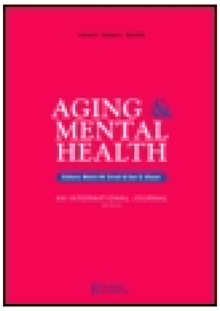

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Effects of community-based meditative Tai Chi programme on improving quality of life, physical and mental health in chronic heart-failure participants

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Effects of community-based meditative Tai Chi programme on improving quality of life, physical and mental health in chronic heart-failure participants

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Background: There is increasing evidence that coronary heart disease is linked with a number of psychosocial risk factors and biophysiological risk factors such as metabolic syndrome. This study aimed to compare Tai Chi programme heart-failure participants between the pre-intervention phase and six month after intervention time in health-related quality of life (HRQoL), including physical health, role-physical, bodily pain, general health, vitality, social functioning, role-emotional and mental health. In addition, the difference between pre-intervention and post-intervention time in psychological distress and resilience, body mass index (BMI), systolic blood pressure (SBP) and diastolic blood pressure (DBP) were compared.
Methods: A prospective intervention study was conducted in 2012 to evaluate the effectiveness of a community-based meditation Tai Chi intervention programme to improve heart-failure patients' health. Measures included the Short-Form 12 Health Survey (SF-12), General Health Questionnaire (GHQ30), resilience scale, BMI, blood pressure and waist circumference. Univariate analysis of variance was used to compare the difference between pre- and post-intervention in Tai Chi participants.
Results: Outcomes differed in significance and magnitude across four HRQoL measures, psychological distress and resilience between the pre- and post-intervention time in heart-failure patients who participated in the Tai Chi exercise. The participants in the post-intervention time also reduced BMI, SBP, and waist circumference.
Conclusions: Regular and more than six months Tai Chi exercises had a beneficial effect to HRQoL, reducing psychological distress, promoting resilience, and reducing the BMI and blood pressure level in heart-failure patients.

Keywords: mind–body meditation approach; heart failure; Tai Chi; quality of life; body mass index; blood pressure

Introduction

Although advances in medical technology have resulted in the increased survival of patients with heart failure (Australian Institute of Health and Welfare [AIHW], 2009b), this condition continues to be the third largest cause of cardiovascular deaths in Australia (Abhayaratna et al., 2006; AIHW, 2009a) after CHD and stroke, accounting for more than 2700 Australian deaths in 2008 (Krum, Jelinek, Stewart, Sindone, & Atherton, 2011). An estimated 300,000 Australians have chronic heart failure, with 30,000 new cases diagnosed each year (AIHW, 2008). Recent estimates of survival based on overseas findings indicate a five-year survival rate of 41% in men and 55% in women. The human and economic burden of heart failure in the community is expected to increase with the ageing of the Australian population (Abhayaratna et al., 2006). In 2004–2005, CVD accounted for 11% ($5942 million) of heath care expenditure – more than any other disease group, and 31% ($1813 million) of CVD expenditure was spent on CHD as the main cause of heart failure (AIHW, 2011). Even with the availability of effective surgery procedures to improve blood flow to the heart muscle due to the coronary arteries (the arteries that supply oxygen and nutrients to the heart muscle) clogged with fatty material called 'plaque' or 'atheroma', the syndrome of heart failure is still associated with substantial mortality, morbidity and economic cost (estimated to be over $1,1813 million in Australia in 2008). Approximately 6.3% Australian adults aged more than 65 are currently diagnosed with some clinical heart failure (Abhayaratna et al., 2006) and accounted for 34% of all cardiovascular deaths in 2008 (AIHW, 2009a, 2011).

Compared with their healthy counterparts, patients with chronic heart-failure surgical procedure require lifelong secondary prevention or medical care, and are at high risk of experiencing decreased health-related quality of life (HRQoL) and increased psychosocial distress (Bunker et al., 2003). There is increasing evidence that heart failure is linked with a number of psychosocial risk factors including depression and anxiety, a decreased level of quality of life and low resilience (Murray & Lopez, 1997), and biophysiological risk factors such as metabolic syndrome (MetS) (Vitaliano et al., 2002). When these disorders are clustered, they represent some of the most challenging problems for public health. For example, psychosocial and biophysiological risk factors have been linked to heart failure and stroke (Frasure-Smith & Lesperance, 2006; Katon, Lin, & Kroenke, 2007; Lane, Chong, & Lip, 2005). Depression, anxiety and MetS have been linked to increased risk of cardiovascular morbidity and mortality (Albert, Chae, Rexrode, Manson, & Kawachi, 2005; Pennix, Guralnix, & Mendes de Leon,

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1998). Treatment of heart failure may be less effective if the above risk factors are ignored because patients are less likely to comply with medication recommendations (Wang et al., 2002), and are also less likely to adhere to rehabilitation programmes (Caulin-Glaser, Maciejewski, Snow, LaLonde, & Mazure, 2007). In this context, this presents as a challenging task to develop an effective secondary prevention programme for heart-failure patients to modify the psychosocial and biophysiological risk factors.

Multiple health behaviour interventions are required to address this issue. Such interventions increase the likelihood that effective action targeting one health behaviour will lead to favourable improvements in a second behaviour and any associated modification of risk factors. For example, while one initiative may target psychosocial risk factors, modification of these factors has a high chance of simultaneously reducing biophysiological risk. The reduction of these psychosocial factors may lead to behavioural changes including increasing exercise level and active participation in more social activities (Sun & Buys, 2013), which may have beneficial effects on MetS in terms of reducing high blood pressure and obesity level.

There is increasing evidence that forms of mind–body meditative exercise practiced in China, such as Tai Chi, are beneficial in the secondary prevention of heart failure. These benefits are not limited to the primary and secondary prevention of heart failure, and extend to the management of symptoms, modification of physiological and psychosocial risk factors and the regression of atherosclerotic plaques in diseased arteries (Channer, Barrow, & Barrow, 1996; Kenny & Fuance, 2004; Wang et al., 2010; Yeh, Wood, & Lorell, 2004; Zheng, 2004). Therefore, the introduction or integration of activities such as meditative Tai Chi into secondary prevention programmes for heart-failure patients may have additionally significant benefits.

Tai Chi, an ancient Chinese art and mind–body meditative exercise, involves slow controlled movements, deep relaxed breathing and correct posture, enacted within a state of awareness and concentration. Tai Chi can provide exercise intensity of 5%–70% of the maximum heart rate that is considered safe and appropriate exercise for heart-failure patients (Yeh et al., 2011). No adverse effects have been found and Tai Chi appears to have greater compliance than other types of exercise, and is complementary to conventional secondary prevention methods (Lei, Yan, Guo, & Yan, 2013). Randomised controlled trails have specifically studied Tai Chi in patients with heart failure (Channer et al., 1996; Liu, Li, & Shnider, 2010; Yeh et al., 2004; Zheng, 2004). It was found that Tai Chi had positive effects on physiological, psychological and physical functioning (PF), and contributed to improved quality of life. Its physiological benefits include lowered blood pressure (Channer et al., 1996), reduced symptoms scores of heart failure (Barrow, Bedford, Ives, O'Toole, & Channer, 2007), improved ventricular ejection fraction (Yeh et al., 2011), increased heart rate (Channer et al., 1996), and improved B-type natriuretic peptide levels. Tai Chi has been demonstrated to have psychological benefits, as well as benefits for quality of life, including reduced depression symptom scores of heart failure as measured by the SCL-90-R depression scale (Barrow et al., 2007) increased exercise capacity (Zheng, 2004), disease-specific quality of life (Zheng, 2004) and quality of sleep (Yeh et al., 2007). Liu and colleagues (Liu et al., 2010) have provided 12 weeks training to CHD patients, including heart-failure patients, and found that Tai Chi had positive effects on PF, including leg strength, flexibility, agility, balance and cardiovascular endurance, compared with the control group.

Despite the potential of Tai Chi to manage conditions such as heart failure, there have been few studies examining its potential to improve health outcomes in heart-failure patients in Australia. Most studies that have been conducted had short-term intervention, ranging from 8 to 16 weeks (Barrow et al., 2007; Channer et al., 1996; Yeh et al., 2011), and there are no studies that have examined the longer term effects (e.g. longer than six months) and regular Tai Chi exercise as a way to improve health in heart-failure patients. This study, therefore, aimed to examine the effects of Tai Chi exercise on health outcomes by comparing differences between pre- and post-intervention time in a group of post-surgery patients with heart failure who participated in a community-based Tai Chi programme. It was hypothesised that heart-failure participants participating in Tai Chi would be have better outcomes in psychosocial factors including depression, resilience and quality of life and that Tai Chi-practising CVD patients would have lower blood pressure and body mass index (BMI) levels in the post-intervention time after six months intervention programme than the pre-intervention time.

Method

Design and procedure

To address the study aim, a prospective quasi-experimental study design was used. Differences in HRQoL and psychological symptoms in heart-failure patients were examined at pre-intervention and at six months post-intervention in a group of heart-failure patients who participated in Tai Chi programme. Pre-intervention measurements were taken in hospital in September 2012 one-year post-surgery. The study was conducted by Griffith University in association with the Gold Coast Hospital, which was the source of participants and delivered the medical care. Informed consent was obtained for participation in the study. The study protocol was approved by the Griffith University Ethics Committee and Gold Coast Health District.

Study participants

Study participants consisted of 41 heart-failure patients who were selected from the post-surgery heart-failure patients' list. They all agreed to participate in a Tai Chi programme at six weeks following cardiac surgery at Gold Coast Hospital in 2011. Their heart-failure events were verified through hospital and medical records. The confirmation rate was 100%.

Criteria for inclusion were as follows:

(1) Patients with reported heart failure who had undergone surgery and needed a secondary prevention programme to maintain their health status.
(2) No previous experience of Tai Chi exercise.
(3) Ability to participate in a Tai Chi class for the duration of the study.

Patients were excluded from the study and referred to relevant health and medical services if they self-reported severe psychopathology such as severe psychotic symptoms, active suicidal behaviour or continuous drug abuse. All heart-failure participants, including those with other comorbid chronic conditions, received their usual medical care, including regular health checks and medication use, during the study period. The Tai Chi group participants were asked to fill in a survey at home and bring it back to their class two weeks later after they received the survey.

Intervention

The intervention consisted of a Tai Chi programme involving a one-hour per session, twice per week over a six-month period. A variety of Tai Chi meditation techniques were taught by a professionally trained instructor, including breathing, balance, flexibility, concentration, calming and stress reduction. All participants received their usual medical care during the intervention, including regular health checks and medication use.

Outcome measures

Three standard assessment instruments were administered to Tai Chi group participants to evaluate the effectiveness of Tai Chi practice on improving psychosocial factors. After participants completed the survey questions, BMI and blood pressure were measured. The three measures are as follows:

(1) HRQoL outcomes were measured with the Short-Form 12 Health Survey (SF-12), which has 12 items and is a reliable and valid means of measuring quality of life in people with chronic conditions (Ware, Kosinsky, & Gandek, 1993). The physical health concept of the SF-12 encompasses (1) PF, (2) role limitations due to physical health problems (RP), (3) bodily pain (BP) and (4) general health (GH) perception. The mental health (MH) concept includes (1) vitality/fatigue (VT), (2) social functioning (SF), (3) role limitation due to emotional problems (RE) and (4) MH status. Physical and mental summary scores are provided based on the physical health concept (PF, RP, BP, GH) and MH concept (VT, SF, RE).
(2) The General Health Questionnaire (GHQ30) (Goldberg, 1978; Goldberg & Williams, 1988) was used as a valid, reliable and sensitive tool to measure psychological distress. Scores for somatic complaints, dysfunctional ability, suicidal depression, life dissatisfaction and social dysfunction are derived from factor analysis. Reliability is high, with a Cronbach alpha of 0.92.
(3) The Resilience Scale (Friborg, Barlaug, Martinussen, Rosenvinge, & Hjemdal, 2005; Friborg, Hjemdal, Rosenvinge, & Martinussen, 2003) was used as a valid and reliable tool to measure patients' ability to manage and take active roles to deal with difficulties and challenges. This 37-item inventory consists of six dimensions and summary scores that combine the six dimensions reported. Scores for family relationship, self-efficacy, social skills, friend support, planning and goal aspiration, and self-esteem are reported in this study. A high score indicates a high-level ability to cope with and manage stressful events.
(4) BMI, systolic blood pressure (SBP) and diastolic blood pressure (DBP) were measured during the interview when the surveys were distributed in Tai Chi class or in Cardiac Clinics when patients attended usual health check in the rehabilitation centre. Height was measured in centimetres and weight was measured in kilograms. SBP and DBP were measured using an electronic blood pressure device. According to the Australian Bureau of Statistics (2005), a normal BMI falls within the 18.50–24.99 range, 25–29.99 is overweight, and 30 and above is obese.

Data analysis

SPSS version 20.00 (SPSS, Chicago, IL, USA) was used to analyse the data. The differences in the scores between pre- and post-intervention time in the Tai Chi groups on standardised outcome instruments were compared by using an univariate analysis of variances (two-tailed, a = .05). The magnitude of treatment-related effects was determined using Cohen's *d*-effect size for *t*-test (Cohen, 1988). Age and gender as confounding factors were controlled in the analyses.

Results

Table 1 presents a summary of the characteristics of Tai Chi group participants relating to age, gender, cardiac disease history, medication use, exercise level and comorbidity. As Table 1 demonstrates, among the 41 Tai Chi group participants who completed the Tai Chi programme, 51.7 are men. The age ranged from 51 to 91 in Tai Chi group, with the mean age of 69. Other than Tai Chi activity, participants also undertook other exercise activities at moderate levels for two hours per day, and two to three hours per day at light activity level per day. All participants in Tai Chi group participants took for six months Tai Chi exercise.

Table 2 presents a summary of the comparative results in pre-intervention and post-intervention time in HRQoL, psychological distress and physiological outcomes in participants in the Tai Chi group. First, HRQoL outcomes differed statistically between pre-intervention and

Table 1. Characteristics of heart-failure patients who participated in Tai Chi exercise.

Variables	Pre-intervention
Number (%) of men	21 (51.7)
Number (%) according to race	
Caucasian	41 (100%)
Asian	0
Age *M* (Range)	69 (51–91)
Cardiovascular disease duration and medication length (months)	142 (67–360)
Medication use	41 (100)
Medical history	
Current smoker	0 (0)
Diabetes	2 (6.90)
Hypertension	9 (31.00)
Cancer	3 (10.30)
Depression	4 (13.80)
Asthma	3 (10.30)
Exercise hours per day	
Vigorous median (range)*	0.37 (0–5.00)
Moderate median (range)*	2.00 (0–9.00)
Light median (range)*	2.00 (0–6.00)
Sitting *M* (SD)	5.02 (4.62)
Sleeping *M* (SD)	8.04 (1.91)

*Data in median are presented when the data are not normally distributed.

post-intervention time. A univariate analysis of variance test revealed Tai Chi participants in the post-intervention time showed a much higher score in role-physical, BP, GH, VT and SF than did those in the pre-intervention time. These differences were statistically significant on each measure. A medium to large effect size difference on all eight SF-12 subscales was registered, with the exception for MH (see Table 2).

Moreover, each SF-12 subscale showed clinically relevant differences of more than five points (again with the exception of for the MH subscale and mental summary scores) between the two times. Post-intervention time Tai Chi participants had three components of HRQoL below the Australian national average, whereas pre-intervention time they had seven components of HRQoL below the Australian national average.

Comparison of the differences in the psychological health between the pre- and post-intervention time revealed small to medium magnitude differences in symptoms of psychological distress (mean *d*'s between 0.20 and 0.60, see Table 2). As shown in Table 2, the psychological distress assessment demonstrated marked inadequate coping, life dissatisfaction and overall psychological distress in pre-intervention time compared to post-intervention.

Table 3 presents a comparison in resilience between pre- and post-intervention times. Participants at post-intervention had higher resilience scores across six subscales with small to medium magnitude effects (*d*'s between 0.19 and 0.65) compared to pre-intervention. Statistically significant differences were only found in self-efficacy and self-esteem, with a *p*-value of less than 0.01.

As indicated in Table 4, Tai Chi participants in the post-intervention time had a much lower BMI and waist circumference than they did in the pre-intervention time, with a 4.5 points difference (mean effect size $d = 0.73$) for BMI and a difference of 14.12 points for waist circumference (large effect size $d = 1.13$). The Tai Chi participants in the post-intervention time had close to average BMI in the normal level (24.64 ± 4.43), while they had a mean BMI of 29.14 (standard deviation is 7.87) in the pre-intervention time, which is in the overweight-to-obese level. The central obesity as measured by waist circumference had close to average waist circumference level (92 ± 13.73 cm, female; 91.17 ± 10.47 cm, male) in the post-intervention time, while the participants had a mean waist circumference of 105.59 ± 13.99 cm (99 ± 14.07 cm, female; 107 ± 13.54 cm, male) in the pre-intervention time. A considerable proportion of participants in the pre-intervention time were overweight and obese (77.1%) as compared with the post-intervention time (44.8%). The

Table 2. Comparisons between pre- and post-intervention in the Tai Chi group in quality of life, psychological distress, body mass index and blood pressure.

		Pre-intervention	Post-intervention	*p*	Mean difference	*d**	Australia standard†
Psycho distress	Somatic complaints	5.22 (3.34)	4.16 (3.10)	0.16	1.06	0.33	
	Inadequate coping	**1.14 (1.90)**	**0.32 (0.82)**	0.02	0.81	0.60	
	Depression	**1.28 (1.75)**	**0.81 (1.27)**	0.19	0.47	0.30	
	Dissatisfaction with life	**0.94 (1.58)**	**0.35 (1.01)**	0.06	0.59	0.46	
	Social dysfunction	**0.11 (0.46)**	**0.05 (0.23)**	0.51	0.06	0.17	
	Total GHQ30	8.69 (7.20)	5.70 (5.08)	0.04	2.99	0.49	
Quality of life	Physical functioning	68.42 (31.67)	82.35 (26.17)	0.12	13.93	0.48	88.6–88.8
	Role-physical	65.55 (29.58)	88.24 (22.30)	0.01	22.69	0.88	84.8–85.6
	Bodily pain	55.12 (21.81)	67.06 (17.24)	0.05	11.94	0.61	79.2–80.4
	General health	50.00 (22.36)	75.00 (15.31)	0.00	25.00	1.33	71.7–76.3
	Vitality	45.12 (25.75)	60.88 (22.59)	0.05	15.76	0.59	62.8–63.5
	Social functioning	78.13 (25.44)	94.12 (18.81)	0.02	15.99	0.72	83.7–86.3
	Role-emotion	80.49 (26.08)	91.91 (13.93)	0.09	11.42	0.57	79.7–84.5
	Mental health	55.18 (12.49)	55.15 (9.94)	0.99	−0.04	0.003	72.8–74.4
	Physical summary score	58.52 (21.75)	78.16 (18.29)	0.00	19.64	0.98	
	Mental summary score	64.25 (12.02)	68.01 (5.58)	0.22	3.76	0.43	

Notes: Figures in bold in table are transformed due to non-normal distribution of the data. Age and gender as confounding factors were controlled in the analyses.
**d* refers to effect size.
†Australian Bureau of Statistics, 1997; significant result: $p < 0.05$.

Table 3. Comparisons between pre- and post-intervention in the Tai Chi group for the resilience scale.

	Pre-intervention	Post-intervention	p	Mean difference	Effect size
Family relationship	38.61 (8.94)	41.05 (7.45)	0.21	2.44	0.29
Self-efficacy	31.64 (6.86)	35.19 (4.32)	0.01	3.55	0.63
Social skills	35.78 (7.52)	37.78 (6.30)	0.23	2.00	0.29
Friend support	34.61 (7.00)	36.70 (4.67)	0.14	2.09	0.36
Planning and goal aspiration	14.14 (6.96)	14.95 (1.86)	0.50	0.81	0.19
Self-esteem	14.17 (2.56)	15.51 (1.61)	0.01	1.35	0.65

Significant result: $p < 0.05$.

former were close to the national standard (54–83% of Australians are overweight and obese) [27], and the latter had a lower than average rate of being overweight or obese. The participants in the post-intervention time also had a much lower SBP than did that in the pre-intervention time (128.44 ±14.55 vs. 135.34 ±15.06 mmHg, post-intervention vs. pre-intervention, $p = 0.05$, $d = 0.47$). However, there was no significant difference in DBP between the pre- and post-intervention (75.91 ± 9.93 vs. 75.60 ± 6.67 mmHg, post-intervention vs. pre-intervention, $p = 0.93$, $d = 0.04$).

In summary, as there were significant differences pre- and post-intervention in Tai Chi participants in HRQoL, psychological health, resilience, blood pressure and BMI, the research hypothesis was supported.

Discussion

This study revealed clinically significant differences pre- and post-intervention in Tai Chi participants in regards to the role physical health plays (role-physical), BP, GH, VT and SF of HRQoL. All participants with heart failure in the Tai Chi group reported clinically meaningful higher scores in HRQoL in the post-intervention time, although the degree of difference varied across the components of HRQoL. They had higher score in GH, BP, role-physical and SF, as compared to pre-intervention time. These results are consistent with the findings of previous studies on heart-failure patients that demonstrated a significant improvement in quality of life (Yeh et al., 2007). Although the current study used the SF-12 to measure general quality of life, its constructs correlate with the Minnesota Living with Heart Failure Questionnaire used in previous studies (Yeh et al., 2008; Yeh et al., 2004). The improvement in the HRQoL in the current study suggests that Tai Chi has positive effects on the overall well-being of heart-failure patients.

Clinically significant differences pre- and post-intervention in Tai Chi participants in blood pressure and BMI were also observed. These are the first Australian findings to demonstrate that Tai Chi may be an effective adjunct of secondary prevention in treating chronic heart failure at community level. Lower blood pressure in the Tai Chi group in post-intervention time than the pre-intervention time indicate that Tai Chi is effective in reducing blood pressure in CVD patients. This supports results reported for chronic heart-failure patients who received Tai Chi intervention in previous studies. These studies have also reported a significant reduction of high-level SBP after eight weeks (Channer et al., 1996) or 12 weeks (Yeh et al., 2004) of Tai Chi exercise. There are no studies that have reported significant improvement in BMI and waist circumference. The significant improvement of BMI and waist circumference in the present study may be because Tai Chi is an activity that requires routine and regular exercise, and long-term training for the effects on BMI and central obesity to be significant. The significant reduction of blood pressure, BMI and waist circumference in heart-failure patients may be present because Tai Chi training can improve metabolic functioning by influencing insulin sensitivity, the partitioning of fuels towards oxidation rather than storage (Tsatsoulis & Fountoulakis, 2006).

All participants in the Tai Chi group in the post-intervention time reported meaningful lower scores in psychological distress and higher resilience scores than did in the pre-intervention time. Patients in the Tai Chi group reported medium magnitude differences in functioning ability, satisfaction of life and overall psychological distress between pre-intervention and post-intervention time. Further, they all demonstrated a higher level of self-efficacy and self-esteem of resilience than did in the pre-intervention time. This is consistent with previous studies demonstrating the health benefits of Tai Chi in reducing

Table 4. Comparisons between pre- and post-intervention in the Tai Chi group for BMI and psychological distress.

	Pre-intervention $N = 41$	Post-intervention $N = 41$	p	Effect size
Body mass index	29.44(6.16)	26.09 (5.32)	0.03	0.58
SBP (mmHg)	135.00 (15.06)	128.00 (14.55)	0.05	0.47
DBP (mmHg)	75.91 (9.93)	75.60 (6.67)	0.93	0.04
Waist circumstance (cm)	105.59 (13.99)	91.47 (11.07)	0.003	1.13
Female ($n = 11$)	99.30 (14.07)	92 (13.73)	0.01	0.51
Male ($n = 30$)	107.68 (13.54)	91.17 (10.47)	0.001	1.38

Significant result: $p < 0.05$.

depression and anxiety and promoting self-efficacy and self-esteem of resilience (Brown et al., 1995; Wang, Collet, & Lau, 2004). The high level of self-esteem and self-efficacy generated by Tai Chi practice may be attributable to the supportive and non-judgemental environment in which Tai Chi is practiced, which can enhance feelings of resilience and increase the patient's desire to engage in regular and long-term practice to manage their chronic condition. The primary effect of Tai Chi on psychological health and resilience may be due to it's capacity to stimulate the neural system by (1) influencing increased grey-matter density in the hippocampus, known to be important for learning, memory and the regulation of emotions (Hölzel et al., 2011); (2) decreasing grey-matter density in the amygdale, known to be important in reducing stress and anxiety; (3) establishing more neural connections involving the anterior cingulate, a brain area related to the regulation of emotions and behaviour (Tang, Lu, Fan, Yang, & Posner, 2012) and (4) increasing connections in the cerebella, which is known to be important for balance and flexibility of body movements (Hölzel et al., 2011).

The significant differences between pre-intervention and post-intervention time in psychological distress, BMI, SBP and quality of life measured by SF-12 may be due to the benefits of long-term and regular exercise in Tai Chi in preventing or ameliorating the metabolic and psychological comorbidities induced by heart failure. Although Tai Chi group participants had moderate exercise two hours per day, which exceeded the required exercise standard in Australia, Tai Chi added more health benefits than conventional forms of exercises. Findings in this study suggest that the integrated psychological and physiological benefits of Tai Chi could be due to the effects of regular and long-term practice of this form of exercise (Jin, 1992), and produce additional effects and health benefits that exceed those resulting from other forms of exercise practised by participants, for example, walking.

This study's limitations are as follows: first, there was no control group that making it unclear how much change had occurred in control group of patients over the last six months in the outcome measures; another limitation is the study was not able to obtain data in examining the neural response to Tai Chi exercise, so it is not clear the differences between pre- and post-intervention times in psychological health and resilience were due to Tai Chi exercise's effect on stimulating neural system. Despite these limitations, the study identified significant differences pre- and post-intervention on physiological measures including blood pressure, BMI, blood pressure, and waist circumference. It is also the first study to explore the benefit of Tai Chi on health in heart-failure patients in Australia.

In conclusion, this study found that there were significant difference pre- and post-intervention on quality of life, resilience, MH and physical health in heart-failure patients. This is exemplified by lower BMI (in normal range), comparable SBP and higher quality of life as compared to the pre-intervention time in heart-failure patients. Findings of the study suggest that the integrated physiological and psychological benefits of Tai Chi could be due to the effect of regular and long-term practice of this form of exercise. A follow-up study is planned that will use randomised control trial to confirm the effects of Tai Chi on promoting cardiovascular disease patient's health. This will inform effective early prevention and intervention programme development to reduce the prevalence of chronic cardiovascular diseases at community and population levels.

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