

## Change in perceived psychosocial status following a 12-week Tai Chi exercise programme

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### Change in perceived psychosocial status following a 12-week Tai Chi exercise programme

**Aim.** This paper reports a study to examine change in psychosocial status following a 12-week Tai Chi exercise intervention among ethnic Chinese people with cardiovascular disease risk factors living in the United States of America.

**Background.** Regular participation in physical activity is associated with protection against cardiovascular disease, and improvements in physical and psychological health. Increasing amounts of scientific evidence suggests that mind–body exercise, such as Tai Chi, are related to improvements in mental health, emotional well-being, and stress reduction. No prior study has examined the effect of a Tai Chi exercise intervention on psychosocial status among people with cardiovascular disease risk factors.

**Methods.** This was a quasi-experimental study. Participants attended a 60-minute Tai Chi exercise class three times per week for 12 weeks. Data were collected at baseline, 6 and 12 weeks following the intervention. Psychosocial status was assessed using Chinese versions of Cohen's Perceived Stress Scale, Profile of Mood States, Multidimensional Scale of Perceived Social Support, and Tai Chi exercise self-efficacy.

**Results.** A total of 39 participants, on average 66-year-old ( $\pm 8.3$ ), married (85%), Cantonese-speaking (97%), immigrants participated. The majority were women (69%), with  $\leq 12$  years education (87%). Statistically significant improvements in all measures of psychosocial status were found ( $P \leq 0.05$ ) following the intervention. Improvement in mood state ( $\eta^2 = 0.12$ ), and reduction in perceived stress ( $\eta^2 = 0.13$ ) were found. In addition, Tai Chi exercise statistically significantly increased self-efficacy to overcome barriers to Tai Chi ( $\eta^2 = 0.19$ ), confidence to perform Tai Chi ( $\eta^2 = 0.27$ ), and perceived social support ( $\eta^2 = 0.12$ ).

**Conclusions.** Tai Chi was a culturally appropriate mind–body exercise for these older adults, with statistically significant psychosocial benefits observed over 12-weeks. Further research examining Tai Chi exercise using a randomized clinical trial design with an attention-control group may reduce potential confounding effects, while exploring potential mechanisms underlying the relaxation response associated with mind–body exercise. In addition, future studies with people with other chronic illnesses in all ethnic groups are recommended to determine if similar benefits can be achieved.

**Keywords:** Chinese, intervention study, mood, nursing, self-efficacy, social support, stress, Tai Chi exercise

## Introduction

Cardiovascular disease (CVD) is on the rise globally, accounting for one-third of all deaths, with two-thirds of those deaths coming from developing countries (Yusuf *et al.* 2001a,b, Mackay & Mensah 2004). In 2001, an estimated 16.6-million deaths worldwide were attributed to CVD, which coincides with a higher prevalence of CVD risk factors worldwide, such as hypertension, hypercholesteremia, tobacco use and diabetes (Mackay & Mensah 2004). In addition, psychosocial stressors are associated with increased risk of acute myocardial infarction, regardless of ethnic group, gender, or geographical region (Rosengren *et al.* 2004).

In the United States of America (USA), CVD is the leading cause of morbidity and mortality (AHA 2003, CDC 2004). Regular participation in physical activity is associated with protection against CVD, and improvements in physical and psychological health (Miller *et al.* 1997, Wenger *et al.* 1999, Thompson *et al.* 2003). Negative psychosocial factors such as major depression, social isolation, or chronic stress can adversely affect pathophysiological mechanisms associated with CVD, and also contribute to poor health behaviour (Rozanski *et al.* 1999, Ziegelstein *et al.* 2000, Mendes de Leon *et al.* 2001, Astin *et al.* 2003, Rosengren *et al.* 2004).

Thoughts, feelings and personal exercise behaviour can affect health outcomes and psychological well-being (Baum & Posluszny 1999). Mind–body communication is thought to occur through two distinct pathways – the sympathetic-adrenal–medullary axis and the hypothalamic-pituitary–adrenal–cortex axis. Communication between the mind and body is very complex, but enables an integrated response to behavioural, physiological, or immunological threats, with the goal of maintaining homeostasis (Watkins & Jonas 1997).

Increasing amounts of scientific evidence suggests that mind–body exercise, such as Tai Chi (TC), are related to improvements in mental health, emotional well-being and

stress reduction (LaPerriere *et al.* 1994, La Forge 1997, Arent *et al.* 2000). Some people, particularly older adults and those with chronic illnesses, experience social, psychological and health-related barriers to exercise, making its adoption and maintenance a great challenge. Careful attention to psychological variables, including perceived self-efficacy, are important for understanding physical activity and exercise behaviour (Nies & Kershaw 2002).

## Tai Chi

TC exercise, an ancient Chinese martial art, is popular among Chinese immigrants to the USA, is gaining interest in older adults, and is suitable for people with CVD (Taylor-Piliae 2003, Taylor-Piliae & Froelicher 2004a). It is a low-impact, moderate-intensity aerobic exercise, incorporating relaxed breathing and mental concentration (Luskin *et al.* 1998). TC movements were originally derived from watching animals and birds over 500 years ago (Cheng & Smith 1967, Lan *et al.* 2002). During the performance of TC exercise, individuals are taught to be mindful of what their body is doing, and how it feels. The mindful movements and body awareness characterize TC as a ‘meditation in motion’, evoking a mind–body connection (La Forge 1997).

Translated versions of the *Tai Chi Classics* from the thirteenth Century, teach both mental and physical aspects of TC exercise, as mind and body must be aligned so that they become inseparable, and work in harmony (Cheng & Smith 1967, Galante 1981, Cheng 1999). To date, only nine studies have examined the effect of TC exercise on affective status (Jin 1989, 1992, Brown *et al.* 1995, Sun *et al.* 1996, Chen & Sun 1997, Ross *et al.* 1999, Chen *et al.* 2001, Bond *et al.* 2002, Tsai *et al.* 2003). Published studies have recruited mainly healthy women (58%), with ages ranging from 16 to 92 years old, to examine this phenomena. Some studies report significant between-group improvements in mood, with TC participants reporting less mood disturbance than

those in comparison groups (Brown *et al.* 1995, Chen *et al.* 2001, Bond *et al.* 2002). Conversely, other studies have reported null findings when evaluating the effect of TC on mood, comparing TC participants with sedentary controls (Jin 1992, Chen & Sun 1997, Tsai *et al.* 2003) (Table 1).

In prior studies, the style of TC was generally not specified. Currently, there is no standard style of TC, and some styles have both short and long forms (e.g. 24–108 postures) varying in duration, likely representing different exercise intensities of TC (Chen & Sun 1997, Ross *et al.* 1999, Tsai *et al.* 2003, Taylor-Piliae & Froelicher 2004a). In addition, the length of the intervention studies ranged from 8 to 16 weeks (Chen & Sun 1997, Ross *et al.* 1999, Tsai *et al.* 2003), while the number of TC exercise sessions held during each intervention study differed greatly, ranging from 12 to 48 sessions (Brown *et al.* 1995, Sun *et al.* 1996). This likely resulted in unequal doses of TC exercise across the studies, making comparisons difficult and limiting generalizability to other populations. Only one published study has examined the effect of TC exercise on perceived stress (Sun *et al.* 1996), though chronic stress is associated with negative CVD health outcomes. No prior study has examined the effect of a TC exercise intervention on psychosocial status among persons with CVD risk factors.

## Theoretical framework

Several behavioural theories have been conceptualized and tested empirically in the past 25 years to address the complexities associated with human behaviour, particularly as it relates to exercise behaviour (Dzewaltowski 1994, Bandura 1997a). Social Cognitive Theory (SCT) is based on an interactional model of human behaviour, useful for understanding the complex and dynamic nature of health behaviour (Bandura 1997b). Behaviour, when applied to exercise, involves the mode, intensity, duration and frequency of the activity (Dzewaltowski 1994, Bandura 1997b). Personal factors include cognitive, affective and biological events. Environmental factors include socioeconomic status, education and family structures. Bandura emphasizes the reciprocal relationships between personal factors, environmental factors and behaviour, which are constantly interacting and influence one another bi-directionally (Bandura 1997b).

Basic tenets inherent in SCT can readily be applied to TC exercise. TC is thought to foster self-efficacy beliefs through enactive mastery, modelling, verbal or social persuasion, and physiological and affective status. Inherent with an enactive mastery experience, TC is taught at a slow progressive pace, with various levels and periods of

refinement built in. Thus, these small steps of success help develop the belief in personal efficacy to perform the entire TC sequence.

Modelling of TC exercise by the instructor serves to build this source of self-efficacy, combined with the group environment as the mode of instruction. Participants can appraise their capabilities in relation to others in the class through social comparison. The instructor shows them exactly how to do it, modelling the behaviour, and at the same time helps them find better ways of doing TC to avoid pain or fatigue.

Verbal or social persuasion occurs through the instructor and peers in the class. Self-efficacy beliefs are strengthened with messages from a credible and knowledgeable source, such as a TC instructor, that they are capable of performing TC. In addition, TC is frequently taught to a group of persons. Social connectedness or group support frequently accompanies this type of a group-based learning, and serves to further strengthen performance capabilities (Bandura 1997b).

Finally, physiological and affective status are further sources of strengthening efficacy beliefs. A review of recent research reported improvements in cardiorespiratory function, balance and postural stability, fall prevention, and stress reduction through practising TC (Taylor-Piliae 2003). It is likely that a cyclical process of performing TC enhances physical functioning, a better physical state reduces stress, and improvement in mood encourages one to continue to perform TC. The model operationalized for this study is based on Bandura's SCT (see Figure 1).

## The study

### Aim

The overall aim of this study was to examine change in psychosocial status following a 12-week TC exercise intervention among ethnic Chinese adults with CVD risk factors. Specific objectives were to determine if TC exercise: (1) improves affective status (mood state and stress reduction); (2) increases TC exercise Self-efficacy (TCSE) or social support; and (3) if TCSE, previous TC exercise experience, or social support predict class attendance.

### Design

This was a quasi-experimental study. Participants attended a 60-minute TC exercise class three times per week for 12 weeks, with data collected at baseline, 6 and 12 weeks following the intervention. Data were collected from February to June 2004.

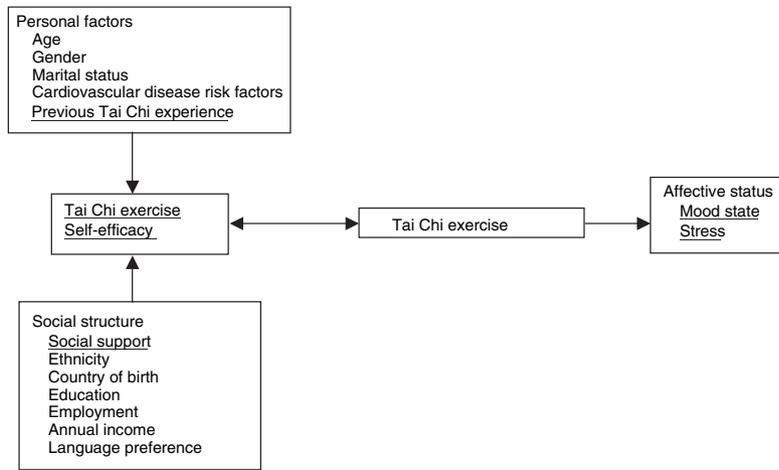
Table 1 Prior studies examining Tai Chi and affective status

Reference	Study design/ location	Tai Chi style	Sample	Intervention length or years of practice	Measure	Findings
Jin (1989)	Quasi-experimental Australia	Yang 108 or Wu variation of Yang	TC skilled (>1 year), <i>n</i> = 33 TC novice (<1 year), <i>n</i> = 33 Age range = 16–75 years 45% females	TC skilled (>1 year), TC novice (<1 year)	Mood POMS-65 items Measured-before, during and after TC	During and after TC ↓ in mood disturbance than before TC, in both skilled and novice TC groups, <i>P</i> = 0.01 0% drop-outs
Jin (1992)	RCT Australia	Yang 108 or Wu variation of Yang	All TC practitioners Treatment conditions: TC, <i>n</i> = 24 Brisk walking, <i>n</i> = 24 Meditation, <i>n</i> = 24 Reading, <i>n</i> = 24; after exposure to mental and emotional stress Age = 36 years 50% females	> 3 years	Anxiety SAI-20 items Mood POMS-65 items	TC treatment condition ↓ anxiety than reading condition, <i>P</i> = 0.00 Mood between groups-NS 0% drop-outs
Brown <i>et al.</i> (1995)	RCT USA	Unspecified style	Moderate-intensity walking, <i>n</i> = 24 Low-intensity walking, <i>n</i> = 34 Low-intensity walking + relaxation response, <i>n</i> = 28 Tai Chi, <i>n</i> = 18 Sedentary Control, <i>n</i> = 31 Age = 53 years 51% females	16 weeks (48 sessions)	Anxiety STAI-40 items Mood POMS-65 items PANAS-not specified STAXI-not specified	TC group (women only) less mood disturbance than other groups, <i>P</i> = 0.04 Anxiety, affect, anger between groups-NS 25% drop-outs
Sun <i>et al.</i> (1996)	RCT USA	Unspecified style	TC intervention, <i>n</i> = 10 Control, <i>n</i> = 10 Hmong immigrants Age range = 60–79 years 65% females	12 weeks (12 sessions)	Stress Not specified	TC group ↓ stress than controls, <i>P</i> = 0.00 0% drop-outs

Table 1 (Continued)

Reference	Study design/ location	Tai Chi style	Sample	Intervention length or years of practice	Measure	Findings
Chen and Sun (1997)	Quasi-experimental USA	24 movements unspecified style	TC intervention, <i>n</i> = 18 Control, <i>n</i> = 10 Age range = 50–74 years 50% females	16 weeks (32 sessions)	Anxiety TMAS-50 items SAI-20 items	Between groups-NS 22% drop-outs
Ross <i>et al.</i> (1999)	Quasi-experimental USA	Unspecified style	TC intervention, <i>n</i> = 17 Age range = 68–92 years 88% females	8 weeks (18 sessions)	Mood MAACL-R- 132 items	Postintervention ↓ mood disturbance, <i>P</i> = 0.05 % drop-outs-not reported
Chen <i>et al.</i> (2001)	Cross-sectional Taiwan	Unspecified style	TC practitioners, <i>n</i> = 40 Sedentary comparisons, <i>n</i> = 40 Age = 74 years 63% females	>20 years	Mood POMS-SF-30 items	TC group ↓ mood disturbance than sedentary, <i>P</i> = 0.05 % drop-outs-not reported
Bond <i>et al.</i> (2002)	Cross-sectional USA	Unspecified style	TC practitioners, <i>n</i> = 71 Aerobic exercise, <i>n</i> = 86 Sedentary comparisons, <i>n</i> = 94 Age = 37 years 59% females	≥6 months	Anxiety STAI-40 items	TC and aerobic exercise groups ↓ anxiety than sedentary, <i>P</i> = 0.05 % drop-outs-not reported
Tsai <i>et al.</i> (2003)	RCT Taiwan	Yang, 108 postures	TC intervention, <i>n</i> = 37 Sedentary control, <i>n</i> = 39 Age = 51 years 50% females	12 weeks (36 sessions)	Anxiety STAI-40 items	Within TC group ↓ in anxiety, <i>P</i> = 0.01; between groups-NS 14% drop-outs

RCT, randomized clinical trial; TC, Tai Chi; STAI, State Trait Anxiety Inventory; POMS, profile of mood states; POMS-SF, profile of mood states short form, MAACL-R, multiple affect adjective check list revised, TMAS, Taylor Manifest Anxiety Scale, SAI, state anxiety inventory, PANAS, Positive Affect/Negative Affect Scale, STAXI, State-Trait Anger Expression Inventory, USA, United States of America.



**Figure 1** Outcomes and predictors of Tai Chi exercise in adults with cardiovascular disease risk factors. Only underlined variables examined.

### Participants

This study was conducted at a community center in the San Francisco Bay Area (SFBA) having a high density of ethnic Chinese people living in the neighbourhood. Information about the study was distributed through flyers, brochures and newspaper advertisements. Interested people contacted the investigator for further information and to determine eligibility. If the eligibility criteria were met, respondents were invited for baseline evaluation.

Inclusion criteria for participation were: (1) self-identified ethnic Chinese and residing in the SFBA; (2)  $\geq 45$  years; (3) speaks Cantonese or English; (4) has at least one major CVD risk factor (current smoker, high blood pressure, high cholesterol and diabetes); (5) has not practised TC on a regular basis in the past 6 months; and (6) willing to sign a informed consent. Exclusion criteria included people diagnosed with cognitive impairments, an unstable cardiac condition such as ventricular dysrhythmias, pulmonary oedema, chest pain, or uncontrolled atrial fibrillation, or other musculoskeletal conditions such as severe debilitating arthritis, that would preclude participation in TC (Lan *et al.* 1999) as judged by a clinical nurse specialist (RTP) experienced in cardiac rehabilitation and exercise testing.

### Power calculation

N-Query 4.0 (Elashoff 2000) statistical software was used to calculate the effect size for an univariate one-factor repeated measures analysis of variance (ANOVA). Effect sizes were derived from prior research using TC exercise as an intervention, and examining affective status (Brown *et al.* 1995, Sun *et al.* 1996, Tsai *et al.* 2003). Sample size calculations using univariate one-factor repeated measures ANOVA to examine significant differences in means at

baseline, 6 and 12 weeks,  $\alpha = 0.05$ , power = 0.80, with a conservative  $\delta^2$  effect size of 0.15 [ $\delta^2 = f^2$ ] required a sample size of 28 participants (Cohen 1988). However, when considering a potential attrition rate of 25% (Brown *et al.* 1995, Sun *et al.* 1996, Ross *et al.* 1999, Tsai *et al.* 2003), 39 participants were required.

### Tai Chi intervention

Participants were recruited in cohorts limited to 20 per group, ensuring individual attention during class instruction. They attended a 60-minute TC exercise class at the community center three times per week for 12 weeks. An experienced TC instructor proficient in the Yang Style 24-posture short-form (Fei 2001) taught all sessions. This form is easier to learn and remember than the classical Yang style 108-posture long-form, though still contains the essential TC principles. The exercise intensity of performing Tai Chi is 4.0 metabolic equivalents (METs), similar in intensity to brisk walking (Ainsworth *et al.* 2000). Older adults and those with chronic illnesses can practise this form safely (Fei 2001).

During class, participants were asked to replicate the motions, postures, and movement speed of the instructor. They were monitored for safety, with corrections given as needed. A Registered Nurse (RTP) experienced in exercise testing/supervision and possessing advanced cardiac life support certification was in attendance at all sessions. Each session consisted of a 20-minute warm-up period, 30-minutes of TC exercise and a 10-minute cool-down period. The 24-posture short-form was taught gradually, and participants were able to learn the entire sequence by the end of 12 weeks. The entire sequence takes 8–10 minutes to perform and was repeated several times, to provide an aerobic benefit (Lan *et al.* 2004).

Participants were encouraged to practise the same routine at home at least two other days, although this was not

monitored. On completion of the 12-week intervention, each participant received a CD-Rom of the TC Master performing the form taught (Fei 2001).

### Instruments

All instruments used in this study were available in Chinese. Translation and independent back-translation of these tools into Chinese by bilingual and/or bicultural persons with translation experience and graduate level education was done, establishing content and semantic equivalence (Short & Johnston 1997, Molassiotis *et al.* 1999, Chen *et al.* 2000, Zhang & Norvilitis 2002, Taylor-Piliae & Froelicher 2004b). Additionally, a pilot study with 18 Chinese adults was conducted to determine the appropriateness of the measures and meaning of the questions or response patterns of these study instruments (Taylor-Piliae & Froelicher 2004b).

#### Mood state

Mood is conceptualized as transient, fluctuating affective states (McNair *et al.* 1992) that is important for understanding emotions that result from the effect of an illness or chronic disease on a person's life, such as CVD. The Profile of Mood States (POMS) is a widely used instrument with established psychometric properties (McNair *et al.* 1992, Molassiotis *et al.* 1999).

The POMS is a 65-item adjective checklist using a five-point Likert format (0, not at all; 4, extremely). It measures six emotional dimensions (tension-anxiety, depression-dejection, anger-hostility, vigor-activity, fatigue-inertia, confusion-bewilderment) and total mood disturbance (McNair *et al.* 1992). Scores can be calculated for each of the six subscales and for overall mood state. The total mood disturbance score is obtained after subtracting the vigor-activity subscale from the sum of the remaining five subscales (58 items). The remaining seven items in the POMS are not incorporated into the mood disturbance score. Possible scores range from -32 to 200, with higher scores indicating greater mood disturbance.

Psychometric testing of the Chinese version has established content, convergent (anxiety,  $r = 0.65$ ,  $P = 0.01$ ; uncertainty,  $r = 0.57$ ,  $P = 0.01$ ) and divergent validity (self-esteem  $r = 0.01$ ,  $P$ -value not statistically significant; POMS subscales  $r = 0.01$ ,  $P$ -values not statistically significant) with strong test-retest reliability reported ( $r = 0.86$ ) (Molassiotis *et al.* 1999, Taylor-Piliae & Molassiotis 2001). Strong internal consistency using Cronbach's alpha coefficient was reported ( $r = 0.90$  to  $0.92$ ) among Chinese populations with heart disease (Taylor-Piliae & Molassiotis 2001, Taylor-Piliae & Chair 2002). The utility of the POMS in measuring

mood state among older adults performing TC, and TC practitioners has been reported (Jin 1992, Brown *et al.* 1995).

#### Stress

Stressful events are thought to increase risk of disease when these events are viewed as threatening or when coping resources are perceived as insufficient (Cohen *et al.* 1983, Cohen & Williamson 1988). The Perceived Stress Scale (PSS) designed by Cohen and colleagues (Cohen *et al.* 1983, Cohen & Williamson 1988) is the most commonly used tool to measure perceived stress. Perceived stress is defined as the degree to which situations in one's life are appraised as stressful (Cohen *et al.* 1983), with the original scale containing 14 items. The PSS was modified by Cohen and Williamson (1988) to a 10-item, 5-point Likert scale (0, never; 4, very often), with possible scores ranging from 0 to 40 (Cohen & Williamson 1988). A higher score indicates more perceived stress. Cohen and Williamson (1988) argue that the PSS-10 ( $r = 0.78$ ) has somewhat better psychometric properties than the PSS-14 ( $r = 0.75$ ), and recommend using the PSS-10 in research (Cohen & Williamson 1988).

The items in the PSS were designed to assess an individual's cognitive evaluation of stress. The central components of perceived stress include situations that people perceive as unpredictable, uncontrollable and overloaded (Cohen *et al.* 1983, Cohen & Williamson 1988). The PSS is a self-administered tool, designed for community samples with limited education (Cohen *et al.* 1983, Cohen & Williamson 1988). Strong reliability ( $r = 0.85$ ) with good test-retest reliability ( $r = 0.85$  and  $0.55$ ) and concurrent and predictive validity have been reported (Cohen *et al.* 1983). Known-groups validity has been demonstrated by the tool's ability to detect differences between age groups ( $P = 0.01$ ), income ( $P = 0.01$ ) and education levels (low vs. high;  $P = 0.01$ ) (Cohen & Williamson 1988).

High internal consistency of the Chinese PSS has been reported ( $r = 0.90$ ) (Lee & Crockett 1994). Chen *et al.* (2000) reported adequate test-retest reliability and construct validity of the PSS among Chinese women ( $n = 60$ ). Following a 4-week intervention to decrease postpartum distress, the PSS demonstrated responsiveness to change in women with postpartum distress ( $t = -3.75$ ,  $P = 0.01$ ; Chen *et al.* 2000).

#### Tai Chi exercise self-efficacy

Several investigators have reported that efficacy beliefs statistically significantly predicted exercise behaviour and that exercise efficacy increased overtime, even among people with heart disease (McAuley 1993, Perkins & Jenkins 1998, Li *et al.* 2001b, Blanchard *et al.* 2002). Tai Chi exercise self-efficacy (TCSE) refers to beliefs in one's capability to perform

TC exercise (Bandura 1997b, 2001). TCSE must have its own measure tailored to the specific domain of functioning and representing gradations of task demands (Bandura 1997b, 2001). An individual's perceived confidence to perform TC exercise can be assessed by the TCSE scale (Taylor-Piliae & Froelicher 2004b). This scale assesses perceived self-efficacy to overcome barriers to TC exercise (TCSE barriers) and self-efficacy to perform TC (TCSE performance; Taylor-Piliae & Froelicher 2004b).

Participants respond to nine items about their perceived confidence in exercising five times per week for 30 minutes (0, not at all confident; 100, very confident) when faced with situations known to impede exercise participation (TCSE barriers; Katula *et al.* 1999, Resnick & Jenkins 2000, Bandura 2001). TCSE performance contains five questions relating to an individual's perceived capability to move their body in a slow, rhythmical continuous fashion (0, not at all confident; 100, very confident), ranging from 2 to 30 minutes (Li *et al.* 2001a,b). Confidence scores for TCSE barriers and TCSE performance are summed separately, and then divided by the total number of items in each scale. A higher score indicates more confidence or perceived self-efficacy.

Reported internal consistency estimates are very high (TCSE barriers,  $r = 0.95$ ; TCSE performance,  $r = 0.97$ ; Taylor-Piliae & Froelicher 2004b). Known-groups validity has been demonstrated by the tool's ability to detect differences between TC practitioners and non-practitioners (TCSE barriers,  $t = -3.3$ ,  $P = 0.01$ ; TCSE performance,  $t = -2.7$ ,  $P = 0.03$ ), with TC practitioners reporting higher self-efficacy (Taylor-Piliae & Froelicher 2004b).

#### *Previous Tai Chi experience*

A mastery experience is one of the most influential ways to cultivate perceived efficacy, particularly when one's personal capability to perform an activity is perceived to be successful (Bandura 1997b). A positive mastery experience is likely to foster increased personal efficacy, while failures often result in negative perceptions of personal capability. A single dichotomous item was used to ascertain if participants had previous TC experience, and respondents who had practised TC regularly in the last 6 months (at least once a week) were excluded from participation in the study, in accordance with the exclusion criteria.

#### *Social support*

Verbal persuasion through social support and encouragement from experts aids in the cultivation of efficacy beliefs (Bandura 1997b). Personal change occurs within a network of social influences and there is no single social network that is

all encompassing and solely able to effect behavioural change. Social support is likely to influence perceived self-efficacy and thus TC exercise behaviour (Bandura 1997b). In addition, TC is usually performed in a group setting, which in turn is likely to enhance exercise participation. Thus, social support adequacy or the actual connection that people have in their environment is important to assess.

The Multidimensional Scale of Perceived Social Support (MSPSS; Blumenthal *et al.* 1987, Zimet *et al.* 1988) is a 12-item tool, used to assess perceptions of social support adequacy available from family members, friends and a significant other. It is a self-administered tool, with a 7-point Likert Scale (1, very strongly disagree; 7, very strongly agree), requiring approximately 5–10 minutes to complete. This response format was devised to avoid possible ceiling effects and increase response variability following initial psychometric testing (Blumenthal *et al.* 1987, Zimet *et al.* 1988). Possible scores range from 1 to 7, and the total score is the sum of the item responses, divided by the number of items. A higher score indicates greater level of perceived support. In addition, scores can be calculated for the three subscales (family, friends, and significant others) by summing the item responses of each subscale and dividing by the number of items contained in the subscale. Reliability in the original sample of college students has been reported as high (Cronbach's alpha = 0.88), with good test-retest reliability at 2–3 months ( $r = 0.85$ ; Zimet *et al.* 1988). Confirmatory factor analysis has consistently reported a 3-factor solution (family, friends and others), with all items loading at 0.74 or greater (Zimet *et al.* 1990, Dahlem *et al.* 1991).

Internal consistency of the Chinese version is good, ranging from 0.82 to 0.94 (Short & Johnston 1997, Zhang & Norvilitis 2002). Content validity has been reported in both the original and Chinese populations (Zimet *et al.* 1988, Short & Johnston 1997, Zhang & Norvilitis 2002). In the original population (college students), anxiety and depression correlated negatively ( $r = -0.18$ ,  $P = 0.01$ ;  $r = -0.24$ ,  $P = 0.01$ ), as hypothesized, with perceived social support, demonstrating convergent validity (Zimet *et al.* 1988). Among Chinese college students, convergent validity was demonstrated by statistically significant associations ( $r = 0.34$ ,  $P = 0.01$  self-esteem;  $r = -0.41$ ,  $P = 0.01$  depression;  $r = -0.21$ ,  $P = 0.01$  suicidal ideation) between hypothesized relationships to perceived social support (Zhang & Norvilitis 2002). Among Hong Kong Chinese mothers, additional evidence of convergent validity was reported ( $r = 0.38$ ,  $P = 0.01$  parenting support;  $r = -0.54$ ,  $P = 0.01$  depression;  $r = -0.46$ ,  $P = 0.01$  somatization and anxiety; Short & Johnston 1997).

**Table 2** Internal consistency of the study instruments over 12 weeks

Instrument/ Cronbach's alpha	Baseline	6 weeks	12 weeks
PSS	0.88	0.89	0.87
POMS	0.96	0.95	0.95
MSPSS	0.86	0.95	0.93
TCSE barriers	0.95	0.94	0.96
TCSE performance	0.95	0.94	0.92

PSS, Perceived Stress Scale, POMS, profile of mood states, MSPSS, Multidimensional Scale of perceived social support, TCSE barriers, self-efficacy to overcome barriers to Tai Chi; TCSE performance, self-efficacy to perform Tai Chi.

### Instrument reliability

In the present study, internal consistency estimates for the instruments were found to be high at all data collection time periods (Table 2). Internal consistency estimates for the tools measuring affective status (PSS and POMS) ranged from 0.87 to 0.96. The tool assessing social support, MSPSS, showed strong reliability over time, with internal consistency estimates ranging from 0.86 to 0.95. Internal consistency estimates of the tools examining self-efficacy (TCSE barriers and TCSE performance) ranged from 0.92 to 0.96.

### Ethical considerations

Approval for the study was obtained from the Institutional Review Board at the University of California San Francisco, with the investigation carried out according to the principles outlined in the Declaration of Helsinki. Written informed consent was obtained from all participants in either English or Chinese (Cantonese), who were assured of confidentiality and the ability to decline participation or withdraw from the study at any time. Permission to use the instruments was obtained from the respective copyright holders.

### Data analysis

All data forms were reviewed for accuracy and completeness at the time of data collection. Frequencies were run on every variable to check for extreme and inconsistent values. Data were analysed using the Statistical Package for Social Sciences (version 10.0) (Norusis 2000). Descriptive statistics were calculated for all variables. Univariate repeated measures ANOVA was used to test for changes in the outcomes variables over time. Mauchly's test of sphericity ( $\geq 0.05$ ) (Shott 1990) was done before proceeding with the analysis. If the compound symmetry criteria were not met, the data were analyzed using the Greenhouse-Geisser adjusted univariate

approach. If the overall ANOVA was statistically significant, then Bonferroni's adjusted paired-samples confidence intervals (Shott 1990) were performed for all three possible comparisons (0–12, 0–6 and 6–12 weeks) to determine where the mean difference was.

## Results

### Baseline characteristics

A total of 39 participants agreed to participate and were on average 66 year old ( $\pm 8.3$ ), married, Cantonese-speaking, immigrant women (Table 3). The majority were retired or unemployed (85%), with  $\leq 12$  years education, and approximately half reported an income  $< \$16,000$  US per year (approx. 8,810 £ sterling or 13,247 Euro). The median household income in the USA is \$43,527, though in the SFBA it is \$65,268 (Census 2002).

Self-reported musculoskeletal conditions, such as arthritis or chronic back pain, were common (Table 3). However, the majority of participants perceived their health to be good, very good or excellent (56%). Only 41% reported having a history of cardiovascular problems, although 92% were found to have hypertension and/or other CVD risk factors. CVD medication use for hypertension and hypercholesterolemia was lower than reported risk factors. Only a few participants ( $n = 4$ ) reported using Chinese medicine for health benefits. Approximately one-fourth had prior TC experience, but none had performed TC regularly in the past 6 months, according to the inclusion criteria (Table 4).

Participants were asked to attend a total of 36 TC exercise classes during the 12-week study. Adherence to the intervention was very high ( $87\% \pm 0.18$ ). Follow-up at 6 weeks was 100%. However, after the 6-week evaluation, one woman dropped out due to recurring health problems. A total of 97% of participants completed the study, with data from these participants used in the analyses ( $n = 38$ ).

### Outcomes

#### *Affective status*

Stress and mood state were assessed using the PSS and the POMS respectively. At baseline, participants reported little stress ( $15.6 \pm 6.9$ ) and very low mood disturbance ( $19.3 \pm 29.6$ ; Table 4). Univariate repeated measures ANOVA examining change in perceived stress was statistically significant over time (Table 5). Approximately 13% of the variance ( $\eta^2 = 0.13$ ) in perceived stress over time could be explained (Table 5). A pairwise contrast of the mean differences (Table 6) was statistically significant between baseline

**Table 3** Baseline subject characteristics and self-reported health status,  $n = 39$ 

	%	$n$
Gender		
Men	30.8	12
Women	69.2	27
Marital status		
Married/domestic partner	84.6	33
Divorced/separated/widowed/single	15.4	6
Education		
Primary (1–6 years)	41.0	16
Secondary (7–12 years)	46.2	18
Tertiary (13+ years)	12.8	5
Employment status		
Retired/unemployed	84.6	33
Full- or part-time	15.4	6
Income (in US dollars per year)		
< 15,999	46.2	18
16,000–34,999	20.6	8
> 35,000	12.8	5
Refused to answer	20.5	8
Birthplace		
Mainland China	87.2	34
Hong Kong	12.8	5
Language spoken at home		
Cantonese	97.4	38
Mandarin	2.6	1
Cardiovascular disease risk factors		
Hypertension	92.3	36
Hypercholesteraemia	48.7	19
Diabetic	20.5	8
Current smoker	2.6	1
Medication use		
Antihypertensives	53.8	21
Statins	28.2	11
Oral hypoglycaemics	17.9	7
Aspirin	33.3	13
Chinese medicine	10.3	4
Self-reported medical disorders		
Cardiovascular	41.0	16
Musculoskeletal	53.8	21
Gastrointestinal	12.8	5
Haematological	12.8	5
Immunological	5.1	2
Respiratory	2.6	1
Psychological	5.1	2
General health perception		
Excellent	7.7	3
Very good	20.5	8
Good	28.2	11
Fair	43.6	17
Poor	0	0

and 12-weeks (Figure 2), with less stress following the 12-week TC intervention.

Univariate repeated measures ANOVA examining change in total mood disturbance, and two subscales, tension–anxiety

and confusion–bewilderment, were statistically significant over time (Table 5). Approximately 12% of the variance ( $\eta^2 = 0.12$ ) in total mood disturbance, 15% ( $\eta^2 = 0.15$ ) of the variance in tension–anxiety, and 10% ( $\eta^2 = 0.10$ ) of the variance in the confusion–bewilderment subscale over time could be explained. Pairwise contrasts examining mean differences found statistically significant reductions in total mood disturbance (Figure 2) and the two subscales for tension–anxiety and confusion–bewilderment between baseline and 12 weeks. In addition, a statistically significant reduction in tension–anxiety was found following the second 6 weeks of the intervention (Table 6).

#### *Tai Chi exercise self-efficacy*

Perceived self-efficacy to overcome barriers to TC exercise (TCSE barriers) was assessed at baseline, 6 and 12 weeks after the intervention. At baseline, participants perceived themselves to be moderately confident to overcome these barriers (TCSE barriers =  $50.3 \pm 33.0$ ; Table 4). At 12-weeks a statistically significant improvement in TCSE barriers (Figure 3) was found, with participants reporting more confidence to overcome the barriers. Univariate repeated measures ANOVA examining change in TCSE barriers was statistically significant over time (Table 5). Approximately 19% ( $\eta^2 = 0.19$ ) of the variance in TCSE barriers over time could be explained. Pairwise contrasts of the mean differences in TCSE barriers found statistically significant increases between baseline and 12 weeks, and following the second 6 weeks of the intervention (Table 6).

TCSE performance was used to assess self-efficacy to perform TC. At baseline, participants were fairly confident that they could perform TC ( $72.5 \pm 28.0$ ) (Table 4). As expected, at baseline they were more confident that they could perform TC continuously for 2 minutes ( $84.2 \pm 27.0$ ) than continuously for 30 minutes ( $56.9 \pm 33.9$ ). At 6 weeks and 12 weeks statistically significant improvements in TCSE performance (Figure 3) were found, with participants very confident that they could perform TC continuously for 30 minutes. Univariate repeated measures ANOVA examining change in TCSE performance at all time levels, were statistically significant over time (Table 5). Approximately 27% ( $\eta^2 = 0.27$ ) of the variance in TCSE performance over time could be explained. Pairwise contrasts of the mean differences in TCSE performance at all time levels were statistically significant between baseline and 12 weeks, and following the first 6 weeks of the intervention (Table 6).

#### *Social support*

The MSPSS was used to assess social support. At baseline, participants reported a moderate amount of social support

**Table 4** Psychosocial status descriptive statistics,  $n = 38$

	Possible range of scores	Baseline	6 weeks	12 weeks	Change from baseline	Desired direction of change in score
Perceived stress	0–40	15.6 (6.9)	14.3 (7.2)	13.1 (6.3)	–2.5 (5.0)	↓
Total mood disturbance	–32–200	19.3 (29.6)	14.0 (32.0)	8.9 (26.8)	–10.4 (21.6)	↓
Tension–anxiety	0–36	7.7 (6.1)	7.4 (6.2)	5.5 (5.3)	–2.2 (4.3)	↓
Confusion–bewilderment	0–28	7.2 (4.5)	6.2 (4.6)	5.7 (3.7)	–1.5 (3.4)	↓
Depression–dejection	0–60	8.1 (9.0)	7.6 (9.5)	6.4 (8.1)	–1.7 (5.5)	↓
Anger–hostility	0–48	6.2 (6.3)	5.3 (5.8)	4.6 (5.7)	–1.6 (5.1)	↓
Fatigue–inertia	0–28	5.8 (5.3)	5.1 (5.2)	4.4 (4.1)	–1.3 (4.2)	↓
Vigor–activity	0–32	15.6 (5.3)	17.6 (5.7)	17.7 (5.4)	2.1 (6.3)	↑
Overall social support	1–7	4.9 (0.8)	5.1 (1.1)	5.4 (0.9)	0.4 (0.7)	↑
Family	1–7	5.3 (1.0)	5.5 (1.2)	5.7 (1.1)	0.4 (1.1)	↑
Friends	1–7	4.6 (1.1)	4.7 (1.2)	4.9 (1.0)	0.3 (1.1)	↑
Significant other	1–7	4.9 (0.8)	5.1 (1.2)	5.4 (1.1)	0.5 (0.9)	↑
TCSE barriers	0–100	50.3 (33.0)	53.1 (33.9)	75.3 (29.5)	25.0 (37.1)	↑
TCSE performance	0–100	72.5 (28.0)	88.5 (18.8)	91.3 (16.1)	18.8 (26.3)	↑
2 minutes	0–100	84.2 (27.0)	93.2 (16.6)	95.8 (13.9)	11.6 (27.6)	↑
5 minutes	0–100	78.7 (30.1)	92.4 (16.7)	93.4 (15.6)	14.7 (28.7)	↑
10 minutes	0–100	75.5 (30.7)	87.6 (21.9)	92.0 (18.1)	16.4 (28.8)	↑
20 minutes	0–100	67.1 (32.8)	85.8 (22.9)	90.5 (19.2)	23.3 (28.4)	↑
30 minutes	0–100	56.9 (33.9)	83.4 (24.6)	85.0 (24.1)	28.1 (32.5)	↑
Previous Tai Chi experience [% ( $n$ )]	Yes/no	25.6 (10)	–	–	–	–

Values are given as Mean (SD).

TCSE barriers, self-efficacy to overcome barriers to Tai Chi; TCSE performance, self-efficacy to perform Tai Chi; SD, standard deviation.

**Table 5** Change in psychosocial status over 12 weeks of Tai Chi exercise,  $n = 38$

Univariate repeated measures ANOVA	$F$ [d.f. <sub>2,36</sub> ]	$P$ value	$\eta^2$
Perceived stress	5.46	0.009*	0.13
Total mood disturbance	5.23	0.008*	0.12
Tension–anxiety	6.61	0.002*	0.15
Confusion–bewilderment	4.16	0.019*	0.10
Depression–dejection	2.10	0.138	0.05
Anger–hostility	2.64	0.087	0.07
Fatigue–inertia	1.85	0.165	0.05
Vigor–activity	2.88	0.063	0.07
Overall social support	5.12	0.008*	0.12
Family	3.38	0.039*	0.08
Friends	1.14	0.324	0.03
Significant other	6.08	0.004*	0.14
TCSE barriers	8.89	0.001*	0.19
TCSE performance	13.66	0.001*	0.27
2 minutes	5.57	0.010*	0.13
5 minutes	8.44	0.001*	0.19
10 minutes	7.62	0.001*	0.17
20 minutes	13.90	0.001*	0.27
30 minutes	18.94	0.001*	0.34

TCSE barriers, self-efficacy to overcome barriers to Tai Chi; TCSE performance, self-efficacy to perform Tai Chi.

\*Significant if  $P$ -value  $\leq 0.05$ .

( $4.9 \pm 0.8$ ) (Table 4). At 12 weeks, a statistically significant improvement in the MSPSS score (Figure 4) was found. Univariate repeated measures ANOVA examining change in overall social support and perceived support from family and significant others were statistically significant over time (Table 5). Approximately 12% ( $\eta^2 = 0.12$ ) of the variance in overall social support over time could be explained. Pairwise contrasts of the mean differences found statistically significant improvements in overall social support and perceived support from family and significant others between baseline and 12 weeks (Table 6).

### Predictors

Social support, TCSE, and previous Tai Chi exercise experience did not predict class attendance ( $P > 0.05$  for all variables). High adherence to the intervention (87%) and a small sample probably contributed to these findings.

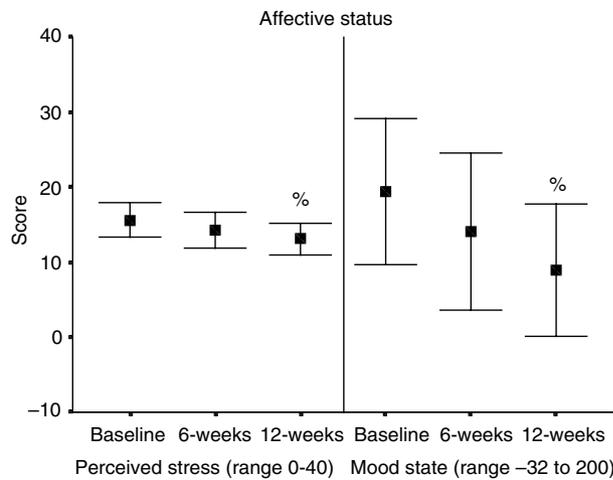
### Discussion

This is the first reported study to examine change in psychosocial status following a TC exercise intervention among ethnic Chinese adults with CVD risk factors, living

**Table 6** Pairwise contrasts of mean differences in psychosocial status over 12 weeks of Tai Chi exercise,  $n = 38$

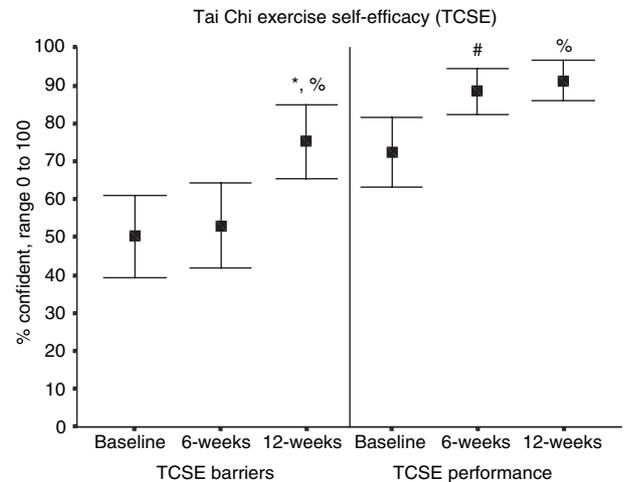
Contrasts	Baseline to 6 weeks				7–12 weeks				Baseline to 12 weeks			
	F [d.f.,1,36]	$\eta^2$	LBCI	UBCI	F [d.f.,1,36]	$\eta^2$	LBCI	UBCI	F [d.f.,1,36]	$\eta^2$	LBCI	UBCI
Perceived stress	2.32	0.06	-0.85	3.48	4.09	0.10	-0.29	2.71	9.85	0.21	0.51	4.55
Total mood disturbance	3.87	0.10	-1.46	12.09	2.25	0.06	-3.41	13.57	8.82	0.19	1.62	19.17
Tension–anxiety	0.16	0.00	-1.40	1.93	9.52	0.21	0.37	3.53	10.07	0.21	0.46	3.96
Confusion–bewilderment	4.63	0.11	-0.17	2.17	0.80	0.02	-0.90	1.90	7.20	0.16	0.10	2.90
Depression–dejection	0.67	0.02	-1.08	2.14	1.50	0.04	-1.19	3.45	3.49	0.09	-0.57	3.88
Anger–hostility	1.96	0.05	-0.67	2.35	1.37	0.04	-0.87	2.40	3.79	0.09	-0.46	3.67
Fatigue–inertia	1.04	0.03	-0.96	2.28	0.81	0.02	-1.22	2.59	3.86	0.09	-0.37	3.06
Vigor–activity	3.97	0.09	-4.58	0.50	0.00	0.00	-2.35	2.24	4.09	0.10	-4.66	0.50
Overall social support	2.03	0.05	-0.14	0.49	2.67	0.07	-0.13	0.61	12.13	0.25	0.12	0.72
Family	2.38	0.06	-0.14	0.57	1.57	0.04	-0.20	0.59	5.42	0.13	0.03	0.86
Friends	0.38	0.01	-0.38	0.63	0.76	0.02	-0.31	0.64	2.47	0.06	-0.17	0.75
Significant other	1.23	0.03	-0.24	0.62	4.69	0.11	-0.06	0.77	15.40	0.29	0.20	0.90
TCSE barriers	0.17	0.00	-14.09	19.68	10.94	0.23	5.37	39.02	17.27	0.32	9.91	40.07
TCSE performance	16.34	0.31	6.07	25.91	0.71	0.02	-5.62	11.34	19.49	0.35	8.14	29.55
2 minutes	7.24	0.16	0.61	17.29	0.80	0.02	-4.73	10.00	6.71	0.15	0.37	22.79
5 minutes	11.21	0.23	3.44	23.93	0.12	0.00	-6.73	8.84	10.00	0.21	3.05	26.42
10 minutes	7.25	0.11	0.83	23.38	1.24	0.03	-5.44	14.12	12.41	0.25	4.74	28.15
20 minutes	12.71	0.26	5.54	31.78	1.28	0.03	-5.72	15.14	25.72	0.41	11.82	34.92
30 minutes	25.84	0.41	13.46	39.65	0.10	0.00	-10.72	13.82	28.39	0.43	14.88	41.33

**Bold**,  $P < 0.0167$ ; LBCI, lower bound confidence interval with Bonferroni adjusted pairwise contrasts; UBCI, upper bound confidence interval with Bonferroni adjusted pairwise contrasts; TCSE barriers, self-efficacy to overcome barriers to Tai Chi; TCSE performance, self-efficacy to perform Tai Chi.



**Figure 2** Mean scores and 95% confidence intervals of perceived stress and mood state, at baseline, 6 and 12 weeks. % baseline vs. 12-weeks,  $P < 0.01$ .

in the USA. TC was a culturally appropriate mind–body exercise for these older adults, with statistically significant psychosocial benefits observed over 12-weeks. Using Bandura’s SCT, sources of information for cultivation of self-efficacy were examined (Figure 1), including affective status, previous TC experience and social support, as well as change in TCSE.

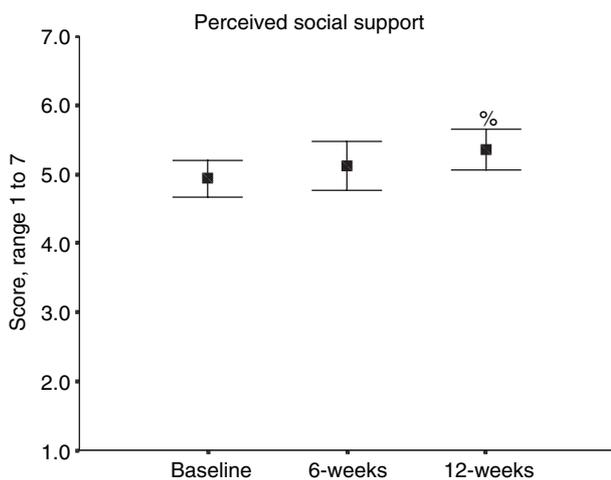


**Figure 3** Mean scores and 95% confidence intervals of self-efficacy to overcome barriers to Tai Chi, and self-efficacy to perform Tai Chi, at baseline, 6 and 12 weeks. # Baseline vs. 6-weeks,  $P < 0.01$ , \*6-weeks vs. 12-weeks,  $P < 0.01$ , % Baseline vs. 12-weeks,  $P < 0.01$ . TCSE barriers, self-efficacy to overcome barriers to Tai Chi; TCSE performance, self-efficacy to perform Tai Chi.

Participants reported very little mood disturbance, which is similar to previously reported mean scores among ethnic Chinese adults (Chen *et al.* 2001, Taylor-Piliae & Chair

2002). However, prior research examining the effect of TC on mood among non-Chinese populations have reported much higher mean scores at baseline and after a TC exercise intervention (Jin 1989, 1992, Brown *et al.* 1995). Among Chinese people, the expression of negative emotions is controlled in order to maintain internal balance and conform to social norms for expected public behaviour (Holroyd *et al.* 1998, Taylor-Piliae & Molassiotis 2001). Negative emotions, such as anxiety, fear, or worry, are thought to cause internal disharmony and allow illnesses to occur (Torsch & Ma 2000, Taylor-Piliae & Molassiotis 2001, Taylor-Piliae & Chair 2002). This may partially explain our findings, as participants were mainly immigrants from mainland China, and more likely to have been influenced by the pervasive cultural and social norms and thus reluctant to express their emotions. In addition, the low level of education of the majority of participants (87% ≤ high school) may have limited their understanding of some of the words in the POMS. Use of alternative tools to assess mood in ethnic Chinese, such as the Positive and Negative Affective Schedule (Watson *et al.* 1988) or the Chinese Stress Symptoms checklist (Cheng & Hamid 1996), may be warranted in future studies.

Only one prior study, among recent immigrants of older Hmong adults to the USA, has examined the effect of TC on perceived stress (Sun *et al.* 1996), with a statistically significant reduction ( $Z = 3.79, P = 0.01$ ) reported following a 12-week TC intervention. However, further comparisons with our study cannot be made as information on the instrument used to measure perceived stress was not given (Sun *et al.* 1996).



**Figure 4** Mean scores and 95% confidence intervals of perceived social support, at baseline, 6 and 12 weeks. % Baseline vs. 12-weeks,  $P < 0.01$ .

Two scales were used to assess TCSE. Our findings obtained were similar to those reported in prior studies examining TCSE barriers and TCSE performance among older adults, with statistically significant improvements reported over time (Resnick & Jenkins 2000, Li *et al.* 2001a, Taylor-Piliae & Froelicher 2004b). Interestingly, improvement in self-efficacy to overcome barriers to TC (TCSE barriers) was statistically significant following the second 6-weeks of TC exercise, while self-efficacy to perform TC (TCSE performance) was statistically significant following the first 6-weeks of TC exercise. Perceived self-efficacy to overcome barriers to TC confirms similar reports in the literature on exercise behaviour (Bandura 1997b), and is important information for researchers. Initially, frequent reminders and extra time may be needed to encourage regular participation in an exercise programme such as TC. TC may be individually tailored for older people, so that only a few movements are taught and mastered before new ones are introduced, and this may have contributed to an increase in perceived TCSE performance in our participants during the first 6 weeks of the classes.

No prior study has examined the effect of TC on social support over time, although social support is likely to occur during exercise classes performed in groups and is also vital in cultivating self-efficacy and further encouraging exercise behaviour. Our findings are similar to those of previous research using the MSPSS to assess perceptions of social support adequacy among Chinese and people with CVD, with increased perceptions of social support reported over time (White & Frasure-Smith 1995, Short & Johnston 1997, Carels *et al.* 1999, Daly *et al.* 2000, Zhang & Norvilitis 2002).

Future research might explore the effect of TC on different domains of social support, such as the perceived availability of functional support. Functional support includes specific behaviours performed by others as expressions of support, including giving material aid, tangible assistance, information or guidance, positive social interaction and affection (Barrera & Ainlay 1983, Sherbourne & Stewart 1991). In addition, different or additional measures to assess TC mastery, modelling, or social persuasion may be needed to explore comprehensively TC information sources for cultivating self-efficacy.

Our participants reported having a major CVD risk factor (current smoker, high blood pressure, high cholesterol and diabetes), in accordance with the inclusion criteria. However, given the high percentage of CVD risk factors reported (Table 3), it is apparent that interventions are needed to address several health concerns and to reduce hypertension and hypercholesteremia in this population.

### What is already known about this topic

- Negative psychosocial factors such as major depression, social isolation, or chronic stress can adversely affect pathophysiological mechanisms associated with cardiovascular disease.
- Expressions of negative emotions or strong personal feelings among ethnic Chinese people are generally controlled.
- Tai Chi exercise is a low-impact, moderate-intensity aerobic exercise incorporating relaxed breathing and mental concentration.

### What this paper adds

- Tai Chi is culturally appropriate mind–body exercise appealing to ethnic Chinese older adults.
- Twelve weeks of Tai Chi was adequate for observing a statistically significant reduction in perceived stress, improvement in mood state, and an increase in perceived social support.
- Longer time was needed to observe statistically significant improvements in perceived confidence to overcome barriers to Tai Chi exercise, than in perceived confidence to perform Tai Chi.

### Study limitations and strengths

The generalizability of our findings may be limited, as only participants uniquely interested in TC and with perceived good health may have volunteered as study participants. No participants reported perceived poor health, and this may not be representative of all Chinese seniors living in the community. Furthermore, without a control group to serve as a comparison, improvement unrelated to TC is possible.

Readability of the English version of the questionnaire was at the 6th to 7th grade reading level, based on the Flesch–Kincaid Grade Level analysis (Microsoft Word 2000 Spelling and Grammar Tool, Microsoft Corporation, Redmond, WA, USA). However, we did not ascertain the readability level of the Chinese version, and it is possible that this was more difficult than the English version. In addition, the majority of participants reported limited education. The use of unfamiliar vocabulary or complex sentences may have limited their understanding of some of the concepts examined and contributed to the results. Further, feelings or expectations about answering a questionnaire may be influenced by personal beliefs, socially desirable answers, or pervasive cultural norms among ethnic Chinese people.

This was an innovative, culturally appropriate exercise programme appealing to ethnic Chinese seniors, with potential linguistic barriers eliminated. The very high adherence to the TC exercise intervention (87%) suggests this was a convenient and acceptable form of exercise for these participants. Expected cultural norms for public behaviour, such as a respect for healthcare practitioners and people in authority or TC classes taught by a gifted, charismatic instructor may have contributed to the very high adherence rate. Additional factors contributing to the success of the study were the availability of participants and their willingness to complete the study (97%). Future studies using a randomized clinical trial design with an attention-control group may reduce potential confounding effects.

### Conclusion

Psychosocial stressors are associated with increased risk of CVD mortality and morbidity worldwide. Mind–body exercise, such as Tai Chi, is related to improvement in psychosocial well-being, and stress reduction. This was the first reported study among ethnic Chinese in the USA, tailored for Cantonese-speaking persons with CVD risk factors. All aspects of this study, assessments and TC classes, were conducted at a local community center providing easy, convenient access and familiarity to the setting. Community-based exercise programmes have several advantages, including the fact that those attending can also be targeted for health screening or education, such as smoking cessation or nutrition classes.

Further research examining TC exercise using a randomized clinical trial design with an attention–control group might reduce potential confounding effects, while exploring potential mechanisms underlying the relaxation response associated with mind–body exercise. In addition, future TC studies among people with other chronic illnesses in all ethnic groups are recommended to determine if similar benefits can be achieved.

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## Author contributions

RTP was responsible for the study conception and design and drafting of the manuscript. RTP performed the data collection and data analysis. RTP obtained funding. WH, CW and ESF provided administrative support. RTP, WH, CW and ESF made critical revisions to the paper. WH, CW and ESF supervised the study.

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