear highly warranted as well as helpful and relevant in the context of the present COVID-19 pandemic and immense number of older persons with osteoarthritis located in communities who may yet be in some form of required isolation. Moreover, those exercises that can simultaneously allay anxiety and depression, those that can help to offset obesity, and that can improve life quality and functional capacity are especially advocated. While many forms of exercise exist, this current paper focuses on examining the results of representative studies that discuss the efficacy of the mind-body exercise approach known as Tai Chi, and its proposed benefits for ameliorating osteoarthritis symptoms in some way, and in maximizing health status, regardless of the presence of comorbid illnesses. The value of this therapeutic mode of intervention in the context of the corona virus pandemic –most prevalent among older adults with multiple morbidities- is also highlighted, as is the value of this information for health educators and others.

Tai Chi was specifically chosen in this respect because it is a well-established system of exercises developed over the span of hundreds of years in China found to be a helpful form of therapy for mature adults facing health problems and neural disturbances [26]. Widely practiced in China for many centuries as an art form, a form of religious ritual, a relaxation technique, method of self-defense, it is a form of exercise that can be undertaken by people of all ages as a preventative and restorative form of therapy for those with as well as without impairments [27, 28]. A health practice that has been shown to improve balance; promote postural stability; decrease falls; enhance cardiovascular and ventilatory functions; as well as being able to reduce

pain, stress, and nightmares [26, 27, 29] is of special interest in the context of osteoarthritis, where many of these overlapping health challenges commonly prevail [see Box 1] and is a core land-based exercise approach currently advocated for treating knee osteoarthritis by experts [4, 22].

Methodology

To support the application of Tai Chi as a beneficial and practical low cost form of therapy for older adults with osteoarthritis, data for this strictly narrative topic overview were downloaded from those available on the **PUBMED** electronic data source. This data source was selected, given the fact it is the largest repository of medical related research journals in the world and generally houses valid and clinically sound research studies. The years searched ranged from January 1, 1980- June 15, 2020 and key words included osteoarthritis and Tai Chi and those listed below, as selected by the author. All potential articles were first carefully scanned for relevance, and excluded if they were non-English based articles, or proposals for study, or did not focus on osteoarthritis or its analogues. Because this review sought to make a strong case for Tai Chi in the context of home based preventive care for older adults with osteoarthritis during the current COVID-19 pandemic, the review was largely focused on exploring a variety of associated empirical studies related to the present topic that employed a randomized controlled trial design, rather than any other design. A brief overview of selected meta-analyses related to TaiChi and osteoarthritis was also undertaken. All forms of Tai Chi were deemed acceptable, as were all years of publication, all forms of osteoarthritis and all geographic locations.

Results

General Findings

Search results from **PUBMED** January 1980-June 2020 showed the following numbers of articles using the keywords below:

Key word applied	Number of citations listed
Osteoarthritis + Tai Chi	138
Knee Osteoarthritis + Tai Chi	92 [25 clinical trials]
Hip Osteoarthritis + Tai Chi	24 [2 clinical trials, one on surgical application]
Hand Osteoarthritis + Tai Chi	10 [No clinical trials]
Spine Osteoarthritis + Tai Chi	8 [No clinical trials]
Ankle Osteoarthritis + Tai Ch	1 [General review]
Shoulder Osteoarthritis + Tai Chi	0
Wrist/Elbow Osteoarthritis +Tai Chi	0
Exercise + Tai Chi	1219
Exercise + Osteoarthritis	6348

Of the 138 possible related osteoarthritis studies highlighted on **PUBMED,** which is only equal to 2.17 percent of all exercise and osteoarthritis studies, a review of their titles and abstract contents consistently revealed very few relevant stand alone research papers or articles on this topic exist. By contrast, many that were posted were not always strictly related to osteoarthritis, were uncontrolled studies, abstracts, reviews of various sorts, or study proposals. Of these, a limited variety of osteoarthritis joint conditions and populations were found to be studied, with most focusing on the knee joints.

Data on Tai Chi generally showed that even at its most basic level, Tai Chi practice will potentially help foster a more relaxed mind, calmer spirit, and flexible body, along with improvements in self-image that may be very helpful in terms of reducing the immense stress associated with painful disabling osteoarthritis [30], and current possible heightened risk for COVID-18 [4]. Regardless, of mode of Tai Chi employed, or samples studied, other commonly observed benefits included: an improved aerobic capacity, improved blood oxygen levels and flow, as well as blood pressure ratings, health attributes very vital to attain during this pandemic time period. Other favourable health promoting benefits reported over time have been increases in balance capacity, immune responses, joint range of motion and kinaesthetic sense [41, 32] [see Box 2].

Empirical evidence of the efficacy of Tai Chi as an intervention for people suffering specifically with osteoarthritis or osteoarthritis symptoms is hence generally supportive of this line of intervention, regardless of study mode, and especially when considering a variety of the more well-controlled studies.

Study Examples

Earlier Studies

Among the various controlled clinically oriented studies that have examined Tai Chi effects for adults with osteoarthritis, an early study by Lee and Lee [33] that focused on establishing the efficacy of the Sun-style 24 form of Tai Chi among older community dwelling knee osteoarthritis subjects found this to be positive. That is, after completing the required study protocol of Tai Chi, the results showed that the experimental group had significantly less pain and stiffness after the intervention than the control group. There were also significant improvements in knee joint motion, rising time, balance, and fear of falling. The 46 subjects in the experimental group were 75 years of age on average, and had practiced the 24 forms of Sun-style Tai Chi for 60 min, twice a week for 12 weeks. In addition to pain relief, Tai Chi reduced fear of falling, while improving balance, sit to stand time, and knee joint motion, all key disabling correlates of knee or hip osteoarthritis.

In a related study, Hartman et al. [34] who examined the effects of another form of Tai Chi known as the nine-form Yang style Tai Chi, adapted this approach individually for those older adults with lower extremity osteoarthritis that were studied. The key study question was whether the intervention would impact arthritis self-efficacy, quality of life indicators, and lower extremity functional mobility. The intervention length was 12 weeks, and the desired outcomes were assessed before and after the intervention using blinded testers. In total, there were 35 community-dwelling participants (mean age 68) who took part in the study, and the Tai Chi training examined was delivered by experts in two 1-hour Tai Chi class periods per week. Results showed that the Tai Chi participants experienced significant improvements in all the above measures, plus a reduced level of tension, on the Arthritis Impact Measurement Scale. They also reported being satisfied with their general health status as measured on the same scale, and improvements in self-care activities and household tasks were also observed. These important clinically relevant findings were quite similar to those observed in another controlled study, in which Adler et al. [35] reported that group self-report pain intensity scores decreased significantly for 16 experimental subjects compared to control subjects after a 10-week program of once-weekly supervised traditional Wu-style Tai Chi exercise, and are probably attainable in the community if a strict protocol and tailoring of this is forthcoming.

In a comparable Tai Chi intervention study, Song et al. [36] examined the effects of Tai Chi exercise on pain, balance, muscle strength, and perceived difficulties in physical functioning in older women with osteoarthritis who completed a 12-week Tai Chi exercise program, executed four times per week for 20 minutes. In this study, 72 cases were randomly assigned to 2 groups, and due to a 41% overall dropout rate, only 22 experimental subjects and 21 controls completed the pre- and post-test measures over the 12 week study period. While the results showed no significant group differences in demographic data and pretest measures at baseline, a mean *t* test comparisons of the change scores revealed that the experimental group perceived significantly less pain and stiffness in their joints, and reported fewer perceived difficulties in physical functioning, while the control group showed no change or even deterioration in physical functioning after 12 weeks. In the physical fitness test, there were significant improvements in balance and abdominal muscle strength for the Tai Chi exercise group. It was concluded that older women with osteoarthritis are able to safely perform the 12 forms of Sun-style Tai Chi exercise for 12 weeks, and that this will significantly improve their arthritic symptoms, balance, and physical functioning, even though the drop-out rate was high.

Similar observations were made by Yip et al. [37] who assessed the effect of supplementing an Arthritis Self-Management Programme for residents in a home for

elderly people in Hong Kong with Tai Chi attributes. In this study, 37 residents completed the course, plus week 1 and week 16 assessments. The 16 residents in the intervention group received a 6-week self-management course. The traditional self-management course followed emphasized Tai Chi movements in the last three sessions. Outcome measures included arthritis self-efficacy, arthritis pain rating, functional and emotional status. At 16 weeks, the investigators found a significantly increased overall arthritis self-efficacy score, a reduction of their current arthritis pain rating, and improvements from baseline in their quadriceps muscle strength and hamstring muscle strength in the experimental group. The findings suggested that a self-management program that uses a Tai Chi approach to improving movement is more effective in enhancing overall self-efficacy to manage arthritis, improving muscle strength and reducing arthritis pain among older people in long-term care settings than a standard approach, a finding that may be one that can similarly be achieved in the community to enhance the older osteoarthritis patients' health and life quality.

To test the comparative effects of Tai Chi with more standard exercise approaches, Fransen et al. [38] designed a study that looked at whether Tai Chi or hydrotherapy classes for individuals with chronic symptomatic hip or knee osteoarthritis produces measurable as well as comparable clinical benefits. They studied 153 older persons with this condition who were randomly allocated to attend 12 weeks of hydrotherapy classes (n = 55), or Tai Chi classes (n = 56), or a waiting list with no intervention (n = 41). Outcomes assessed at 12 and 24 weeks after randomization showed that at 12 weeks, the exercise groups improved more favorably than the control group for pain and physical function. All significant improvements were sustained at 24 weeks, but fewer participants chose to stick with Tai Chi when compared to hydrotherapy. However, the outcomes for all attendees were positive and favorable, and may be helpful to note, in the present time, where hydrotherapy may be off limits.

In another comparative study Brismee et al. [39] evaluated the effects of group Tai Chi plus home-based sessions among elderly subjects with knee osteoarthritis using a randomized, controlled, single-blinded 12-week trial of 42 older adults with knee osteoarthritis stratified by age and sex. The Tai Chi programme consisted of 40 min/sessions, three times per week, followed by another six weeks (weeks 7 -12) of home-based Tai Chi training. Subjects were requested to discontinue Tai Chi training during a six-week follow-up detraining period (weeks 13-18). Subjects in the attention control group attended six weeks of health lectures following the same schedule as the group-based Tai Chi intervention (weeks 0 -6), followed by 12 weeks of no activity (weeks 7-18). The results showed knee pain, knee range of motion and physical function showed no significant changes in the attention control group throughout the study. The Tai Chi group reported lower overall pain and better physical function than the attention control group at weeks 9 and 12. All improvements disappeared after detraining, stressing the importance of encouraging a continuous, rather than any short-term Tai Chi strategy

Later Studies

In 2010, Song et al. [40] who had assigned 82 women with osteoarthritis to a Tai Chi group or a control group showed that after a 6-month study period, subjects in the experimental group had significantly greater knee extensor endurance than the controls, plus significantly greater bone mineral density in the neck of the proximal femur, Ward's triangle, and trochanter. The fear of falling during daily activities was reduced significantly in the Tai Chi group compared to the control group. It was concluded that the Tai Chi participation increased the participants' knee extensor muscle endurance and bone mineral density, and decreased their fear of falling during daily activities.

Later, Wang et al. [41] who noted that few remedies prevail to effectively treat long-term pain and disability from knee osteoarthritis, similarly examined if indeed Tai Chi would indeed help to alleviate osteoarthritis symptoms, and if so, if this would compare favorably with standard therapies for osteoarthritis. Using

a randomized, 52-week, single-blind comparative effectiveness trial design 204 participants with symptomatic knee osteoarthritis (mean age, 60 years; 70% women; 53% white) were studied. The active group received Tai Chi twice a week for 12 weeks) or standard physical therapy (twice per week for 6 weeks, followed by 6 weeks of monitored home exercise). The primary overall outcome was assessed using a validated composite function score that was administered at 12 weeks. Secondary outcomes included depression, medication use, and quality of life. Results showed that at 12 weeks, the overall disability score was substantially reduced in both groups. Both groups also showed similar clinically significant improvements in most secondary outcomes, and the benefits were maintained up to 52 weeks. Of note, the Tai Chi group had significantly greater improvements in depression and the physical component of the quality of life measure. The benefit of Tai Chi was consistent across instructors, and no serious adverse events were reported. Tai Chi thus produced beneficial effects comparable to those of a standard course of physical therapy, and may thus be of great advantage in instances at present where formal physical therapy is not readily accessible.

In another recent study, Lu et al. [42] who elected to explore the effects of a 24-week Tai Ji Quan training program on sleep quality, quality of life, and physical performance among 46 elderly Chinese women with knee osteoarthritis, randomized them to either a Tai Ji Quan group (n = 23) or a control group (n = 23). Participants in the Tai Ji Quan group completed training sessions 3 times per week, while those in the control group had bi-weekly educational classes. The primary outcome was the total score on the Pittsburgh Sleep Quality of Index (PSQI). Secondary outcomes were assessed using the seven subscales of the PSQI; sleep latency; total sleep time; sleep efficiency; physical component summary and mental component summary of the 36-item Short Form Health Survey (SF-36); as well as balance indicators. Results showed the Tai Ji Quan group had significantly improved primary as well as secondary outcomes. This novel study showed Tai Ji Quan training to be a highly effective for improving sleep and life quality among elderly Chinese women with knee osteoarthritis, very important correlates of osteoarthritis disability.

In a further interesting study, Liu et al. [43] who strove to compare the modulatory effects of different exercise modalities on the periaqueductal grey and ventral tegmental area, which play important roles in descending opioidergic pathways and reward/motivation systems in patients with knee osteoarthritis found positive results for Tai Chi. They did this by recruiting and randomizing 140 patients into Tai Chi, Baduanjin, stationary cycling, and health education control groups for 12 weeks. Knee injury and Osteoarthritis Outcome Scores, functional and structural MRI measures, and blood biomarkers taken at baseline and at the termination of the experiment showed: all exercises significantly reduced pain and serum programmed death 1 concentrations. Grey matter volume in the medial orbital prefrontal cortex was significantly increased in all exercise groups. There was also a significantly decreased resting-state functional connectivity level between the left ventral tegmental area and the medial orbital prefrontal cortex in the Tai Chi and Baduanjin groups. The afore mentioned data were taken to imply that there are multiple benefits to be achieved by 12 weeks of Tai Chi practice that can greatly help the sufferer and can be comparable to other forms of exercise, and may even be better in some respects for the older adult with osteoarthritis and chronic unrelenting pain.

Additional Observations

As well as the stand alone studies highlighted above, available meta-analyses have been generally in favor of Tai Chi form of intervention as outlined below by Wang et al. [44], Yan et al. [45], Chen et al [46]. Tai Chi also appears to improve disease-specific symptoms of pain and stiffness in osteoarthritis, and appears safe for individuals with different chronic conditions, including chronic obstructive airways disease, heart failure and frailty.

According to Duan et al. [47], compared with walking, Tai Chi may also safely yield improvements in hip range of motion and coordination of the neuromuscular system, and this form of exercise can hence be highly

recommended as suitable for treating patients with hip osteoarthritis, who are older, and have incurred severe muscle losses.

Chang et al. [48] who recently searched MEDLINE, PUBMED, EMBASE, and CINAHL databases for relevant studies in the context of Tai Chi Chuan and knee osteoarthritis found that of the eleven studies selected and retrieved, Tai Chi Chuan practice favored the physical component of the activities and participation domain most. Insufficient data was included in the meta-analysis as far as any mental component of the disease goes due to an insufficient evidence base, and can hopefully be explored in the future.

Rogers et al. [49] however, has noted that older adults who participate in Tai Chi appear to improve physical function, while showing reductions in blood pressure, fall risk, and depression and anxiety, all outcomes of great import to the osteoarthritis sufferer. The form of weight bearing exercises used in Tai Chi may specifically stimulate bone growth and strengthen connective tissue [50], while improving joint proprioception and balance among older adults [51]. In addition, mental health benefits as a result of Tai Chi practice that are observed include stress reduction, an improved ability to concentrate, and the adoption of a tranquil state of mind [52]. As well, Chan et al. [53] have been able to show that Tai Chi exercise is more effective than brisk walking in reducing cardiovascular disease risk factors among adults with hypertension using a randomized controlled trial design.

In sum, as depicted in Box 2, the various research based outcomes observed over more than 20 years shows Tai Chi may prove highly efficacious for promoting the wellbeing of older adults living in the community who suffer from one or more forms of osteoarthritis. These benefits are very important to note, given that they can be attained safely at almost no cost, and appear to help this group overcome multiple rather than single health challenges, which are not limited to physical benefits alone. Moreover, in a disease that often has few treatment options that can impact the disease itself effectively and favorably, the potential physical benefits alone including improvements in strength, reductions in stress and increased energy, increased control over one's own health, without applying stress to the joints, and improved joint stability are all beneficial outcomes that can potentially slow the progress of the disease, even if the disease is not reversible.

Very interestingly as well, is the fact that although data often reveal exercise is not well adhered to in general as a health measure, Yau [54] recounts that Tai Chi exercise is often chosen by the elderly, for its gentle and soft movements. This may also be because besides its physical benefits, the benefits described by practitioners of this art form include lifestyle issues, as well as psychological and social benefits. Moreover, findings from numerous studies support the belief that the practice of Tai Chi has multiple personal benefits, not only physical benefits, and is generally pleasurable.

Mechanisms of Action

Theories of why Tai Chi can affect favourable outcomes specifically among people who suffer from osteoarthritis of one or more joints, are first, that the physical movement itself, which closely resembles those used in most western physical therapy rehabilitation settings, improves flexibility and builds muscle strength, within the limits of the individual patient's potential [21]. Another is its holistic approach that integrates the physical body with the emotions and spirit [55]. Tai Chi is also found to improve brain metabolism and muscle energetics in older adults [10].

Lui et al. [56] showed that the grey matter volume of the thalamus and hippocampus was larger in a Tai Chi group compared with a control group, suggesting there may be a protective role of long-term Tai Chi exercise as far as slowing gray matter atrophy, improving the emotional stability, and achieving successful aging for elders.

Discussion

Although modern medicine has been successful in managing infection and saving victims of trauma [21], traditional medicine to counter or prevent disability associated with osteoarthritis, the most common chronic condition remains very limited.

Hence, new approaches to health promotion for this growing population are sorely needed, especially to overcome the sedentary tendencies imposed by the disease, as well as the corona virus pandemic [4, 11]. In this regard, Tai Chi, interchangeably known as Tai Chi Chuan, is an ancient Chinese health-promoting martial art form that has been recognized in China, as an effective arthritis therapy for centuries [56].

Indeed, research shows that the low to moderately intense exercise programs such as Tai Chi, especially forms that use slow graceful, low impact, low velocity movements that do not include a lot of bending seem particularly appropriate for older individuals often affected by this condition, because of its many worthwhile physiological and psychological long-term benefits [57], plus its relatively low stress impact on joints [29]. Importantly, Tai Chi can enhance muscle strength, as well as aerobic capacity, which can improve functional capacity and participation, while improving life quality [58], and in terms of the present 'lock down' mode of restricted social interactions in the US and other countries, its importance is heightened because the exercises seem conducive to fostering adherence, and can be done successfully in the home environment without equipment or personnel [9]. Enabling older adults and others with osteoarthritis to live better lives and possibly to have better long-term outcomes [14] Tai Chi is safe with considerable benefits in as little as 2-5 weeks [59] or 8- 12 weeks [33, 60] even if the sufferer has a diagnosis of mild cognitive impairment [61]. In addition to self-reports of enjoyment by people participating in Tai, data indicate this form of exercise may not only be sufficiently flexible to accommodate different people's preferences for exercise quite successfully, and the nature of the disease itself [8], but the exercise intensity and affective responses elicited during these types of exercises reportedly enable participants to feel good and infused with energy, likely creating a positive memory and reinforcing continued physical activity participation [62]. Associated with an exercise intensity that may be less injurious to joints than commonplace high intensity exercises often advocated for improving aerobic capacity, while reducing stress and promoting important physical and mental health benefits, it appears Tai Chi practice is especially likely to foster independence and well-being, such as reductions in pain and cardiovascular disease symptoms [53] among other health benefits. These movements, which incorporate deep breathing, while maintaining an upright posture are designed to soothe rather than stress, and are hence very important in the context of osteoarthritis treatments, where it is crucial to place no undue strain on the affected muscles, joints, and connective tissues surrounding the diseased joints, and where cognitive stress is a feature as well. They can also be effectively combined with resistance training exercises to enhance effects of exercise in older adults [63].

Because Tai Chi is a pleasurable activity for most people, this together with their reported psychological benefits may encourage and motivate people with osteoarthritis to participate regularly, rather than sporadically, as well as adhere to this form of exercise participation over the long-term. This is important given that most patients with osteoarthritis will commonly fail to participate in activities that are perceived as difficult and painful, especially if the activity worsens their joint pain [64]. The large benefits of Tai Chi exercise on knee extensor strength, proprioception and postural stability [65] may also foster better balance control, as well as less overall joint damage and proclivity to injury, such as falls [66] that can lead to a hastening of progressive disability and disablement [52]. In addition to all these potential benefits, programs using alternative exercise approaches such as Tai Chi may prove especially beneficial for those who cannot take medication, but who have considerable degrees of pain, given the evidence that pain can be reduced substantially [64], even if the exercises are only practiced one per week [35].

Conclusion

In light of the above arguments, and given the magnitude of the public health problem associated with osteoarthritis and the likelihood of this increasing—rather than decreasing as society ages—along with the finding of no short-term detrimental effects post-intervention on arthritis

disease activity, the potential for Tai Chi to encourage physical activity among these sufferers should not be ignored. Carefully applied, and encouraged, the consistent and long term practice of one or more forms of Tai Chi may be especially helpful, not only for both reducing the osteoarthritis burden among older adults due to sedentary behaviors as well as the pain and joint destruction processes associated with the disease, but also for helping this group to maintain a favorable health profile, despite associated commonplace health issues [44, 67, 69] and additional COVID-19 associated tasks and demands and possible infection [77]. Tai-Chi also appears to be safe, easy to practice in or outdoors, in standing, or sitting, alone or in a group, and may have currently important oftentimes overlooked benefits for the older community dwelling adult with osteoarthritis including, a positive impact on their immune system and cognitive functions [see Box 2]. More work to confirm current observations in different setting and osteoarthritis cohorts, as well as a focus on less well known outcomes that may reveal additional benefits of Tai Chi, including any associated fatigue effects, sleep health, falls, obesity, postural stability and motor control [70], as well as the mechanisms underlying the proven benefits noted to date, is also likely to be immensely helpful in the future and is strongly advocated.

In the meantime, osteoarthritis, which poses an enormous burden on society remains the most prevalent chronic disease disabler and with no effective treatment remedies, and many related comorbidities and an increased risk of acquiring COVID-19 infections in this older population group, this is a very serious deterrent to a life of quality and functional independence for many, with immense cost ramifications for society. In this respect, and to assist older adults who currently reside or wish to reside in the community and who suffer with various degrees of osteoarthritis, many may be helped in our view by health providers who can direct their clients to the combined effects of education and Tai Chi. Even those who eventually need surgery, may benefit, as they may be healthier than not through active practice, even if they may currently have to wait many painful months for elective surgeries at the present time. To this end, disseminating and providing demystifying information about Tai Chi in an understandable manner, especially to those elders who feel too weak to exercise or have never thought about practicing Tai Chi, is clearly of high importance, especially for those with concomitant pathologies such as diabetes, and cardiovascular diseases that are not only shared with COVID-19 risk, but also with increased pain and disability. Moreover, different osteoarthritis treatments such as NSAIDs, paracetamol, corticosteroids, opioids or other molecules have a wide array of iatrogenic effects, potentially increasing COVID-19 secondary infection incidence or complications and need to be avoided if at all possible [5].

In sum, the benefits of the slow gentle movements of Tai Chi as applied to older adults with osteoarthritis as well as other chronic lionesses have been fairly well demonstrated in a reasonable number of well-controlled trials in different settings and among different cohorts for over 20 years. As such, physicians, allied health workers, and others can be fairly certain that even if they cannot consult with their osteoarthritis patients in a face to face manner for various reasons at present in the face of COVID-19, they can still help their older osteoarthritis clients to better their health status and functional ability, while reducing their pain, any frailty or obesity risk, as well as excess anxiety and depression, and COVID-19 risk among those with comorbid health conditions by encouraging them to participate regularly in Tai Chi activities. Reviewing what aspects of Tai Chi will be most useful, as well as safe, plus making instructive videos, audio tapes, and written documents in understandable terms available and accessible in this regard, along with remote support, as indicated, appears to hold great promise for helping to attain one or more benefits listed in Box 2, and especially in mitigating co-occurring stresses attributable to osteoarthritis, in the face of COVID-19, without exacerbating existing conditions {79]. Moreover, post- operative joint replacement benefits may be anticipated [80], and if group activity can be safely implemented, the added social influences that may accrue may further enhance the multiple life-affirming benefits anticipated from regular Tai Chi practice [76] as outlined below.

Box2. *Specific Outcomes Tai-Chi Could Promote Among Older Community Dwelling Adults With Osteoarthritis if Practiced Consistently (*=outcomes that may reduce COVID-19 risk and foster more favourable recovery than not)*

- Activity tolerance [31, 79]
- Arthritis self-efficacy [67]
- Aerobic capacity [32]
- Balance [26, 31, 32, 72]
- Bone mineral density [40]
- Cardiovascular status [26, 31, 53, 75]*
- Degree of fatigue [78]
- Fear of falling [26, 66]
- Falls risk [31]
- Fitness [45]
- Flexibility [31, 79]
- Functional ability [67, 68, 74, 80]
- Gait kinematics [68]
- General health status [54, 79]*
- Immune responses [31]*
- Inflammation [77]*
- Mood status [26, 41, 67, 76, 77]*
- Motor control [70]
- Muscle endurance [40]
- Muscle strength [31, 72]
- Muscle tone
- Pain [31, 45, 67, 68, 69, 73, 74]
- Postural stability [70, 71]
- Proprioception [31, 52]
- Quality of life [41, 58, 67]
- Posture [32]
- Social well-being [76]
- Sleep [42]
- Stiffness [68]
- Strength respiratory muscles [77]*
- Stress levels [77]*
- Weight control*

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