The Benefits of Tai Chi for Health Outcomes: A Summary of Selected Recent Research and Clinical Guidelines.©

The Tai Chi Association of Australia (TCAA) submission to the Review of the Commonwealth Government Rebates on Private Health Insurance for Natural Therapies 2019-2020 (NTR 2019-20). February, 2020

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EXECUTIVE SUMMARY

The Tai Chi Association of Australia (TCAA) welcomes the current Commonwealth Government's Review of the Rebates on Private Health Insurance for Natural Therapies 2019-2020 (NTR 2019-2020). This TCAA submission aims to inform the Review Panel Members of the effectiveness of Tai Chi as a stand-alone and an adjunctive treatment for a variety of health outcomes and to provide evidence of the particular interest in Tai Chi taken by medical and health faculties and research institutions world-wide.

TCAA strongly supports the principle of requiring solid research evidence as the basis for the reinstatement of rebates for private health insurance in the Australian health sector. This is both to ensure not only that the robustness of rebatable items in the private health insurance system is maintained but also as a measure which assists in general consumer protection. We also support a wide inclusion of evidence in the Review's work, or certainly somewhat wider than characterised at the last Commonwealth Government review of natural therapies, 2014-2015 (NTR 2014-2015).

Consistent with the terms of reference of the NTR 2019-2020, the TCAA submission focuses on carefully selected systematic reviews of Randomised Controlled Trials (RCTs) examining the effects of Tai Chi on various health conditions for the period from 2015 to 2020. TCAA found a significant increase in published research studies over the five-year period from 2015 to 2019 when compared with the same period from 2008 to 2013 covered by the NTR 2014-2015. For example, a search of systematic reviews of RCTs for the term 'Tai Chi', TCAA identified 170 published systematic reviews for the period from 2015 to 2019 compared with only 63 for the period from 2008 to 2013, nearly a threefold increase.

In identifying and selecting recent higher-quality published systematic reviews supporting Tai Chi as an effective non-pharmacological intervention for a number of chronic, non-communicable diseases, most of the studies cited in this TCAA submission were published between 2017 and 2019, with the majority published in 2018 and 2019.

The systematic reviews for specific disease processes cited in this submission demonstrate the benefits of Tai Chi for diseases of the main systems of the human body, viz. musculoskeletal (osteoarthritis, chronic pain and falls prevention); metabolic (diabetes); immune (cancer); cardiovascular (CHD and heart failure); neurological (Parkinson's disease, brain disorders); pulmonary (COPD); and psychiatric (major depression) systems. In an earlier publication, Huston and McFarlane, in the Medical Journal *Canadian Family Physician,* in 2016 reported that of the 500 research studies and 120 systematic reviews, the strongest evidence of health benefits of Tai Chi included: Falls prevention in older adults; Osteoarthritis; Parkinson's disease; Chronic Obstructive Pulmonary Disease (COPD); and Diabetes, type 2. The details of Huston & McFarlane's (2016) findings are summarised in Table 1 of this submission, however as mentioned, most of the selected studies cited in this submission were published later than this, in 2018 and 2019.

In addition, the TCAA submission also presents evidence supporting Tai Chi as a form of physical exercise, with moderate aerobic exercise effects, similar to brisk walking, and with muscle strength building properties. This view is in line with the inclusion of Tai Chi in Australian and international clinical treatment guidelines published by peak medical and health

representative organisations. With this in mind, TCAA believes that the evidence in favour of Tai Chi as a form of physical exercise in health maintenance and treatment therefore requires a broader approach than the classification of Tai Chi as a 'natural therapy'.

Tai Chi is one of the few health-related interventions, that are classified as a 'natural therapy', to have such a substantial research evidence base with recommendations for its use by several eminent health and medical organisations worldwide. The international organisations named in this submission who have made their recommendations for the prescription of Tai Chi as a safe and effective health intervention in clinical practice guidelines, have done so on the basis of systematic reviews of RCTs and meta-analyses. TCAA submits that Tai Chi provides a safe, affordable, cost effective health intervention when compared with other less-evidenced natural therapies and provides a greater choice of interventions for health professionals and consumers.

In this submission, TCAA notes that in the US, Tai Chi and Qigong are already accepted by many third-party insurance companies as reimbursable health and wellness interventions (Klein et al., 2019). Similarly, the UK National Health Service (NHS) has adopted a broader view of interventions in an attempt to balance evidence-based clinical best practice with patient/consumers needs by, for example, including Tai Chi as a first-line non-pharmacological treatment for low back pain. TCAA recommends that a similar approach be adopted in Australia.

Taken together, the research supporting Tai Chi for specific non-communicable diseases, the broader body of research evidence supporting physical exercise, and therefore Tai Chi, as a clinical intervention, and the endorsement of Tai Chi by Australian and international peak medical and health organisations, provides a strong case for TCAA's recommendation for the reinstatement of Tai Chi as a claimable health intervention for Australian private health insurance rebates.

Accordingly, **TCAA recommends:**

1. **That the Australian private health insurance rebates for Tai Chi be reinstated.**

2 **That the Review panel adopt a broader approach in its examination of the benefits of Tai Chi for a range of specific chronic and complex health conditions having regard to the recommendations of Australian and international peak medical and health organisations.**

3 **That the Review panel adopt a broader approach in its consideration of Tai Chi, not only as an effective natural therapy, but also as a form of physical exercise and, as such, an effective non-pharmacological intervention.**

Introduction and Terms of Reference of Natural Therapies Review (NTR) 2019–20:

TCAA fully supports the Commonwealth Government's 2019-20 Review of Rebates on Private Health Insurance for Natural Therapies (Natural Therapies Review; NTR). TCAA also supports the view that the NTR is based on the question of whether there is research evidence to support the use of Tai Chi as a health intervention and, if so, that the rebates for Tai Chi be restored for private health insurance purposes.

The previous NTR conducted by Professor Baggoley's committee in 2015 is to be commended for adopting a measured approach to reviewing the scientific research literature that was available to it at that time, and despite what TCAA sees as shortcomings in its approach, made its recommendations on the basis of that review of evidence, solely. However, TCAA contends that since the previous NTR review, Tai Chi has demonstrated its efficacy as a specific form of physical exercise and as an evidence-based health intervention on the basis of an established body of valid empirical evidence. Furthermore, TCAA believes that the acceptance and recommendations in favour of Tai Chi by a significant number of peak representative medical and health organisations evidences its efficacy as an established and effective clinical intervention for chronic non-communicable diseases.

TCAA provided a comprehensive submission to the previous NTR in 2014-15. The current submission will cover the matters raised in the terms of reference of the NTR 2019-20 as detailed below. The review is timely because much has changed. Over the last five years, there was a significant increase in the number of published research articles on Tai Chi and health conditions in medical and allied health peer-reviewed publications and an increase in interest among the general Australian public about the health benefits of Tai Chi.

The NTR 2019-20 will examine the following:

- any additional evidence of (Tai Chi's) clinical effectiveness since the 2014-15 Review, or;
- high quality evidence not included in the 2014-15 review to be assessed by the National Health and Medical Research Council (NHMRC) including:
    - any evidence identified by the Expert Review Panel Members; and
    - any other evidence submitted to the Panel Members.

It is also TCAA's understanding that, at the previous stakeholders' meeting in September 2019, it was stated that consideration will also be given to evidence of the health benefits of Tai Chi on "quality of life" for participants.

Findings of Natural Therapies Review, NTR 2014-15:

In arriving at its conclusions and recommendations on natural therapies and private health insurance rebates, Professor Baggoley's 2014-15 NTR panel examined systematic reviews for the period from 2008 to 2013, used A Measurement Tool to Assess Systematic Reviews (AMSTAR) and concluded that they could not find "clear evidence" of the clinical effectiveness of any of the 16 natural therapies reviewed, including Tai Chi (Baggoley, 2015). Moreover, Professor Baggoley noted that the absence of evidence did not mean that reviewed therapies do not work, but rather that the panel of reviewers did not find "reliable, high-quality evidence" from the review. Professor Baggoley's (2015) report called for more rigorous, well designed Randomised Controlled Trials (RCTs) in the future, a view that is echoed worldwide by

academics and research institutions who are interested in examining the effects of Tai Chi (and Qigong) on health conditions (Kedzior & Kaplan, 2019; Sherrington, 2019; Wayne & Kaptchuk, 2008a; 2008b).

Despite adopting an objective, systematic approach in its methodology, TCAA believes that there were limitations in Professor Baggoley's (2014-2015) NTR. Firstly, the review panel limited its searches of databases to systematic reviews of only English language publications and was therefore, in our opinion, too narrow in scope. Secondly, although the AMSTAR assessment tool has been widely used by researchers to examine methodological quality of systematic reviews, it is not without limitations (Pieper et al., 2018), and has been criticised as "relying heavily on reporting quality rather than methodological quality", and applied by review authors inconsistently (Pieper et al., 2018; Wegewitz et al., 2016). Thirdly, the review panel did not examine the Cochrane Database of Systematic Reviews which contains high quality evidence and will form part of the TCAA's submission.

As well, clinical health practice requires a balanced and broader assessment of evidence-based best practice interventions with a patient-focused approach where health professionals attempt to provide patients with best available treatments while recognising individual patient needs. Relying solely on empirical evidence without recognising the clinical significance of treatments in a patient-centred approach, in TCAA's opinion, limits the choices for efficacious treatment for both clinicians and patients/consumers (Buetow, 2016; Papandony et al., 2017).

In this regard, TCAA has been able to identify recommendations for the use of Tai Chi for a number of specific disease processes by several eminent health and medical representative organisations, both as a general recommendation and as part of recommended clinical practice guidelines. These peak Australian and international representative bodies who support the use of Tai Chi as an intervention include the:

- *Royal Australian College of General Practitioners (RACGP),*
- *American College of Physicians,*
- *Canadian College of Family Physicians,*
- *American College of Rheumatology,*
- *Osteoarthritis Research Society International,*
- *Australian Arthritis Foundation,*
- *Ottawa Panel of Clinical Experts in Arthritis,*
- *Australian NHMRC Research Translational Faculty,*
- *Prevention of Falls Network Europe,*
- *American Geriatrics Society,*
- *British Geriatrics Society,*
- *Diabetes Australia,*
- *American Diabetes Association,*
- *Clinical Oncology Society of Australia,*
- *Canadian Cancer Guidelines Development Group,*
- *Cancer Councils Australia, WA & NSW,*
- *Australian Heart Foundation,*
- *American College of Cardiology,*
- *American Heart Association,*

- *Parkinson's Australia,*
- *American Parkinson's Disease Association,*
- *Parkinson's Disease Society of the UK,*
- *Lung Foundation of Australia,*
- *British Thoracic Society,*
- *American Thoracic Society,*
- *European Thoracic Society,*
- *U.K National Institute for Health and Care Excellence (NICE),*
- *German Pain Society,*
- *Australian Dementia Centre for Research Collaboration,*
- *Canadian Network for Mood and Anxiety Treatments,*
- *U.S. Department of Health and Human Services, and*
- *World Health Organisation (WHO).*

Several of these organisations made their recommendations for the use of Tai Chi in clinical practice guidelines on the basis of their own and/or existing systematic reviews of RCTs, and following the clinical judgement of guideline developers who concluded that there was sufficient evidence for the benefits of Tai Chi as a safe and effective health intervention (RACGP, 2014, 2016; Huston & McFarlane, 2016; Alison et al., 2017; Brosseau et al., 2017; Qaseem et al., 2017; Segal et al., 2017a; 2017b; Ni et al., 2018; U.S. Dept. of Health and Human Services, 2018; Bannuru et al., 2019; Kolasinski et al., 2019; Kraus et al., 2019).

An example of this broader approach was taken by the British Medical Journal's *Clinical Evidence* resource which identified categories of efficacy for research studies and pointed out that in 2017, in a review of the effectiveness of 3,000 commonly used conventional treatments in the UK National Health Service (NHS), only 11% were classified as "beneficial" whereas 24% were classified as "likely to be beneficial" and 50% classified as having "unknown effectiveness" yet all treatments continued to be subsidised by Medicare and rebated by private health insurers (Your Health Your Choice, 2019). TCAA supports the NTR's 2019-20 terms of reference that rebated health interventions be evidence-based, while acknowledging that using a broader approach towards considering interventions for private health insurance rebates will give health consumers and clinicians more choice of treatment and self-management options.

Two examples of Tai Chi's inclusion in clinical practice guidelines include the following recommendations. In its 2017 *Clinical Practice Guidelines: Non-invasive Treatments for Acute, Sub-acute and Chronic Low Back Pain,* the *American College of Physicians* made a "*strong recommendation*" for prescribing "Exercise" (among other treatment modalities) as a non-pharmacological intervention for back pain based on moderate quality evidence, and a "*strong recommendation*" for Tai Chi (among other treatment modalities) based on low quality evidence (Qaseem et al., 2017). Given that Tai Chi is evidenced as a specific form of physical exercise and has been described in research studies as having a moderate aerobic effect (Ainsworth et al., 2011; Chan et al., 2018; Lan et al., 2008; Taylor-Piliae et al., 2004), similar to brisk walking (Audette et al 2006; Chan et al 2018), when taken together these strong recommendations by an eminent group of researchers and clinicians adds weight to the efficacy of Tai Chi as an effective intervention for chronic low back pain, a leading cause of disability in our community.

The *Royal Australian College of General Practitioners* (RACGP), in its *2016 Clinical Guidelines: Exercise for Chronic Low Back Pain* classified Tai Chi as a form of *"Exercise Therapy"* and, as a non-pharmacological intervention, made the recommendation that "Tai Chi… has been shown to be safe and effective for treating low back pain, with improvements in pain intensity and disability level.", on the basis of an earlier RCT viz. Hall et al., (2011).

Accordingly, it is TCAA's contention that the decision to exclude Tai Chi from the list of Natural Therapy interventions for private health insurance rebates was flawed in its methodology and too narrow in its scope of findings. Furthermore, TCAA believes that it is important to note that Australian health consumers, as was found in the UK NHS, are seeking a greater choice of complementary and preventative interventions to improve and maintain their quality of life.

For example, Lim et al., (2017) reported an estimate that one in four people with cancer in Australia used a complementary therapy and 87% of patients with breast cancer used complementary and alternative medicine (CAM). Similarly, Papandony et al., (2017) in an Australian scoping systematic review of patient's perceived needs in the treatment of osteoarthritis (OA) commented that "exercise" was recommended as a treatment in all of the clinical guidelines reviewed and that "90% of patients with OA regularly used CAM or had done so in the past" (p. 1016).Von Conrady and Bonney (2017) reported that in the general population two out of three Australians will use CAM, accounting for $3.5 billion in expenditure each year. TCAA supports the view that Tai Chi is a specific form of "exercise" and will cite evidence to that effect in this submission.

In this regard, there is a parallel body of research literature supporting the clinical effectiveness of regular physical exercise as a non-pharmacological intervention for the onset and trajectory of many chronic, non-communicable diseases (WHO, 2016; 2017). TCAA believes that this body of research is applicable to Tai Chi, which is a specific form of physical exercise with moderate aerobic effects (Ainsworth et al., 2011; Chan et al., 2018; Lan et al., 2008) and with muscle strength training properties (Qi et al., 2018), and that this parallel research in favour of regular exercise should also be considered as supporting the efficacy of Tai Chi as a safe exercise intervention for these chronic diseases.

In this submission to the NTR 2019-20, TCAA will briefly outline higher quality evidence supporting Tai Chi as a form of exercise generally, and summarise higher quality research studies that specifically identify the clinical effectiveness of Tai Chi (and in some cases, with Qigong) as an evidence-based health intervention. Most of these peer-reviewed studies were published in reputable medical and health journals during 2018 and 2019. TCAA asks the NTR Review Committee to consider the broader body of empirical evidence in favour of physical exercise as supporting the clinical effectiveness of Tai Chi as a form of exercise, as well as considering the higher-quality evidence demonstrating the effectiveness of Tai Chi for the specific non-communicable disease processes listed hereunder.

TCAA's Research findings since the NTR 2014-15:

A TCAA search of the PubMed database, maintained by the U.S. National Library of Medicine, for the term "Tai Chi" in published journal articles over the five-year period from 2015 to 2019, identified 1077 published research studies. This figure represents nearly a 50% increase in the number of published articles from the five year period from 2008 to 2013 (726), the period covered by the NTR 2014-15, which led to the decision to cease private health insurance rebates

for 16 Natural Therapy interventions including Tai Chi. A further database search for terms "Tai Chi" and "randomized controlled trials" (RCTs) in journal articles published between 2015 and 2019, resulted in 290 articles being identified, almost doubling the 165 RCTs found in a search of articles between 2008 and 2013. A search of the terms "Tai Chi" and "systematic review" (of RCTs) for the period from 2015 to 2019 identified 170 published systematic reviews compared with 63 systematic reviews (of RCTs) on Tai Chi for the period from 2008 to 2013, the period covered by the NTR 2014-15.

These figures do not include separate searches in research databases for the term "Qigong", nor do they include searches for "Tai Chi" and related terms in the Cochrane Database of Systematic Reviews, a source of data which Professor Baggoley stated was not included in the NTR 2014-15. Qigong is often described as "stationary Tai Chi" and comprises a set of physical exercises with a long history of practice in China and with the same characteristics as Tai Chi, including relaxed slow breathing, meditation or mindfulness and slow movement components (Larkey et al., 2009). Several of the research articles cited in this submission are studies that included Tai Chi and Qigong as an intervention, and in terms of their health benefit components, TCAA contends that the terms Tai Chi and Qigong are often used interchangeably.

Similarly, as far as we could determine, searches of research databases in the NTR 2014-15 also did not include broader terms such as either "meditative movement" or "mind-body" therapies, which by definition includes Tai Chi, Qigong and Yoga (Larkey et al., 2009; U.S. Dept Human Services and Health, 2019), and have previously been examined in systematic reviews for chronic, non-communicable disease processes (Chen et al., 2016; Klein et al., 2019; Lee & Ernst, 2012).

Consistent with the terms of reference of the 2019-20 NTR, TCAA's submission focuses on carefully selected systematic reviews of RCTs examining the effects of Tai Chi, in some cases combined with Qigong, on various chronic health conditions for the period from 2015 to 2020, with most of the studies published between 2017 and 2019. Before examining these studies, however, TCAA's submission will present evidence supporting Tai Chi as a form of physical exercise, with a moderate aerobic exercise effect, similar to brisk walking and with muscle strength building properties (Ainsworth et al., 2011; Audette et al., 2006; Chan et al., 2018; Qi et al., 2018; Taylor-Piliae et al., 2004; Wang et al., 2013; Xie et al., 2019).

Evidence Supporting Tai Chi as a Form of Physical Exercise:

The links between the "pandemic of physical inactivity" (Kohl et al., 2012; Pratt et al., 2019) and chronic non-communicable disease is well established and widely acknowledged (Ding et al., 2016; 2019; Durstine et al., 2013; Guthold et al., 2018; Stenholm et al., 2016; U.S. Dept. of Health and Human Services, 2018a). Tai chi, as a specific form of physical activity of moderate aerobic intensity with muscle strength training properties, has the advantage of bridging both psychological and physiological domains in terms of its benefits as a "mind-body" activity (Bower & Irwin, 2016; Esch et al., 2007; Manskey et al., 2006), and has been described in research studies as "meditative movement" (Kelley & Kelley, 2015; Larkey et al., 2009) and "moving meditation" (Robins et al., 2012).

The *2018 U.S. Physical Activity Guidelines Advisory Committee (PAGAC) Scientific Report* described Tai Chi (and yoga) as a physical activity that "…typically combine muscle-strengthening, balance training, light-intensity aerobic activity, and flexibility in one package."

(U.S. Department of Health and Human Services, 2018b). Other research studies have demonstrated that Tai Chi yields an exercise intensity of between 3 to 6 metabolic equivalents of task (MET; Fan et al., 2018; Xie et al., 2019), and the Compendium of Physical Activities References List shows Tai Chi and Qigong as having an average of 3 to 4 METs, placing them in the moderate intensity range of aerobic exercise (Ainsworth et al., 2011).

In searches of the PubMed database for the terms "physical activity OR exercise AND systematic review" in the "Title" search fields, AND "Tai Chi" in the "All fields" search field, 49 systematic reviews of RCTs were identified specifically examining Tai Chi as a form of aerobic exercise and physical activity health-intervention. These results are separate to the larger body of literature on physical activity and exercise of a moderate aerobic intensity per se, which is equivalent to the moderate aerobic intensity and metabolic output of Tai Chi (Ainsworth et al., 2011; Xie et al., 2019).

A significant body of research literature on the health benefits of physical activity/exercise for chronic diseases is well documented and beyond the scope of this TCAA submission to the NTR 2019-20 (Booth et al., 2012; Durstine et al., 2013; Kujala, 2009; Pederson & Saltin, 2015; Roberts & Barnard, 2005; Warburton & Bredin, 2017). However, three systematic reviews of RCTs examining physical activity and exercise prescription for chronic, non-communicable disease processes have been selected and are highlighted below.

Pederson and Saltin (2015), in a comprehensive review of evidence supporting the prescription of exercise for chronic diseases, identified 26 chronic, non-communicable diseases for which physical exercise was recommended as first-line treatment. Categories of diseases into which these 26 separate disease processes fell included psychiatric, neurological, metabolic, cardiovascular, pulmonary, and musculoskeletal diseases and cancer, and prescribed exercise therapy interventions focused on improving aerobic capacity and muscle strength. As stated previously, TCAA believes that Tai Chi is a specific form of physical exercise with aerobic and muscle-strengthening effects and has equivalent health benefits when compared with other more traditional forms of physical activity, e.g. brisk walking. Thus, in our view, Pederson and Saltin's (2015) review of evidence in favour of physical exercise, per se, also provides empirical support for Tai Chi as an equivalent form of physical exercise. (Ainsworth et al., 2011; Qi et al., 2018; Xie et al., 2019).

In a systematic review published in the peer-reviewed *British Journal of Sports Medicine*, Northey and colleagues (2018) examined 39 RCTs on the effects of ""physical exercise", including Tai Chi, on cognitive decline in people over 50 years of age. Selected studies were generally assessed to have a low risk of bias and on the McMaster University "Health Evidence" assessment, which independently assesses the quality of research evidence on the effectiveness of health interventions and included the PICO review strategy (Health Evidence, 2019), the review of Northey et al., (2018) was assessed as having "strong" methodological quality with a score of 8 out of 10.

Northey and colleagues (2018) reported that overall, physical exercise interventions, including Tai Chi, significantly improved cognitive functioning in older adults and that significant positive gains occurred for this population when a physical exercise intervention that included Tai Chi, or resistance and aerobic training was prescribed, either alone or combined.

An Australian-led study in the Cochrane Database of Systematic Reviews on *"Exercise for preventing falls in older people living in the community"* (Sherrington et al., 2019) examined 108 exercise-based RCTs with 23,407 participants across 25 countries. Sherrington et al (2019) used an internationally recognised taxonomy developed by the *Prevention of Falls Network Europe*, an international consensus panel of experts in falls prevention and health research, to categorise types of exercises as falls-prevention interventions (Lamb et al., 2011). Of the 13 types of exercises, allocated to 7 categories of exercise in the taxonomy, Sherrington and colleagues (2019) found sufficient high-quality evidence to recommend only 3 types of exercise for falls prevention viz. balance and functional exercises, multiple types of exercises (mostly balance and functional exercises plus resistance exercises) and Tai Chi, categorised as a "3-Dimensional" exercise. This paper adds more weight to TCAA's view that Tai Chi is widely recognised by health researchers and clinicians throughout the world as a specific form of exercise/physical activity.

An extensive review of research evidence on physical activity and chronic disease was published in the *2018 U.S. Physical Activity Guidelines Advisory Committee (PAGAC) Scientific Report* which led the U.S. Department of Health and Human Services to release the *2018 Physical Activity Guidelines for Americans: 2nd Edition* and specifically identify Tai Chi in the section titled "*Spotlight on Aerobic Activities*", as a popular exercise option of light-to-moderate aerobic intensity, with the intensity dependent on the age category of the participants, i.e. either younger or older adults (U.S. Dept. of Health and Human Services, 2018a; 2018b). The *PAGAC* Scientific Report examined the relationship between physical activity and risk of falls and physical functioning in older adults, generally, and those with chronic illnesses. It included Tai Chi (and yoga) in its definition of a "multicomponent" activity "…because they often incorporate multiple types of physical activity" and recommended that "…all older adults do multicomponent physical activities" to reduce the risk of injury from falls (p73).

In identifying 7 of the 10 most common chronic diseases that were favourably impacted by physical activity, the *PAGAC* report nominated Tai Chi as a moderate intensity aerobic activity for older adults that included benefits for balance and muscle strength (Ainsworth et al., 2011; U.S. Dept. of Health and Human Services, 2018a; 2018b). In summary, the *PAGAC* report also found "strong" evidence that physical activity improves physical functioning in frail, older people and older people with Parkinson's disease; and "moderate" evidence that, for older people, extended exercise programs, as part of rehabilitation, improves physical functioning after a hip fracture and walking function after a stroke. (U.S. Dept. of Health and Human Services, 2018b).

When the evidence supporting regular physical activity is considered together with the substantial body of research literature supporting the use of mindfulness and other meditative practices for general stress management and improved quality of life for people with chronic diseases (Black & Slavich, 2016; Bower & Irwin, 2016; Kennedy & Resnick, 2015; Pascoe et al., 2017; Victorson et al., 2015), and in the prevention and treatment of several psychiatric disorders (Kong et al., 2019), the evidence in favour of Tai Chi as a form of aerobic exercise and as a mind-body intervention is compelling.

The following sections outline two studies that examined the overall health benefits of Tai Chi (and in some cases Qigong) and other higher quality systematic reviews of RCTs evidencing the benefits of Tai Chi (and Qigong) on specific chronic, non-communicable disease processes.

Recent Evidence Supporting Tai Chi for Health-related Conditions, in General:

Research studies supporting Tai Chi as a general health-promoting activity are many and varied. An examination of the PubMed database in 2019 showed that in the ten years between 2000 and 2009, there were 567 health-related journal articles published on Tai Chi, and between 2010 and 2019 this number jumped to 1785 research articles, a threefold increase. In 2019 alone there was around 300 research articles published in journal on health-related Tai Chi. A research article published in 2016 in the Medical Journal *Canadian Family Physician*, summarised and reviewed much of the recent research and listed the positive health benefits of Tai Chi (Huston & McFarlane, 2016).

Huston and McFarlane (2016) examined an "evidence map" from 120 systematic reviews that had been published up to 2015 on the benefits of Tai Chi for 25 health-related conditions and for general health and fitness, and classified the evidence in favour of Tai Chi as a health intervention according to its level of benefit. An "evidence map" has been described as a systematic process of reviewing evidence that makes large bodies of research literature more "accessible, digestible and useable" (Miake-Lye et al., 2016). The results of these classifications are shown in Table 1.

Table 1. Evidence of Benefits of Tai Chi for Health-related Conditions

Excellent evidence	***Good evidence***	***Fair evidence***	***Evidence of no direct benefits***
• Falls prevention and balance • Osteoarthritis • Parkinson's disease • Chronic obstructive pulmonary disease • Aerobic capacity • Diabetes, type 2	• Depression • Cardiac and stroke rehabilitation • Cognitive impairment • Dementia • Lower limb strength • Osteoporosis	• Quality of life for cancer patients • Fibromyalgia • Hypertension • Multiple Sclerosis	• Rheumatoid arthritis • Chronic heart failure

(Source: Huston & McFarlane, 2016)

Huston and McFarlane (2016), reported that of the 500 research studies and 120 systematic reviews published since the early 1970s, the strongest evidence of health benefits of Tai Chi included: *Falls prevention in older adults; Osteoarthritis; Parkinson's disease; Chronic Obstructive Pulmonary Disease (COPD); Cognitive capacity; Balance and Aerobic capacity; and Diabetes type 2*, as shown in Table 1.

In a survey of systematic reviews conducted between 2010 and 2016 on the effects of Tai Chi and Qigong on physical health conditions, Klein and colleagues (2019) examined 41 systematic reviews rated as "medium" in methodological quality (AMSTAR $\geq$ 6/11) and identified 5 clinical areas where Tai Chi and Qigong interventions were supported by independent research evidence. The areas of clinical application supporting Tai Chi and Qigong in a complementary and/or alternative role to conventional treatments were for: *Falls prevention and balance training, Cancer care, COPD, Parkinson's Disease and Cardiovascular disorders* (Klein et al., 2019).

Klein and colleagues (2019) noted that in the United States, Tai Chi and Qigong were already accepted by many third-party insurance companies as reimbursable health and wellness interventions. TCAA proposes a similar policy approach in Australia. Although commenting that much of the earlier research on Tai Chi as a health intervention lacked methodological rigour, Klein et al., (2019) identified these five clinical areas as more rigorous in methodology and suitable as complementary interventions with existing treatment protocols.

Following are selected, recent higher quality systematic reviews supporting the benefits of Tai Chi (and in some cases Qigong) for specific disorders and disease processes.

Recent Evidence Supporting Tai Chi for Specific Disease Processes:

Tai Chi and Falls Prevention:

The incidence of falls in the community is more prevalent in older populations with around 30% of people over 65 years of age falling at least once in a year. Given that the proportion of Australians who are over 65 is predicted to rise from 14% (3 million) in 2010 to 23% (8 million) by 2050, the cost of falls in the community is expected to rise to $1.4 billion by 2051 and government-led strategies are required to reduce this huge strain on the Australian health system (Australian and New Zealand Falls Prevention Society, 2019).

In response to the "…huge and growing burden of falls and minimal trauma fractures in Australia…" the *NHMRC Research Translation Faculty in 2015* published *"A Case For Action"* on falls and fracture prevention and stated that "…strength and balance exercise and Tai Chi prevents falls and promotes health and well-being more generally (Buchbinder et al., 2015). This expert advisory steering group comprising 18 eminent researchers and clinicians proposed that either strength and balance exercise or Tai Chi have the greatest amount of evidence that they are effective approaches for preventing falls and that for over 65 year-olds, "… a 15 week Tai Chi program would lead to 1,000 hospital admissions being averted over 12 months" (Buchbinder et al., 2015. p21).

A recent study in the Cochrane Database of Systematic Reviews on *"Exercise for preventing falls in older people living in the community"* (Sherrington et al., 2019), included Tai Chi as an exercise modality and examined a total of 108 exercise-based RCTs with 23,407 participants across 25 countries. This study is particularly important given that at least one-third of older adults over the age of 65 and living in the community, fall each year. On the basis of 59 RCTs (n=12,981), rated as "high-certainty evidence", Sherrington and colleagues (2019) concluded that: exercise overall, (all types including Tai Chi) reduced the rate of falls (i.e. falls per person per year) in adults over 60 years of age by 23% (95% CI 17% to 29%); in 7 RCTs (n=2,655), rated as "low-certainty evidence", Tai Chi reduced the rate of falls in older adults by 19% (95% CI 1% to 33%), and; in 8 "high certainty evidence" RCTs (n=2,677) Tai Chi reduced the number of older adults who experienced one or more falls by 20% (95% CI 9% to 30%).

In a follow-up to the Sherrington et al., (2019) study, Ng and colleagues (2019) examined trial and participant characteristics of the 108 RCTs with 146 intervention arms and reported on the three types of exercise interventions that most reduced falls, based on taxonomy developed by the *Prevention of Falls Network Europe*, viz., Tai Chi, balance and functional training programs, and programs containing multiple types of exercises. For Tai Chi, Ng et al., (2019) identified the median program duration as 20 weeks with a median of 45 total hours of exercise and that the majority of Tai Chi sessions were delivered in a group setting.

When considered together these two studies (Ng et al., 2019; Sherrington et al., 2019) provide further evidence of Tai Chi's role within the broader category of exercise interventions and provides health professionals with an additional exercise modality to prescribe as a falls-prevention intervention.

These research findings and Australian epidemiological data are reflected in recent U.S. reports on the burden of chronic disease and mortality in the U.S. and the need for physical activity of at least moderate intensity to prevent falls and maintain healthy functioning as the population ages (Dipietro et al., 2019). As mentioned previously, the *2018 Physical Activity Guidelines for Americans: 2nd Edition*, were based on the *2018 Physical Activity Guidelines Advisory Committee (PAGAC) Scientific Report* (U.S. Dept. of Health and Human Services, 2018b). The 2018 *PAGAC* report updated the findings of the 2008 *PAGAC* report with a further review of more recent research studies citing that "…since the 2008 Report, considerable evidence has emerged regarding the relative benefits of various modes or combinations of physical activity"(pF9-2), including Tai Chi, for specific fall-related physical function outcomes such as strength, gait speed and balance and activities of daily living. The *PAGAC* report defined Tai Chi as a "multicomponent" fall-prevention physical activity.

Specifically, the *PAGAC* Report found "strong evidence" that for older adults, multicomponent exercise programs can significantly reduce the risk of fall-related injuries by 30% to 40% and fractures by 40% to 66%. This constitutes a significant finding given that in the U.S. falls in this population are the leading cause of fatal injury and the most common cause of nonfatal trauma-related hospital admissions (U.S. Dept. of Health and Human Services, 2018b), and an estimated cost of $9389 per fall was spent in 2017 by U.S. Medicare beneficiaries for fall-related injuries (Hoffman et al., 2017).

In a subsequent study reviewing and updating the 2018 *PAGAC* literature review, Di Pietro and colleagues (2019) cited "strong and consistent evidence from RCTs demonstrating that multicomponent physical activity (ie. combinations of aerobic, muscle-strengthening, balance and flexibility exercises) significantly reduced the risk of fall-related injuries by about 32% to 40%..." (DiPietro et al., 2019, p. 1306). Specifically, Tai Chi was identified from 5 meta-analyses as reducing the risk of fall-related injuries by 50% (relative risk: RR. 0.50; 95% CI 0.35-0.71) in community-dwelling older adults in Asian countries (DiPietro et al., 2019).

These findings were supported in a systematic review and meta-analysis by Zou and colleagues (2019), in the *Archives of Physical Medicine and Rehabilitation*, examining the effects of Tai Chi on lower limb proprioception, a key component in coordinated movement control, balance and risk of falls in older people. Eleven RCTs with 584 adult participants over the age of 55 were sourced from English and Chinese-language databases and rated as "moderate to high" in methodological quality on a modified Physiotherapy Evidence Database (PEDro score = 5 to 8). Zou et al (2019) reported that Tai Chi had significant positive effects on lower limb joint proprioception, and thus falls prevention, as measured by ankle and knee flexion, with moderate to large effect sizes (SMD ranged from -0.55 to -0.83). Although falls in the elderly are due to multiple factors including strength, vestibular, visual and proprioceptive aspects, this study points to at least one potential underlying mechanism and thereby, a prospective preventative factor for Tai Chi reducing the risk of falls (Zou et al., 2019).

A very recent overview of previous systematic reviews of RCTs published by Zhong and colleagues (2020) in the *Annals of Physical and Rehabilitation Medicine* examined the

methodological rigour of 14 systematic reviews on the effects of Tai Chi for improving balance and reducing falls and expressed caution in recommending Tai Chi for reducing the rate of falls and improving balance in older adults because of low methodological quality in the studies reviewed. This cautionary conclusion is not surprising given that, as stated previously, Sherrington et al (2019) found "low-certainty evidence" that Tai Chi reduced the rate of falls in older adults, but also found 8 "high certainty evidence" RCTs (n=2,677) showing that Tai Chi reduced the number of older adults who experienced one or more falls by 20% (95% CI 9% to 30%), an aspect that Zhong et al., (2020) did not examine.

These findings are additional to the recommendation of the *Royal Australian College of General Practitioners* (RACGP) in its *Clinical Guidelines: Exercises for Falls Prevention (Grading: NHMRC Level 1 evidence)* stating that "Tai Chi was the only *single* exercise intervention proven to reduce the risk of falling although it was not definitely proven to reduce the falls rate. There was no evidence that any other single category of exercise – balance-retraining, muscle-strengthening or walking – was effective on its own." (RACGP, 2014). This recommendation is consistent with that made by the *Canadian College of Family Physicians* who concluded that there was "excellent evidence" of benefit in favour of Tai Chi for falls-prevention (Huston & McFarlane, 2016), and the *NHMRC Research Translational Faculty* who recommended Tai Chi as an falls-prevention intervention and called for "urgent action" to reduce the burden of falls and fractures in Australia (Buchbinder et al., 2015).

In terms of the relative financial burden of health costs on the Australian economy from falls, apart from the physical and psychological costs to these individuals, their carers and families, these reviews highlight the need for a strategic approach towards falls prevention by including private health insurance rebates for interventions such as Tai Chi and Qigong in Australian health care. With an increasingly aging population and a higher age-standardised incidence of falls in Australia, adding to the substantial global burden of falls (James et al., 2020), affordable and necessary preventative and treatment interventions for fall-related injury in older people is a significant and critical issue for health policy makers.

In NSW alone, with the expected rise in over 65 year olds from 1.27 million in 2017 to 2.3 million in 2051, increases in the cost of hip fractures alone are predicted to rise from between $139 million to $209 million in 2017, to between $321 million to $482 million by 2051 (Australian and New Zealand Falls Prevention Society, 2019). These figures for NSW are consistent with Australian national data where the annual cost of fall-related acute care in Australian hospitals for older people was estimated in 2006-2007 to exceed $600 million. (Public Health Association Australia, 2019).

Further highlighting this need, Winser and colleagues (2019) in a systematic review of 12 studies (n=3668) examined the cost-effectiveness of exercise programs for falls prevention in older adults and concluded that an exercise program of moderate intensity that strengthens lower limb muscles and improves balance, which are the components of Tai Chi, carried out twice per week for 60 minutes each and lasting at least 6 months is likely to be cost effective for preventing falls in older people.

Supporting this recommendation is the National Institute for Health and Excellence's (NICE) examination of the incremental cost-effectiveness ratio (ICER) for falls risk assessment in the UK, reporting that Tai Chi, as a falls prevention strategy for an older cohort, had a high

probability of being cost-effective per quality-adjusted life years (QALYS), when compared with a younger cohort of those at risk of falls (Franklin & Hunter, 2019).

Tai Chi and Osteoarthritis:

Osteoarthritis (OA) is one of the most common forms of arthritis in Australia accounting for 62% of arthritic conditions, with an estimated 2.2 million (9%) Australians suffering from this chronic, degenerative disease in 2017-18, and a predicted 3.1 million by 2030. OA is the leading cause of hip and knee joint replacement surgery in Australia and its impacts include moderate to very severe chronic pain, reduced mobility and physical limitations and increased psychological distress including increased depression, with high rates of comorbidities with other chronic conditions. In 2015-16, it was estimated that the cost of OA to the Australian health system was $3.6 billion, representing 28% of disease expenditure on musculoskeletal conditions (Australian Institute of Health and Welfare, 2019).

Tai chi, as a form of land-based regular exercise, is strongly recommended as a treatment intervention for OA of the hip and knee by Australian and international medical organisations including:

- the *Royal Australian College of General Practitioners* in its *Guideline for the Management of Knee and Hip Arthritis, 2nd Ed.* (RACGP, 2018) who strongly recommend Tai Chi as a first-line treatment for knee OA;
- *the Canadian College of Family Physicians* who recommend Tai Chi for OA (Huston & McFarlane, 2016);
- *the Ottawa Panel Clinical Guidelines for the Management of Knee Osteoarthritis* who strongly recommend Tai Chi for knee OA (Brosseau et al., 2017);
- *the Osteoarthritis Research Society International (OARSI) Guidelines for the Non-surgical Management of Knee, Hip and Polyarticular Osteoarthritis* who recommend Tai Chi as a "Core Treatment" option for people with knee OA (Bannuru et al., 2019);
- the 2018 *U.S. Department of Health and Human Services: Physical Activity Guidelines Committee Scientific Report* leading to the *2018 Physical Activity Guidelines for Americans, 2nd Ed.*, who recommend Tai Chi for hip and knee OA (Kraus et al., 2019); and,
- The *American College of Rheumatology* (ACR) and the *American Arthritis Foundation* (AF) in the *Guideline for the Management of Osteoarthritis of the Hand, Hip and Knee* who strongly recommend Tai Chi for knee and/or hip OA (Kolasinski et al., 2020).

Details of some of these recommendations and their basis in evidence are as follows:

Brosseau and colleagues (2017) in the peer-reviewed journal *Clinical Rehabilitation* published the results of a systematic review which led the *Ottawa Panel* of experts to publish clinical practice guidelines for using land-based mind-body exercises for the management of knee OA. The panel of experts selected four high quality RCTs of mind-body exercises, three of which included Tai Chi and/or Qigong (TCQ) with 197 participants, and found that the three RCTs for TCQ were of high quality in terms of the Physiotherapy Evidence Database (PEDro score = 7 to 8). The *Ottawa Panel* concluded that there was Grade B level of evidence (clinically important level of evidence demonstrated) in favour of TCQ for pain relief and improved physical function and quality of life in OA patients (Brosseau et al., 2017).

On the basis of their findings, the *Ottawa Panel* in its *Clinical Practice Guidelines for the Management of Knee OA*, *strongly recommended* a 20-week Tai Chi program of 20 to 40-minute classes three times per week for pain relief and improved physical function; and recommended an 8-week Tai Chi/Qigong program of 60 minute classes twice each week for improved quality of life and pain relief, and a 12-week Tai Chi program of 60 minute classes once per week for improved physical function (Brosseau et al, 2017).

Similarly, in its *2018 Physical Activity Guidelines Advisory (PAGAC) Committee Scientific Report* leading the U.S. Department of Health and Human Services to publish the *Physical Activity Guidelines for Americans, 2nd Edition*, Tai Chi was identified and recommended as a land-based exercise with benefits for pain relief, physical function and health-related quality of life for people with knee and hip OA (Kraus et al., 2019). Given, that over an entire week 40% of adults in the U.S. with lower extremity joint problems did not engage in a single session of moderate intensity physical activity lasting at least 10 minutes, Tai Chi provides an efficacious alternative to conventional aerobic and muscle strengthening exercises (Kraus et al., 2019).

The *American College of Rheumatology* (ACR) in conjunction with the *American Arthritis Foundation* (AF) in publishing the 2020 *Guideline for the Management of Osteoarthritis of the Hand, Hip and Knee* conducted its own systematic review of RCTs of pharmacological and non-pharmacological interventions for OA and an Expert Panel using PICO and GRADE criteria assessed the methodological quality of the studies reviewed. In its clinical guideline, the ACR/AF states that "Tai Chi is *strongly recommended* for patients with knee and/or hip OA." (Kolasinski et al., 2020). The Expert Panel made "*strong recommendations*" for interventions if the associated research literature "…inferred compelling evidence of efficacy and that benefits clearly outweighed harms and burdens." (Kolasinski et al., 2020).

The *Osteoarthritis Research Society International (OARSI)* conducted a systematic review and meta-analysis prior to releasing its *2019 Guidelines for the Non-surgical Management of Knee, Hip and Polyarticular Osteoarthritis* (Bannuru et al., 2019). RCTs were selected using a PICO protocol and an assessment of methodological quality made using GRADE Evidence Profiles before an international panel of experts independently ranked interventions ranging from "Core Treatment options" (*strongly recommended in favour*) to "Level 5" (*strongly recommended against*) a priori, on the basis of strict criteria and panel consensus.

In the OARSI review and guidelines Tai Chi was identified as a non-pharmacological "Core Treatment" (i.e. the highest level of evidence) for knee OA and deemed "*appropriate for use by the majority of patients in nearly any scenario and deemed safe for use in conjunction with first line and second line treatments*" (Bannuru et al., 2019). For hip OA, Tai Chi was given a "conditional" treatment recommendation due to a "lack of evidence", however, the *OARSI* study noted that because of Tai Chi's favourable results for efficacy and safety as an intervention for knee OA, these qualities were applicable to hip OA.

The comprehensive research study and set of guidelines by *OARSI* is the first occasion that Tai Chi has been recommended by an eminent international body of health professionals as "Core Treatment" for OA and highlights a broader and more patient-centred view of balancing effective interventions with the overall health needs of patients. (Bannuru et al., 2019).

Similarly, Goh and colleagues (2019) conducted a systematic review and meta-analysis of different forms of exercise, including Tai Chi, as mind-body therapies for the treatment of pain,

improved function, performance and quality of life for people with knee and hip OA. Goh et al (2019) examined 103 RCTs with 9,134 participants and concluded that compared to usual care, aerobic and mind-body therapies (Tai Chi and Yoga) had the largest effect sizes for pain reduction in OA (ES=1.11; range 0.63 to 1.59) and improved physical function (ES=0.81; range 0.27 to 1.36).

These systematic reviews and meta-analyses, and the Australian and international clinical guidelines for the management of knee and hip OA, strongly favour the prescription of Tai Chi as a non-pharmacological intervention for OA and provide strong evidence supporting TCAA's recommendation for the reinstatement of Tai Chi as a claimable health intervention for Australian private health insurance rebates.

Tai Chi and Diabetes:

The World Health Organisation (WHO, 2016) estimated that the global prevalence for diabetes mellitus, of which type-2 is the most prevalent, had quadrupled from 108 million in 1980 to 422 million in 2014, which is fast approaching, and will likely exceed the 2010 predicted estimate of a global prevalence of 439 million by 2030 (Shaw et al., 2010; WHO, 2016).

Diabetes has a substantial cost, both to the Australian health care system as well as indirectly through productivity loss and patient financial costs. In Australia, diabetes is considered to be the epidemic of the 21st century and the biggest challenge facing Australia's health care system with the annual cost impact estimated to be about $14.6 billion (Source: Diabetes Australia website, 31 January 2020). With about 1.7 million Australians suffering from all types of diagnosed diabetes, Diabetes Australia singled out Tai Chi as one of the exercise regimes to increase the level of physical activity of Australians and thereby reduce the negative impacts of this disease.

Zhou et al. (2019) in the peer-reviewed *Journal of Rehabilitation Medicine* published a systematic review and meta-analysis of the effects of Tai Chi on biomedical outcomes and quality of life for people with type-2 diabetes from English and Chinese-language databases and examined 19 RCTs with a total of 1,235 adult participants. Methodological quality of the studies was assessed on the McMaster University "Health Evidence" assessment, which independently assesses the quality of research evidence on the effectiveness of health interventions and included a PICO study assessment (Health Evidence, 2019). The review of Zhou et al., (2019) was assessed as having "strong" methodological quality with a score of 9 out of 10.

Zhou and colleagues (2019) concluded that Tai Chi was effective for type-2 diabetes by lowering levels of fasting plasma glucose, glycosylated haemoglobin (HbA1c) and insulin resistance, and beneficial for reducing body mass index, total cholesterol, reduced systolic and diastolic blood pressure, and improved quality of life outcomes in terms of increased physical and social functioning and reduced bodily pain.

Physical activity plays an important role in moderating symptoms of diabetes (American Diabetes Association, 2018). A recent meta-analysis by Chao and colleagues (2018) examined the effects of different forms of regular exercise, including Tai Chi, on markers of type-2 diabetes in a study that was rated "strong" for methodological quality (score = 8/10, including a clearly focused PICO assessment) on the McMaster University "Health Evidence" assessment (Health Evidence, 2019). Chao et al., (2018) found that, compared to no exercise, Tai Chi and aerobic exercise had significantly greater positive benefits for fasting plasma glucose and glycosylated

haemoglobin in people with type-2 diabetes, with no significant differences between these two exercise modalities.

Taken together, these high quality systematic reviews and meta-analyses evidence the positive effects for Tai Chi on clinical symptoms and biological markers of type-2 diabetes, with Tai Chi in one study achieving similar results to aerobic exercise and, thereby, providing a greater choice of effective exercise modalities for the 1.7 million Australians living with diabetes.

Tai Chi and Cancer:

Improvements in detection and treatment of all forms of cancer has resulted in decreased mortality and increased numbers of cancer survivors with the overall cancer death rate in the U.S. dropping by 27% from 1991 to 2016, or an estimated 2.6 million fewer cancer deaths (Siegel et al., 2019). Quality of life, both physically and psychologically, will be severely impacted for many cancer survivors who are to undertake and/or have already undergone conventional cancer treatment. A 2011 systematic review estimated that more than 50% of cancer survivors in the U.S. used complementary therapies, including Tai Chi, to manage the adverse effects of surviving cancer and to promote their physical and mental health (Horneber et al., 2012).

The *Canadian Exercise for People with Cancer Guideline Development Group*, as part of *Cancer Care Ontario's Program in Evidence-based Care*, published a systematic review in the journal *Current Oncology* (Segal, 2017a) examining the effects of physical exercise on cancer care and advocated moderate intensity exercise (3-6 METs), the equivalent range of metabolic output for Tai Chi, for physiological, psychological and quality of life benefits for people living with cancer in its active and post-treatment stages. These recommendations led to the publication of *Clinical Practice Guidelines: Exercise for People with Cancer* (Segal et al., 2017b), and are echoed by the *Clinical Oncology Society of Australia* in its *2018 Position Statement on Exercise in Cancer Care* (COSA, 2018).

Wayne et al., (2018), in an updated systematic review and meta-analysis published in the peer-reviewed *Journal of Cancer Survivorship* examined the effects of Tai Chi and Qigong (TCQ) on cancer survivors in 22 studies, of which 15 were RCTs with 1,283 participants, and found an overall low risk of bias in 12 of the RCTs. Wayne and colleagues (2018) reported that TCQ exercise programs ranging from 3 to 12 weeks in duration had beneficial effects on levels of fatigue, sleep difficulty, cancer-related depression and quality of life in cancer survivors.

These findings were supported in a more recently updated systematic review and meta-analysis in the peer-reviewed *Current Oncology Reports* by Zeng et al., (2019) who examined 12 RCTs of TCQ effects for cancer survivors with 915 participants and found positive clinical effects for TCQ in reduced levels of symptoms of fatigue, improved sleep quality, reduced anxiety, stress, depression and improved quality of life in cancer survivors. Compared to control conditions, TCQ demonstrated significant reductions in levels of fatigue symptoms and disturbed sleep for participants (Zeng et al., 2019).

In another recent systematic review and meta-analysis, Ni and colleagues (2019) examined 22 RCTs from Chinese and English-language databases with 1410 participants for the effects of Tai Chi on measures of quality of life in cancer survivors. In a risk of bias assessment, Ni et al., (2019) found a low risk of bias for the domains of selective outcome reporting, randomization, allocation concealment and incomplete data in most of the studies. However, not surprisingly because of the obvious nature of Tai Chi as an intervention, blinding was rated as high-risk in

the studies, leading to a conclusion that there are low to moderate levels of evidence in favour of the positive effects of Tai Chi on the physical and psychological dimensions of quality of life for cancer survivors (Ni et al., 2019).

In the 2016 *Australian Clinical Guidelines for Implementing Exercise Programs for Cancer Patients*, published jointly by *RACGP* and the *Cancer Council of Western Australia* (CCWA), evidence was presented supporting Tai Chi (among other exercise modalities) for cancer-related fatigue. Fatigue affects most patients during radiation and/or chemotherapy stages of treatment and reduces physical function and quality of life. Physical activity, such as Tai Chi, before and after active treatment can ameliorate the effects of cancer-related fatigue in patients and improve their quality of life (CCWA, 2016).

Tai Chi and Cardiovascular Processes:

Cardiovascular diseases (CVD), including coronary heart disease (CHD), stroke and heart failure are the most common non-communicable diseases and the leading cause of global mortality accounting for nearly 18 million deaths worldwide (Mensah et al., 2019). In Australia, CHD was the single leading cause of death in 2017 and CVD accounted for nearly 30% of all deaths that year (Australian Bureau of Statistics, 2018). Although most of these deaths are preventable, physical inactivity has been identified as a major risk factor for developing CVD (Australian Heart Foundation, 2018).

Exercise-based interventions that target modifiable cardiac risk factors can improve the prognosis for people with CVD. A,n updated Cochrane Database systematic review and meta-analysis by Anderson and colleagues (2016) examined 63 studies with over 14,000 participants and found that exercise-based cardiac rehabilitation (CR) programs following myocardial infarction (MI) reduced cardiovascular mortality from 10% to 7.5% and the risk of hospital admissions from 31% to 26% compared to no-exercise controls, with an added advantage of improving health-related quality of life. Despite these encouraging figures, more than 60% of patients in the U.S. rejected CR programs following an MI (Salmoirago-Blotcher et al., 2017).

In this regard, Tai Chi has been endorsed by the *American College of Cardiology* and the *American Heart Association* as a safe and effective alternative CR program to conventional programs, and by *the Australian Heart Foundation* as a safe multicomponent and muscle strengthening activity.

In this section we review systematic reviews examining a cardiac-focussed Tai Chi intervention for CHD (Liu et al., 2018), and Tai Chi as a mind-body intervention for heart failure (Gok Metin et al., 2018), and an RCT comparing the effects of Tai Chi and brisk walking on CVD risk factors (Chan et al., 2018), evidencing Tai Chi as an exercise and mind-body intervention suitable and effective for CR.

Liu and colleagues (2018) conducted a systematic review and meta-analysis of the effects of cardiac-focussed Tai Chi interventions on physiological and psychological outcomes and cardiovascular risk factors for people with coronary heart disease (CHD). Examining 13 research studies, comprising 2 RCTs and 11 non-randomised Controlled Clinical Trials (CCTs), and despite having fewer RCTs than CCTs, the review was assessed as having "strong" methodological quality, (score = 8/10, including a clearly focused PICO assessment) on the McMaster University "Health Evidence" assessment process (Health Evidence, 2019).

Liu et al (2018) concluded that when compared with active (walking and stretching) and non-active control conditions, Tai Chi-focussed CR interventions showed significantly improved aerobic endurance, as measured by VO_2max, and when compared with non-active controls, Tai Chi resulted in significantly lower scores for anxiety and depression and significantly better quality of life scores. Liu and colleagues (2018) concluded that Tai Chi, as a safe, affordable and moderate-intensity aerobic exercise, seemed a better alternative to higher intensity aerobic interventions for many CHD patients.

In a systematic review of the effects of mind-body interventions, including Tai Chi, on symptoms of heart failure, Gok Metin and colleagues (2018) examined Tai Chi as an intervention in 7 RCTs with 256 participants and concluded that, compared to usual heart failure care, Tai Chi improved exercise capacity and quality of life, and reduced blood pressure, heart rate variability, and a biological diagnostic marker of heart failure. Despite methodological limitations, the authors concluded that mind-body interventions such as Tai Chi impacted favourably on symptoms of heart failure and provided an alternative form of exercise for heart failure patients who may be less able to tolerate higher intensity aerobic-based exercise programs (Gok Metin et al., 2018).

An RCT conducted by Chan and colleagues (2018) compared the effects of Tai Chi and brisk walking on cardiovascular disease (CVD) risk factors and psychological well-being for adults with hypertension. The RCT was assessed as "high" in methodological quality on the Physiotherapy Evidence Database (PEDro score = 7). A total of 246 adults with hypertension were randomly allocated to a 3-month intervention of a Tai Chi or brisk walking group, both of moderate aerobic intensity, or a usual-care control group. Measures of physiological CVD risk factors and psychological well-being were assessed at baseline, at the conclusion of the intervention and at 9 months post-intervention.

When compared to the control and brisk walking groups, Tai Chi resulted in significantly greater reductions in systolic and diastolic blood pressure, fasting blood glucose levels, glycosylated haemoglobin, perceived psychological stress and improved mental health, and these gains were maintained at a 9-month follow-up. Chan et al., (2018) concluded that, as previously evidenced, regular moderate intensity exercise (viz. Tai Chi and brisk walking) can modify CVD risk factors and improve psychological well-being, and of the two exercise options, Tai Chi provided greater health benefits.

In 2017, the *American College of Cardiology* and the *American Heart Association* endorsed a research study where participants who had declined participating in a conventional CR program following MI, undertook a 6-month group Tai Chi program as an alternative CR program. The Tai Chi program resulted in a retention rate of 90% of participants at its conclusion, compared with a reported 40% retention rate in conventional CR programs and participants in the Tai Chi CR program were significantly more active, lost weight and reported better quality of life at its conclusion (Salmoiraga-Blotcher, 2017). A suggested reason for the higher retention rate for the Tai Chi group was that Tai Chi provided a safe, lower intensity CR option given that fear of exercise and a perception that exercise is dangerous are two of the most common reasons for the high drop-out rates in CR programs (Salmoiraga-Blotcher, 2017).

Besides providing evidence of Tai Chi's effectiveness as a safe exercise modality in CR, these studies also highlight the benefits of Tai Chi for modifiable risk factors in cardiovascular functioning such as reduced blood pressure, blood glucose levels and psychological stress.

Tai Chi and Parkinson's Disease:

Parkinson's Disease (PD) is one of the most common neurodegenerative diseases in the elderly and as the disease progresses, impairments deteriorate in motor control e.g. gait, posture control and balance, and in non-motor symptoms e.g. sleep disorders, cognitive decline and depression. Pharmacological interventions are considered first-line treatment for PD, however long-term use of medications results in side-effects and decreased drug efficacy over time, meaning that non-pharmacological interventions play an important role in integrated treatments (Jin et al., 2019). Exercise is considered as an essential component of integrated pharmacological and non-pharmacological treatment plans (Song et al., 2017; Sherrington et al., 2017). Unlike other mind-body practices such as yoga and meditation, Tai Chi's standing posture and dynamic movements has benefits for gait, balance and functional activities of daily living for people with PD (Song et al., 2017).

Song and colleagues (2017) in a systematic review and meta-analysis examined the effects of Tai Chi and/or Qigong (TCQ) on motor (gait, balance, falls etc.) and non-motor (depression and cognitive) function in 21 studies (15 RCTs and 6 non-RCTs) involving 823 participants with a diagnosis of idiopathic PD. The methodological quality of the selected studies was examined using the 10 item Cochrane Collaboration Tool for assessment of risk of bias and 6 studies were rated as methodologically "strong", 7 as "moderate" and 2 as "weak". None of the reviewed studies met the predetermined threshold for exclusion from the analyses.

Song et al., (2017) reported clinically relevant medium effect sizes showing benefits of TCQ for PD-related motor symptoms involving balance and falls reduction, which remained significant when compared to active controls, and clinically relevant small-to-medium effect sizes in favour of TCQ for non-motor symptoms of depression and quality of life. Despite some methodological limitations, Song et al., (2017) concluded TCQ has multi-component benefits for training motor control, postural awareness, cognition, breathing and stress reduction making it a safe and efficacious intervention for people with PD across all stages of disease progression.

Winser et al., (2018) in the peer-reviewed journal *Clinical Rehabilitation* reported the results of a systematic review and meta-analysis of 10 RCTs (n=720) on the effects of Tai Chi on falls prevention in a sub-group of older adults with diagnosed neurological conditions viz., Parkinson's disease and stroke. Winser and colleagues (2018) rated 7 of the 10 RCTs as having high "GRADE" methodological quality and found significant effects in favour of Tai Chi for reducing the incidence of falls in people with PD, but insufficient evidence that Tai Chi improved balance, significantly. Winser et al., (2018) reported that the high methodological quality of RCTs demonstrated the effectiveness of Tai Chi for reducing the incidence of falls in PD patients, however, expressed caution in interpreting the results for measures of balance because of the limited number of studies pertaining to Tai Chi in the meta-analysis.

Ni and colleagues (2018) conducted a systematic review and meta-analysis to provide evidence-based recommendations to the *American Society of Neurorehabilitation* to formulate *"Exercise Guidelines for Gait Function in Parkinson's Disease"*. Examining 40 RCTs for the effects of exercise, including Tai Chi, on gait function in PD, with 1656 participants diagnosed with PD. Ni and colleagues (2018) reported methodological quality across all studies ranging from low to high on the PEDro scale, with the Tai Chi RCTs scoring ≥6/10 and no indication of either heterogeneity or publication bias across all studies.

Ni et al., (2018) identified that, compared to active (stretching and resistance training) and no-active (no intervention) control conditions, Tai Chi and other similar movement-based exercises (e.g. Yoga and dance) significantly improved walking function in PD patients with specific improvements in gait speed, stride length, timed up-and-go scores and freezing of gait. Ni and colleagues (2018) proposed that, as an exercise-modality, the specific benefits of Tai Chi on gait function in PD may be attributable to the nature of its dynamic movements (viz. large, alternating steps reducing freezing and increasing control of centre of gravity) and improved muscle strength in the lower extremities.

The studies listed above are examples of higher-quality systematic reviews demonstrating the efficacy of Tai Chi as an intervention for movement-related symptoms of PD. The study of Ni et al (2018) highlights the importance of Tai Chi as an exercise modality intervention for PD which is supported in Tai Chi being recommended as an exercise modality by *Parkinson's Australia, the Australian Parkinson's Mission, the American Parkinson's Disease Association, the U.S. Parkinson's Foundation, the Parkinson's Disease Society of UK and the Parkinson's Society of Canada.*

Tai Chi and Chronic Obstructive Pulmonary Disease (COPD):

According to the 2015 Global Burden of Disease study (GBD 2015 Chronic Respiratory Disease Collaborators, 2017) it was estimated that in 2015 more than 170 million people were diagnosed with COPD making it the third highest ranked cause of death and disability-adjusted life years (DALYS) (Li et al., 2019; Ratarasan & Kundu, 2019). In Australia, COPD affects an estimated 1.5 million, including 1 in 13 people over the age of 40, with an estimated total cost of $8.8 billion annually in financial costs and $929 million in direct health system costs, largely due to hospitalisations. For Indigenous Australians, COPD prevalence estimates for mortality, morbidity and health burden of disease are 2.5 to 3 times higher than for the non-Indigenous population (Alison et al., 2017).

Despite pharmacological interventions comprising first-line treatments for COPD, with their concomitant systemic and local adverse effects, many people with COPD continue to experience symptoms of breathlessness, impaired exercise capacity, fatigue, depression, anxiety and panic attacks, which are reported as frightening for patients and frustrating for clinicians (Gao et al., 2019). Regular physical activity as part of pulmonary rehabilitation (PR) programs are strongly supported for reducing mortality and morbidity in people with COPD (Ratarasan & Kundu, 2019).

A protocol for a systematic review of RCTs examining the effects of Tai Chi on COPD by Gao and colleagues (2019) published in the peer-reviewed journal *Medicine* calls for urgent identification of non-pharmacological interventions to alleviate the suffering that this insidious disease brings to patients and their families, and to provide an additional complementary or alternative intervention for specialist respiratory physicians, GPs and allied health clinicians.

In a systematic review of RCTs examining the effects of Tai Chi, Qigong and Yoga on the main symptoms of COPD, Reychler and colleagues (2019) reviewed 17 studies, of which 12 involved Tai Chi and/or Qigong with a total of 1,032 participants. The three interventions (Tai Chi, Qigong and Yoga) share common characteristics of body movement, breathing control and relaxation in their practice which makes them suitable for investigation for their effects on lung function and functional exercise capacity in COPD. Assessment of methodological quality of the

RCTs was made using the PEDro scale, with the Tai Chi RCTs scoring ≥6/9, and the Downs and Black (27 item) scale with 10 of the Tai Chi RCTs rated as "Good" and 2 rated as "Excellent" in terms of reporting quality, external and internal validity and statistical power.

Compared to treatment as usual or breathing exercises/walking control conditions, Reychler et al., (2019) reported that Tai Chi had significant benefits for lung function, as measured by forced expiratory volume in one second (FEV1) and lung vital capacity in 7 of 11 reviewed RCTs, and significant benefits for functional lung capacity, as measured on the 6-minute walk test, in 9 of the 11 reviewed RCTs with these clinical gains being maintained at follow-up ranging from 6 weeks to 6 months. Tai Chi, as a moderate intensity exercise offers patients and clinicians a safe alternative to higher intensity exercise programs for COPD, particularly for either older patients or those with comorbid physical conditions.

Examining the psychological effects of COPD, Li and colleagues (2019) conducted a systematic review and meta-analysis of the effects of Tai Chi, Qigong and Yoga on anxiety and depression in COPD patients. It was estimated that the morbidity rate of depression in the "acute exacerbation" stage of COPD was as high as 86%, whereas the morbidity rate of anxiety in hospitalised settings was as high as 55%. Assessing the methodological quality of 13 RCTs with 906 participants, selected from English and Chinese-language databases, Li et al., (2019) rated the studies on the PEDro scale as ranging in scores from 4 to 9 out of 9, with 10 RCTs scoring ≥ 6/9.

Li et al., (2019) reported significant benefits for Tai Chi, Qigong and Yoga on symptoms of anxiety in COPD (ES ranging from -0.91 to -0.60) and on symptoms of depression (ES ranging from -1.14 to -0.58). In sub-group analyses, Qigong practice of 30 to 60 minutes per session, 2 to 3 times per week for 24 weeks had greater benefits for anxiety for older patients with a longer history of COPD, whereas for depression, Qigong practice of 30 to 60 minutes per session, 2 to 3 times per week had greater benefits for older patients with less than 10 years history of the disease.

Pulmonary rehabilitation (PR) as a first-line non-pharmacological intervention for people with COPD, is endorsed by the *Lung Foundation of Australia* and the *British, American and European Thoracic Societies*. The 2017 *Australian Clinical Guidelines for Pulmonary Rehabilitation*, following a PICO assessment of methodological quality, recommended that people with mild-to-severe COPD should undertake PR to improve quality of life and exercise capacity and to reduce hospital admissions (Alison et al., 2017). PR for COPD usually includes aerobic exercise and educational components, is frequently gym-based, however, home-based and community-based programs have been recommended ("weak" recommendation) based on low-to-moderate quality research evidence. Uptake of PR is estimated at only 5-10% of those with moderate-to-severe COPD who would likely benefit from PR (Alison et al., 2017). Research evidence supporting Tai Chi as a moderate level of physical activity, with no adverse effects, makes it a suitable and efficacious component for inclusion in PR programs.

Comparing Tai Chi (including a COPD-specific educational component) to standard PR over 12 weeks, as an adjunct to a standard prescribed dose of pharmacological inhalant, an RCT by Polkey and colleagues (2018) examined the effects of both interventions on 120 bronchodilator-naïve participants and reported similar significant benefits for Tai Chi and PR on measures of COPD-specific quality of life and exercise capacity (6-minute walk test) at the completion of the intervention, and in favour of Tai Chi over PR at 12 weeks follow-up. Polkey et al., (2018)

concluded that Tai Chi showed equivalent health benefits as a non-pharmacological intervention for COPD when compared with standard PR and can be used as an alternative or complementary treatment, including in conjunction with pharmacology.

A review of clinical evidence by respiratory specialists Ratarasan and Kundu (2019) in the journal *Current Opinion in Pulmonary Medicine* cited "consistent evidence" in favour of Tai Chi either as a stand-alone or complementary intervention for functional and psychological symptoms of COPD, including exercise tolerance, functional performance and pulmonary function. Ratarasan and Kundu (2019) suggest explanatory mechanisms for Tai Chi's effects on COPD involve its benefits for cardiopulmonary and musculoskeletal health through moderate intensity aerobic exercise effects which optimise oxygen utilisation, increase exercise capacity, and improve muscle strength and endurance.

Tai Chi and Chronic Pain:

In 2018, it was estimated that 3.24 million Australians were living with chronic pain and that the total cost of chronic pain in Australia was $73.2 billion, with a total cost in productivity losses of about $48.3 billion (Deloitte Access Economics Ltd., 2019). Pain syndromes are diverse and are generally seen as either *nociceptive* in nature (relating to tissue damage) e.g. lower back pain, or *neuropathic* (relating to nervous system damage) e.g. fibromyalgia, or a combination of both (Painaustralia, 2019).

This section will summarise two recent systematic review of RCTs examining the effects of Tai Chi on low back pain (Qin et al., 2019) and on chronic non-cancer pain (Tang et al., 2019), and a meta-analysis of the effects of Tai Chi on fibromyalgia (Cheng et al., 2019), as well as highlighting the *American College of Physicians* and the *National Institute for Health and Care Excellence (NICE)* recommendations in favour of Tai Chi as an exercise-based, non-pharmacological intervention for low back pain (Bernstein et al., 2017; Qaseem et al., 2017).

According to the Global Burden of Disease study in 2016, low back pain is the leading cause globally of years-lived-with-disability and 16% of Australians reported experiencing low back pain in the previous 12 months (2014-15), while many of these were older community-dwelling patients (Almeida et al., 2018). A 2018 review of clinical practice guidelines for the management of chronic lower back pain recommended a range of exercise regimes, including Tai Chi, as second line, non-pharmacological interventions either as a sole therapy, or as a component of multidisciplinary rehabilitation therapy for chronic lower back pain (Almeida et al, 2018).

Qin et al (2019) in a systematic review and meta-analysis published in the peer-reviewed journal *Medicine* examined the effects of Tai Chi alone or as an adjunctive therapy, such as accompanying physiotherapy and massage, on lower back pain and reported fair to good quality of evidence from 10 RCTs obtained from English and Chinese-language databases. Qin and colleagues (2019) concluded that Tai Chi either alone or in combination with conventional therapy (physiotherapy, massage and health education) could reduce pain levels and improve functional disability in patients with chronic low back pain.

The *American College of Physicians* in its *Clinical Practice Guidelines: Non-invasive Treatments for Acute, Sub-acute and Chronic Low Back Pain* made a "*strong recommendation*" for using Tai Chi, among other modalities, as a first-line non-pharmacologic treatment for people with chronic low back pain (Qaseem et al., 2017). Despite finding "low-to-moderate quality" evidence in favour of Tai Chi for reducing pain and improving function, when taken together

with a "*strong recommendation*" based on moderate-quality evidence for exercise therapy, of which Tai Chi is a specific exercise routine with moderate aerobic and strength training effects, the *American College of Physicians* noted that treatments such as Tai Chi for low back pain had reported less harmful, serious adverse effects compared to pharmacological interventions (Qaseem et al., 2017). Importantly, the *American College of Physicians* noted that an effective dose-response for Tai Chi from reviewed studies was for sessions of 40 to 45 minutes, 2 to 5 times per week for 20 to 24 weeks (Qaseem et al., 2017).

The 2017 *U.K National Institute for Health and Care Excellence (NICE)* updated *Guidelines on Low Back Pain and Sciatica in Over 16s* also recommends that clinicians "consider exercises such as… Tai Chi in a group setting for all patients with low back pain and sciatica as the main component of non-invasive treatment."(Bernstein et al., 2017).

These recommendations in clinical guidelines and the systematic review of Qin and colleagues (2019) indicates strong evidence in favour of Tai Chi either alone, or as an adjunctive treatment with conventional therapy for chronic low back pain, one of the most prevalent causes of disability in Australia and globally.

Fibromyalgia is a painful and debilitating condition characterised by widespread neuropathic pain, fatigue, disturbed sleep, cognitive impairment and major negative impacts on health-related quality of life (Wolfe et al., 2013). Dysfunction in central, autonomic and peripheral nervous systems, as well as psychological aspects have been implicated in its aetiology, yet the mechanisms of fibromyalgia remain unclear (Cheng et al., 2019; Grayston et al., 2019).

Cheng and colleagues (2019) conducted a meta-analysis of 6 RCTs with a total of 657 participants diagnosed with fibromyalgia to examine the effects of Tai Chi as an intervention for fibromyalgia-related pain and associated behavioural symptoms. Cheng et al., (2019) examined the methodological quality of the included studies and reported some concerns about heterogeneity of treatment effects, small sample sizes, and difficulties with blinding which is common among interventions where a sham treatment condition is difficult to implement. Despite these concerns, on the Cochrane risk of bias protocol, Cheng et al., (2019) reported low risk of bias on most aspects of the studies and concluded that 12 to 16 weeks of Tai Chi had significant positive effects for reducing scores on the Fibromyalgia Impact Questionnaire and subjective pain scores, relieving fatigue, symptoms of depression, and improving sleep and quality of life compared to control conditions.

Cheng and colleagues (2019) commented that physical exercise is an essential non-pharmacological intervention for the symptoms of fibromyalgia, however, symptom flare-ups such as increased pain and fatigue associated with higher intensity aerobic exercise makes Tai Chi, as a more moderate form of physical activity with mind-body treatment components, an attractive alternative form of prescribed exercise.

In 2017, Langhorst and colleagues, in association with the *13 German scientific societies and the German Pain Society*, published a regular consensus update to clinical guidelines for the treatment of fibromyalgia and on the basis of systematic reviews of RCTs concluded that "…the use of meditative movement therapies (Qigong, Tai Chi and Yoga) are strongly recommended" as either a stand-alone or complementary treatment for adults with fibromyalgia.

Tang and colleagues (2019) in a systematic review of non-pharmacological interventions, including Tai Chi and Qigong, for chronic non-cancer pain in community dwelling older adults

examined 10 RCTs with a total of 1,061 participants. Estimates for the prevalence of chronic pain in this population ranges from 25% to 50%. Using the Jadad Scale to assess the methodological quality of the included RCTs, Tang et al., (2019) rated 6 of the studies as a score of 3 out of 5, whereas the remaining studies rated 2 out of 5 indicating, according to Tang et al., (2019), satisfactory standards of methodology.

Tang and colleagues (2019) reported that the reviewed studies featuring Tai Chi and Qigong as interventions showed significant reductions in pain intensity at the conclusion of the intervention with those clinical gains maintained at follow-up ranging from 2 weeks to 24 weeks. Tang et al., (2019) concluded that the immediate and sustained pain-relieving effect of Tai Chi and Qigong interventions offers an effective self-help intervention for chronic pain in older community dwelling adults which will likely also promote better health and quality of life.

Analgesics remain the most effective pain management tool, however, given the mounting evidence of the increasing harm and adverse effects of analgesics, including the increasing trend in opioid misuse, non-pharmacological strategies in conjunction with medications are increasingly found to be effective within multidisciplinary pain management care plans (Becker et al., 2017; Tang et al., 2019). In 2017-18, the cost of hospitalizations in Australia as a result of opioid misuse was an estimated $13.4 million, with 823 deaths related to prescribed opioids in that period and the estimated cost associated with premature mortality of $1 billion (Deloitte Access Economics Ltd., 2019).

Despite the effectiveness of pharmacology for pain relief, two-thirds of people with chronic pain will seek non-pharmacological CAM interventions, including Tai Chi, and given that increasing physical activity/exercise is a common treatment goal across multidisciplinary pain management programs, Tai Chi provides an alternative cost-effective supervised and self-help exercise modality, particularly for older patients with chronic pain (Deloitte Access Economics Ltd., 2019; Geneen et al., 2017; Houze et al., 2017).

Tai Chi and Cognitive Function:

The physiological processes of aging result in a decline in motor and cognitive functions associated with changes in brain structure and function (Tomasi & Volkow, 2012). However, regular physical exercise has been shown to assist the processes of neural plasticity and reverse age-related decrements in brain connectivity (Erickson et al., 2013). Most of the following selected studies examined the effects of Tai Chi on brain structure and function in older adults, however, the final study reviewed in this section demonstrates the benefits of Tai Chi on brain plasticity compared to aerobic exercise in a younger cohort of college students (Cui et al., 2019), illustrating the benefits of Tai Chi on cognitive function across the lifespan and as a moderator of cognitive decline.

Lim and colleagues (2019) conducted a systematic review of 9 studies, including 6 RCTs on the effects of Tai Chi for older people diagnosed with the early stages of dementia across 5 countries. Methodological quality of the studies was reported in the "fair to excellent" range of scores with a median score of 21 out of 28 on study quality and risk of bias, with the majority of studies rated as "good" in terms of methodological quality. Lim et al., (2019) reported positive effects of Tai Chi on global cognitive function in this population comparable with the positive effects of regular physical exercise found in active control groups and significantly better global cognitive outcomes when compared with non-active control conditions. As well, Tai Chi had positive

effects on visuospatial skills, semantic memory, verbal learning/memory and self-perception of memory and showed potential to improve short-term cognitive function in older people with early stages of dementia.

In a novel systematic review, Pan and colleagues (2018), in the peer-reviewed journal *Frontiers in Aging Neuroscience*, examined neuroimaging studies assessing the benefits of Tai Chi on neurological changes in the human brain in healthy adults. The neuroimaging techniques examined, included MRI and fMRI, and EEG, as well as cognitive and behavioural performance tests from 11 research studies involving 482 participating healthy, older adults (ages ranging from 50 to 68). Of these 11 studies, 5 were RCTs and 5 were quasi-experimental designs and all were found to have study designs of moderate to high quality.

Pan et al., (2018) concluded that Tai Chi benefitted older adults in correlates of mental control, memory, fitness, cognition and brain executive function. Of significant note, was the inclusion of results from brain neuroimaging studies evidencing the benefits of Tai Chi on neural plasticity in the brains of healthy, older adults which was reported as ether delaying or reversing the rate of neurological degeneration. Other neurological brain changes associated with Tai Chi practice included increased cortical thickness associated with the intensity of Tai Chi practice, better functional connectivity between brain regions, and enhanced spontaneous brain activity associated with Tai Chi-induced improved cognitive functions (Pan et al., 2018).

Similarly, two RCTs in 2019 used brain imaging techniques to examine the effects of Tai Chi practice on brain structure and function in older community-dwelling participants. Xie and colleagues (2019) in an RCT published in the leading multidisciplinary journal *Nature Research*, examined the mechanisms of Tai Chi on brain function in healthy adults. Xie et al., (2019) noted that Tai Chi has an equivalent metabolic output (3-6 METs) to brisk walking (moderate aerobic intensity) and that this movement component, combined with meditative, mindful breathing contributed to the prevention of cognitive decline with aging.

Using cerebral functional near-infrared spectroscopy (fNIRS), Xie and colleagues (2019) found that long-term (>5 years) Tai Chi practice enhanced brain function in the prefrontal cortex, motor cortex and occipital cortex, improved sympathetic and parasympathetic nervous system modulation, improved blood supply to the brain and enhanced brain connectivity when compared with matched controls in movement and at rest. The authors also noted that Tai Chi can "…help delay the brain neurological deterioration process…", and "…improve cognition and the anti-memory decline potential." (Xie et al., 2019. p9).

In another RCT, Liu and colleagues (2019) used magnetic resonance imaging (MRI) and behavioural measures to demonstrate that long-term practitioners of Tai Chi (>10 years of practice) showed neurological viz., greater brain grey matter volume (GMV), associated with neural plasticity and emotional stability, and behavioural benefits viz., higher meditation level, greater emotional stability and less risk-taking tendencies compared to matched controls. It was concluded that these results support the role of Tai Chi in slowing brain atrophy and promoting emotional stability in aging (Liu et al., 2019).

Cui and colleagues (2019) in a neurophysiological study published in the leading multidisciplinary journal *Nature Research*, used structural and functional MRI techniques to compare the effects of 8 weeks of Tai Chi and 8 weeks of aerobic exercise (brisk walking) on brain structure and functional connectivity in college students (mean age 22 years). The authors

found that both Tai Chi and aerobic exercise significantly increased regional GMV and functional connectivity compared to a matched control group, indicating benefits of both Tai Chi and aerobic exercise for memory retrieval, attention, self-related processing and depression. When compared with aerobic exercise, Tai Chi resulted in significantly greater increases in GMV and correlates of functional connectivity in specific regions suggesting greater benefits of Tai Chi for cognitive processing and control, memory retrieval, emotional processing and "…more mature, efficient patterns of brain activation" (Cui et al., 2019). It was suggested that the multimodal, meditative aspects of Tai Chi as a mind-body exercise may induce greater structural and functional changes in specific brain regions associated with cognitive control, memory retrieval and perception of movement than physical exercises of a repetitive nature (Cui et al., 2019).

In summary, the results of Lim et al., (2019) support the use of Tai Chi as a non-pharmacological intervention for maintaining and improving cognitive function in the early stages of dementia, whereas the neuroimaging studies of Pan et al., (2018), Xie et al (2019) and Liu et al., (2019), using state-of-the-art neurophysiological techniques, illustrates the ability of Tai Chi to enhance neural plasticity in older brains and either delay or reverse the neural degeneration processes and cognitive decline associated with aging. Interestingly, the study by Cui and colleagues (2019) demonstrates that the benefits of Tai Chi on brain structure and function in younger people is equivalent to the benefits of aerobic exercise, adding further evidence to the contention that Tai Chi is a specific exercise modality that can enhance brain functioning and potentially reduce the effects of cognitive decline with aging.

Given that the global proportion of people aged over 60 is estimated to double between 2000 (11%) and 2050 (22%), and that in Australia dementia is the second leading cause of death with the prevalence of all forms of dementia estimated to increase from 447,000 in 2019 to 1.1 million by 2058, it is incumbent on policymakers to act now to change the trajectory of one of the most prevalent and costly neurodegenerative diseases (Dementia Australia, 2020; Lim et al., 2019).

In 2018, the *Australian Dementia Centre for Research Collaboration (DCRC)* of the *NHMRC National Institute for Dementia Research* published *Physical Activity Guidelines for Older Australians with Mild Cognitive Impairment (MCI) or Subjective Cognitive Decline (SCD)* and stated that aerobic, resistance and multimodal (including Tai Chi) physical activity interventions had all demonstrated benefits for global cognition, physical health and function with Level 1 and Level 2 quality RCTs (Lautenschlager et al., 2018).

The DCRC's recommendations for older adults to engage in a minimum total of 150 minutes of aerobic physical activity of moderate intensity each week, and strength and balance training activities (Lautenschlager et al., 2018) adds to the growing evidence in favour of Tai Chi as a relatively low-cost and safe intervention for those with MCI, SCD or early dementia, either as a multimodal stand-alone or adjunctive non-pharmacological treatment to delay the neurodegenerative effects of aging.

Tai Chi and Major Depression:

The World Health Organisation (WHO) estimates that in 2018, more than 300 million people globally (4% of the world's population) were living with depression and that the incidence of major depression increased by 18% between 2005 and 2015. In high-income countries depressive disorders will be the leading cause in the global burden of disease by 2030 and it is a major

contributor to the overall health costs of the world's major economies (WHO, 2017, 2018). At its worst, depression can lead to suicide which according to WHO is the second most prevalent cause of death in the 15 to 29-year-old age range (WHO, 2018).

Although a range of pharmaceutical and psychological treatments are available for major depressive disorder (MDD), 50% of those who are depressed do not seek treatment (WHO, 2018), and those who do, often withdraw before completing a full course of treatment (Dunn et al., 2015). Side-effects of antidepressant medication can be one reason for people stopping medication prematurely (Kong et al., 2019). Pharmaceutical interventions for MDD are at best moderately effective, and about one-third of people taking antidepressant medication alone will experience remission of symptoms after one course of treatment (Dunn et al., 2015). Success rates for psychological therapy (CBT or psychodynamic therapy alone) are at about one-fifth (20%) of patients experiencing remission of symptoms after therapy (Dunn et al., 2015).

The failure of conventional biomedical therapies to effectively stem the increasing wave of clinical depression over the past 50 years and the continued provision of suboptimal treatment for MDD (Blackburn, 2019) requires an urgent review of available natural therapy interventions, either as preventative measures, stand-alone therapy or in conjunction with conventional treatments.

In an RCT using an integrated medicine approach, Lavretsky and colleagues (2011) administered 10 weeks of Tai Chi in conjunction with an antidepressant (6 weeks of 10mg of escitalopram) and found that the participants with MDD who had their antidepressant medication augmented with Tai Chi showed greater reduction of symptoms of depression and were more likely to achieve remission than a control group receiving escitalopram and health education (Lavretsky et al., 2011).

Two recent systematic reviews and an RCT have examined the effects of Tai Chi as an intervention for low mood and anxiety. In 2018, Zou and colleagues in a systematic review and meta-analysis of 16 fair-to-high quality RCTs selected from English and Chinese-language databases examined the effects of "meditative movement", which by definition includes Tai Chi, Qigong and Yoga (Larkey et al., 2009), on MDD. Of the 16 RCTs for "meditative movement", 4 RCTs examined Tai Chi alone, 1 examined Qigong and 1 combined Tai Chi and Yoga as interventions for MDD. Of the 6 "Tai Chi" RCTs, 4 were rated as "high quality" (PEDro score = 8 to 9). Overall, Zou and colleagues (2018) found support for "meditative movement" having positive effects on MDD either as an alternative intervention or augmented with conventional treatments for MDD.

A systematic review and meta-analysis by Zhang and colleagues in 2019 examined the effects of Tai Chi on "negative emotions" (depression and anxiety) in a non-clinical sample of 1,285 healthy adults. From 14 "fair to high quality" (PEDro scale = 4 to 8) studies of which 8 were RCTs selected from English and Chinese-language databases, moderate to large effect sizes were reported in favour of Tai Chi on depression (SMD = -0.495, 95% CI: -0.762 to -0.229) and anxiety (SMD = -0.561, 95% CI: -0.714 to -0.408) compared to active and non-active control conditions, and despite finding a moderator effect of age (Tai Chi benefits older adults more than younger ones), the mental health benefits of Tai Chi were found to apply to both younger and older adults (Zhang et al., 2019).

Despite often being categorised as an exercise for older people, Tai Chi has also been found to benefit the mental health of younger age groups. In an RCT published in the peer-reviewed journal *Neuropsychiatric Disease and Treatment*, Zhang and colleagues (2018) found support for a mindfulness-based Tai Chi intervention reducing levels of sub-threshold depression in Chinese adolescents. Given that epidemiological and longitudinal studies show that the critical period for the onset and trajectory of depression is between 13 and 18 years (11% life time prevalence) and that regular physical exercise moderates symptoms of depression in adolescents, regular practice of Tai Chi provides an effective intervention in the physical and psychological domains for young people. (Hankin et al., 2015; Radovic et al., 2017; Zhang et al., 2018).

In a review paper in *Frontiers in Psychiatry*, Kong and colleagues (2019) reviewed research evidencing Tai Chi as an intervention for MDD and suggested a comprehensive biomedical model explaining the underlying mechanisms of Tai Chi's effects on MDD involving interacting modulatory effects of improved mood-related brain networks and brain connectivity, anti-inflammatory processes in the immune system and restoring homeostatic balance in the autonomic nervous system (Kong et al., 2019).

In 2016, the *Canadian Network for Mood and Anxiety Treatments* (CANMAT), a group of researchers and clinical experts on mood and anxiety disorders, published *Clinical Guidelines for the Treatment of Major Depressive Disorder* and found Level 1 evidence in favour of exercise as first line monotherapy for mild-to-moderate MDD (Ravindran et al., 2016).

Tai Chi, with its moderate aerobic effects (Ainsworth et al., 2011; Fan et al., 2018; Xie et al., 2019), equivalent to brisk walking (Audette et al 2006; Chan et al., 2018), and its meditational qualities of "mindfulness" offers a low cost, effective form of exercise as an intervention for MDD across the lifespan (Kong et al., 2019).

Conclusions about Tai Chi and Specific Disease Processes:

Evidence in favour of Tai Chi as a health intervention for the 10 disease processes described in the above section represents recent selected research studies of higher quality within the timeframe of the NTR 2019-2020. Of the 26 systematic reviews of RCTs described above, all were published later than 2017 and most were published in either 2018 (10 SRs) or 2019 (15 SRs), highlighting the increased interest among researchers, clinicians and communities worldwide seeking evidence supporting non-pharmacological interventions, such as Tai Chi, for chronic non-communicable diseases.

Similarly, the broad selection of health representative organisations worldwide listed in this submission who have recommended Tai Chi as an intervention in their Clinical Guidelines includes the *RACGP, American College of Physicians, Canadian College of Family Physicians, American College of Rheumatology, Osteoarthritis Research Society International, Australian Arthritis Foundation, Ottawa Panel of Clinical Experts in Arthritis, Prevention of Falls Network Europe, Australian NHMRC Research Translational Faculty, American Geriatrics Society, British Geriatrics Society, Diabetes Australia, American Diabetes Association, Clinical Oncology Society of Australia, Canadian Cancer Guidelines Development Group, Cancer Councils Australia & WA & NSW, Australian Heart Foundation, American College of Cardiology, American Heart Association, Parkinson's Australia, American Parkinson's Disease Association, Parkinson's Disease Society of the UK, Lung Foundation of Australia, the British, American and European Thoracic Societies, U.K National Institute for Health and Care*

Excellence (NICE), German Pain Society, Australian Dementia Centre for Research Collaboration, Canadian Network for Mood and Anxiety Treatments, U.S. Department of Health and Human Services and *the World Health Organisation.*

Taken together, this recent research evidence supporting Tai Chi as a health intervention and the recommendations of these peak medical and health representative bodies in favour of the clinical effectiveness of Tai Chi, strengthens TCAA's case for the reinstatement of Tai Chi as an intervention claimable for rebates under private health insurance. In requesting that Tai Chi be reinstated for private health insurance rebates, TCAA asks that the NTR 2019-2020 adopt a broader approach, in its decision-making process and help enable clinicians to better balance evidence-based practice with a patient-centred approach that allows professionals and patients more choice in the availability and affordability of health interventions in their treatment plans.

The following section highlights other relevant evidence supporting Tai Chi's reinstatement as a claimable intervention for the NTR 2019-20 to consider.

Other Relevant Evidence for the NTR 2019-20:

Tai Chi and the World Health Organisation (WHO) and Australian Heart Foundation (AHF) Recommendations:

The global "pandemic of physical inactivity" (Kohl et al., 2012; Pratt et al., 2019) across all ages and its links to the onset and trajectory of chronic, non-communicable diseases is well established and acknowledged (Ding et al., 2016; Durstine et al., 2013; Guthold et al., 2018). TCAA asks the NTR 2019-20 to also examine the data on Australia's poor global ranking in terms of physical inactivity and to specific references for Tai Chi as an exercise modality in the 2018 WHO "*Global Action Plan for Physical Activity 2018-2023: More Active People for a Healthier World*" (Guthold et al., 2018; WHO, 2018). This report specifically recommends to member states, including Australia which is a signatory to the *WHO Action Global Plan*, that Tai Chi is a suitable exercise to positively impact on the global trend towards increased physical inactivity, and thereby reduce the impact of a major underlying cause of chronic, non-communicable diseases. (WHO, 2018).

The report states that Australia is ranked in the bottom half, 97th of 168 countries in a WHO study measuring insufficient levels of physical activity in adults around the globe. In a population-based study in *The Lancet Global Health* journal, Guthold and colleagues (2018) examined self-reported activity levels in 1.9 million people aged 18 years and over, and found that in 2016, 30.4% of Australian adults did not reach the recommended levels of physical activity to stay healthy, and that 27% of Australian men are insufficiently active, compared with 33.6% of women (Guthold et al., 2018).

The Australian Heart Foundation (AHF) in its 2019 "*Blueprint for an Active Australia*" specifically identified Tai Chi as a multicomponent and muscle strengthening activity that "…can improve and maintain both physical and cognitive function, improve social connectedness, prevent falls, and maintain capacity to independently cope with the activities of daily living in old age."(Australian Heart Foundation, 2019, p73). This recommendation is echoed in the *American College of Cardiology* and the *American Heart Association* endorsement of Tai Chi as a safe and effective alternative for conventional cardiac rehabilitation programs (Salmoiraga-Blotcher et al., 2017).

More alarming than the WHO (2018) rankings for adults is a report published in *The Lancet* in November, 2019 on global and regional prevalence and trends in physical inactivity in adolescent school children aged from 11 to 17, where Australia ranks 140th of the 146 countries studied. In this report 89% of these Australian children in 2016 did not meet WHO global recommendations for adequate levels of physical activity (Guthold et al., 2019). These figures should be ringing alarm-bells for Australian researchers and public policymakers and demands that public and private sector health policies be held accountable for preventing a continuing epidemic of chronic, non-communicable diseases in future generations (Ding et al., 2019). In this regard, Tai Chi has been found to be a suitable exercise regimen for young people (Ristowski & Almeheyawi, 2019) and presents a valuable opportunity for families, through the reinstatement of private health rebates for Tai Chi, to access an evidence-based form of exercise and reduce the financial and health burden of disease.

Ristowski & Almeheyawi (2019) conducted a systematic review of the effects of Tai Chi and Qigong on the health outcomes of children and adolescents, and examined 13 research studies, including 6 RCTs with 696 participants and 5 studies containing youth with specific health problems ranging from fibromyalgia and juvenile arthritis to learning and behavioural problems, across the age ranges from 7 to 16. Ristowski and Almehewayi (2019) identified 7 of the studies reviewed as high in methodological quality and found that Tai Chi and/or Qigong may be an effective intervention to improve physical health and function in children and adolescents. This finding adds weight to the conclusion that Tai Chi is a suitable health intervention across the lifespan for younger, middle-aged and older members of the community.

In view of these significant findings from leading national and international health organisations and eminent peer-reviewed research journals, it is the TCAA's contention that the effectiveness of Tai Chi on selected chronic health conditions discussed in this submission highlights the need to offer individuals and their families a wider range of evidence-based rebated interventions, either as complementary or stand-alone treatment, to suit their individual needs and budgets rather than limiting their choice to conventional treatments only.

Conclusions:

The carefully selected recent research studies in this submission provides an updated review of the literature supporting the clinical effectiveness of Tai Chi for chronic and complex healt conditions with examples of some of the better designed and higher quality systematic reviews of RCTs. Moreover, TCAA contends that research supporting the positive effects of Tai Chi on health conditions should not only be considered in isolation, but in the context of addressing one of the main underlying causes of chronic, non-communicable disease, viz. physical inactivity (Ding et al., 2019; Pratt et al., 2019; WHO, 2018).

The systematic reviews for specific disease processes cited in this submission identify the benefits of Tai Chi for diseases of the main systems of the human body, viz. musculoskeletal (osteoarthritis, chronic pain, falls prevention); metabolic (diabetes); immune (cancer); cardiovascular (CHD and heart failure); neurological (Parkinson's disease, chronic pain, brain disorders); pulmonary (COPD) and psychiatric (depression and anxiety) systems. As demonstrated in this submission, Tai Chi is one of the few health-related interventions that are classified as natural therapies which also has a substantial research evidence-base with recommendations for its use by peak medical organisations worldwide. Given that the larger body of evidence supporting physical exercise as the most commonly used non-pharmacological

health intervention, also applies to Tai Chi as a specific exercise modality, the evidence in favour of Tai Chi as a treatment intervention is strengthened.

TCAA therefore requests that the Natural Therapies Review Expert Advisory Panel adopt a broader approach in its examination of the benefits of Tai Chi for a range of specific chronic and complex health conditions and consider Tai Chi as a form of regular physical exercise and as such, an effective non-pharmacological health intervention. This view is in line with the inclusion of Tai Chi in Australian and international clinical treatment guidelines published by peak medical and health representative organisations.

TCAA believes that reinstating private health insurance rebates for Tai Chi as a health intervention is not only supported by recent research evidence, as outlined in this submission, but also by the World Health Organisation's call for member states, including Australia, to reduce the level of physical inactivity and thereby reduce a major precipitant of chronic diseases and reflects the balancing of evidence-based treatments and clinical effectiveness with a patient-centred approach.

Over the last six years, Tai Chi has experienced an increase in interest among the general Australian public commensurate with an increase in the number of published research articles on Tai Chi and health conditions in medical and allied health peer-reviewed journals.

In terms of the number of people taking part in Tai Chi activities in Australia, it is estimated that there was a slight increase in participation rates in Tai Chi/Qigong in Australia over the period from 2001 to 2010 (Vergeer, 2017). On the basis of data from an independent, cross-sectional survey of the Australian public's exercise and related activities, participation rates for Tai Chi were estimated with 95% confidence, of between 103,000 and 157,000 participants in 2010, increasing to an estimate of between 127,000 and 149,000 participants in 2018 (I. Vergeer, personal communication, 23/05/2018). It is TCAA's contention that reinstating rebates for Tai Chi under private health insurance, on the basis of the evidence presented and recommended clinical practice guidelines, would assist in further growth and help reverse the trend towards greater physical inactivity and increasing morbidity from chronic, non-communicable diseases. Moreover, recognising Tai Chi as an exercise modality for preventative health and for treating chronic health conditions would lead to a reduction in the financial burden of mortality and morbidity in an ageing population. Any decision to the contrary would make Tai Chi less attractive and could lead to a significant decline in participation rates.

Given that physical inactivity is a significant risk factor for the onset and trajectory of many chronic and complex health conditions (e.g. diabetes), Tai Chi provides a low cost form of exercise that has the potential to help reverse this trend and ameliorate the effects of some of these disabling and costly health conditions (Australian Heart Foundation, 2019; WHO, 2018).

TCAA's Recommendations:

TCAA concludes that the research evidence in favour of the clinical effectiveness of Tai Chi as an intervention for a number of chronic, non-communicable diseases has been sufficiently demonstrated, and the acceptance of Tai Chi by a number of Australian and international peak medical and health representative organisations in their clinical practice guidelines indicates that the clinical advantages of Tai Chi as an intervention far outweighs any adverse effects.

Accordingly, **TCAA recommends:**

1. **That the Australian private health insurance rebates for Tai Chi be reinstated.**

2 **That the Review panel adopt a broader approach in its examination of the benefits of Tai Chi for a range of specific chronic and complex health conditions having regard to the recommendations of Australian and international peak medical and health organisations.**

3 **That the Review panel adopt a broader approach in its consideration of Tai Chi, not only as an effective natural therapy, but also as a form of physical exercise and, as such, an effective non-pharmacological intervention.**

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