Jing Sun* and Nicholas Buys

A comparison between a Tai Chi programme and usual medical care programme chronic cardiac participants in quality of life, psychological health, resilience, blood pressure, and body mass index

Abstract

Background: There is increasing evidence that cardiovascular disease (CVD) is linked to a number of psychosocial risk factors and biophysiological risk factors such as metabolic syndrome. The development of effective therapeutic interventions for CVD patients, such as Tai Chi practice, to modify high-risk lifestyles and behaviours and reduce psychosocial and biophysiological risk factors, is a promising primary healthcare approach. This study compared Tai Chi programme CVD participants with CVD patients who did not participate in the Tai Chi programme as the control group 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, psychological distress and resilience, body mass index (BMI), systolic blood pressure, and diastolic blood pressure were measured.

Methods: In 2012, a case-control study was conducted to compare a group of CVD patients participating in a community based meditation intervention programme with CVD patients who did not participate in the programme. Measures included the Short-Form 12 Health Survey (SF-12), General Health Questionnaire (GHQ30), Resilience Scale, BMI, and blood pressure. Univariate analysis of variance was used to compare the difference between participants with cardiac chronic diseases who had taken part in 2 years regular Tai Chi and cardiac patients who did not participate in the Tai Chi programme.

Results: Outcomes differed in significance and magnitude across four HRQoL measures, psychological distress, and resilience. The Tai Chi group also showed fewer incidences of being overweight or suffering from obesity and psychological distress.

Conclusions: Regular and more than 2 years meditation exercises had a beneficial effect on HRQoL, reducing psychological distress, promoting resilience, managing and

taking an active role in managing health condition, and reducing BMI and blood pressure level in CVD patients.

Keywords: blood pressure; body mass index; mind-body meditation approach; psychological health; quality of life; resilience; Tai Chi.

***Corresponding author: Jing Sun**, School of Public Health and Griffith Health Institute, Griffith University, Queensland 4222, Australia, E-mail: j.sun@griffith.edu.au

Nicholas Buys: School of Human Services and Social Work, and Griffith Health Institute, Griffith University, Queensland, Australia

Introduction

Although advances in medical technology have resulted in the increased survival of patients with severe cardiovascular disease (CVD) [1], this condition continues to be the leading cause of mortality in Australia [2]. Approximately 3.5 million Australian adults are currently diagnosed with some form of CVD, and CVD accounted for 34% of all deaths in 2008 [2]. CVD is generally classified into different types, including hypertension, coronary heart disease, and congestive heart failure. Compared with their healthy counterparts, patients with these chronic conditions require life-long secondary prevention or medical care, and are at high risk of experiencing decreased health-related quality of life (HRQoL) and increased psychosocial distress[3].

There is increasing evidence that CVD is linked to a number of psychosocial risk factors including depression and anxiety, a decreased level of quality of life and low resilience [4], and biophysiological risk factors such as metabolic syndrome [5]. 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

individual components of CVD such as myocardial infarction, coronary artery disease, heart failure and stroke [6–8]. Depression, anxiety, and metabolic syndrome have been linked to increased risk of cardiovascular morbidity and mortality [9, 10]. Treatment of CVD may be less effective if the above risk factors are ignored because patients are less likely to comply with medication recommendations [11], and are also less likely to adhere to rehabilitation programmes [12]. In this context, the development of effective therapeutic interventions for CVD patients, both in terms of modifying high-risk lifestyles and behaviours and reducing psychosocial and biophysiological risk factors, remains a challenge.

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 [13], which may have beneficial effects on metabolic syndrome in terms of reducing high blood pressure and obesity level.

Current methods of managing CVD include pharmacotherapy [14] and equipment-based (e.g., treadmill) exercise training programmes [15]. However, both of these interventions have disadvantages. Pharmacotherapy has side effects and is expensive for participants with low incomes [14], and exercise training programmes have a very low participation rate, with only 20%–27% of patients accessing such programmes [15, 16]. There is increasing evidence that forms of mind-body meditative exercise practiced in China, such as Tai Chi, are beneficial in the management of CVD. These benefits are not limited to the primary and secondary prevention of CVD, and extend to the management of symptoms, modification of risk factors, and the regression of atherosclerotic plaques in diseased arteries [17–21]. Therefore, the introduction or integration of activities such as meditative Tai Chi into treatment programmes for CVD 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. Three studies have specifically studied Tai Chi in patients with CVD [17, 20, 21]. It was found that Tai Chi had both physiological and psychological benefits because it lowered blood pressure [17], increased exercise capacity [21], and improved

B-type natriuretic peptide levels, disease-specific quality of life [21], and quality of sleep [22]. Tai Chi also appears to have greater compliance than other types of exercise and is complementary to conventional secondary prevention methods.

Despite the potential of Tai Chi to manage conditions such as CVD, there have been few studies examining its potential to improve health outcomes in CVD in Australia. This study therefore aimed to examine the effects of Tai Chi exercise on health outcomes by comparing a group of patients with cardiovascular conditions who participated in a community based Tai Chi programme with a control group undertaking a usual medical care programme. It was hypothesised that participants in Tai Chi would 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 than participants who did not participate in the community based Tai Chi programme.

Methods

Design and procedure

To address the study aim, a case-control study design was used to assess the differences in health-related quality of life and psychological symptoms between chronic CVD patients with 2–5 years' Tai Chi exercise practice and a group of chronic CVD patients who were receiving conventional medical care. The medical care was delivered through the Gold Coast Hospital, located on the Gold Coast, in Queensland, Australia. The benefit of using a case-control study design lies in its reduced incidence of errors and bias in health outcomes, which the potentially large attrition rate resulting from long-term follow-up of patients can produce. Therefore, data were only collected once in December 2012, the time after both Tai Chi group participants and control group patients were admitted to hospital when they had cardiac events for 2 years. The difference between the two groups is that Tai Chi group participants took part in the Tai Chi program for 2 years since 2010, and control group participants did not participate in the Tai Chi program and had only received usual medical care for at least 2 years since 2010. Informed consent was obtained for participation in the study. The study protocol was approved by the Griffith University Ethics Committee.

This study was conducted in 2012 through Griffith University. Participants who participated in the Tai Chi meditative program at the Gold Coast Hospital and CVD patients who visited the Department of Cardiology at the Gold Coast Hospital in 2010 were invited to participate in the study. The inclusion criteria for both Tai Chi and control group participants included those who reported one or more physician-diagnosed CVD conditions including coronary heart disease or heart failure, and/or comorbidity with diabetes and depression. People 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 and dependence. Their self-reported CVD events were verified by checking hospital and medical records for 50% of the participants for each group. The confirmation rate was 95%. All participants, including those with chronic conditions, received their usual medical care, including regular health checks and medication use, during the study period.

Tai Chi group participants were asked to fill in a survey at home and bring it back to their class 2 weeks after they received the survey. Control group participants were asked to bring the questionnaire to a rehabilitation centre at the Gold Coast Hospital within 2 weeks of when they received the survey.

Study participants

During the data collection period, among 310 participants who participated in the Tai Chi program, 29 CVD patients who had been practising Tai Chi for more than 2 years were recruited at the Gold Coast Hospital. A group of 45 patients who met the inclusion criteria of having chronic cardiovascular conditions were recruited from the Department of Cardiology at the Gold Coast Hospital. These chronic disease patients had not participated in the Tai Chi program and had been doing usual activity for at least 2 years. This group was recruited as a comparison group. Inclusion of participants in the Tai Chi group included those patients who had been participating in a Tai Chi class at least 1 h/session, twice a week, for more than 2 years. The class was taught by a professionally trained Tai Chi instructor with 40 years' experience. Participants were taught a variety of meditation techniques including breathing, balance, flexibility, concentration, calming, and stress reduction techniques.

Outcome measures

Three standard assessment instruments were administered to both Tai Chi and control 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 [23]. The physical health concept of the SF-12 encompasses (i) physical functioning (PF); (ii) role limitations due to physical health problems (RP); (iii) bodily pain (BP); and (iv) general health (GH) perception. The mental health concept includes (i) vitality/fatigue (VT); (ii) social functioning (SF); (iii) role limitation due to emotional problems (RE); and (iv) mental health (MH) status. Physical and mental summary scores are provided based on the physical health concepts (PF, RP, BP, GH) and mental health concepts (VT, SF, RE, SF).
2. The General Health Questionnaire (GHQ30) [24, 25] 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 Cronbach's α of 0.92.

3. The Resilience Scale [26, 27] 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.

BMI, systolic blood pressure (SBP), and diastolic blood pressure (DBP) were measured during the interview when the surveys were distributed in Tai Chi classes or in cardiac clinics when patients attended usual health checks in the rehabilitation centre. Height was measured in centimetres (cm) and weight was measured in kilograms (kg). SBP and DBP were measured using an electronic blood pressure device. According to the Australian Bureau of Statistics [28], 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 the Tai Chi and control groups on standardised outcome instruments were compared by using a univariate analysis of variance (ANOVA, two-tailed, $\alpha=0.05$). The magnitude of treatment-related effects was determined using Cohen's *d*-effect size for *t*-test [29]. Age and gender as confounding factors were controlled in the analyses.

Results

Table 1 presents a summary of the characteristics of Tai Chi and comparison group participants relating to age, gender, cardiac disease history, medication use, exercise level, and comorbidity. As demonstrated in Table 1, there are no statistically significant differences in length of cardiac disease history since it was diagnosed, medication use, comorbidity of diseases including diabetes, hypertension, cancer, depression, and asthma, and exercise level. Among the Tai Chi group participants, 51.7 are men, and in the control group 75.6% are men. The age ranged from 51 to 91 years in the Tai Chi group, and 38–78 years in the control group, with a mean age of 69 years and 64 years, respectively. Both Tai Chi and control group participants exercised at a moderate level for 2 h/day, and 2–3 h/day at a light activity level. All participants in both Tai Chi and control groups took part for approximately 11 years. As age and proportion of gender in Tai Chi and control groups are different, these two variables were controlled in the follow-up ANOVAs (see Tables 2 and 3).

Table 2 presents a summary of the comparative results for the Tai Chi and control groups in HRQoL, psychological

Table 1 Characteristics of cardiac disease participants according to allocation to Tai Chi and control groups.

After 2 years intervention	Tai Chi group	Control group	t-Value or χ^2	p-Value
No. of men (%)	15 (51.7)	34 (75.6)	4.48	0.03
No. according to race (%)				
Caucasian	29 (100)	44 (97.8)		
Asian	0	1 (2.2)		
Age M (range)	69 (51–91)	64 (38–78)	2.54	0.01
Cardiovascular disease duration and medication length	141.7 (67.76)	138.84 (58.37)	0.07	0.94
Medication use	29 (100)	45(100)		
Medical history				
Current smoker	0 (0)	5 (11.10)	3.46	0.15
Diabetes	2 (6.90)	6 (13.6)	1.86	0.39
Hypertension	9 (31.00)	15 (33.30)	1.16	0.56
Cancer	3 (10.30)	6 (13.30)	0.42	0.81
Depression	4 (13.80)	5 (11.10)	0.23	0.89
Asthma	3 (10.30)	8 (17.8)	0.84	0.66
Exercise, h/day				
Vigorous median (range) ^a	0.37 (0–5.00)	0 (0–5.0)	0.70	0.49
Moderate median (range) ^a	2.00 (0–9.00)	2.00 (0–2.00)	–0.25	0.80
Light median (range) ^a	2.00 (0–6.00)	3.00 (0–11.00)	0.36	0.72
Sitting M (SD)	5.02 (4.62)	4.40 (2.53)	0.74	0.46
Sleeping M (SD)	8.04 (1.91)	7.14 (2.05)	1.88	0.06

^aData in median are presented when the data are not normally distributed.

distress, and physiological outcomes. First, HRQoL outcomes differed statistically between the Tai Chi and control groups. A univariate ANOVA revealed statistically significant differences in role-physical, bodily pain, general health, vitality, and social functioning. A medium to large effect size difference on all eight SF-12 subscales

Table 2 Comparisons between the Tai Chi group and the control group in quality of life, psychological distress, body mass index, and blood pressure^a.

		Tai Chi Mean (SD) n=28	Control Mean (SD) n=42	F-value	p-Value ^b	Mean difference	d ^c	Australia standard ^d
Psycho distress	Somatic complaints	4.16 (3.10)	5.22 (3.34)	–1.41	0.16	–1.06	0.33	
	Inadequate coping	0.32 (0.82)	1.14 (1.90)	–2.39	0.02	–0.81	0.60	
	Depression	0.81 (1.27)	1.28 (1.75)	–1.31	0.19	–0.47	0.30	
	Dissatisfaction with life	0.35 (1.01)	0.94 (1.58)	–1.91	0.06	–0.59	0.46	
	Social dysfunction	0.05 (0.23)	0.11 (0.46)	–0.67	0.51	–0.06	0.17	
	Total GHQ30	5.70 (5.08)	8.69 (7.20)	–2.06	0.04	–2.99	0.49	
Quality of life	Physical functioning	82.35 (26.17)	68.42 (31.67)	1.59	0.12	13.93	0.48	88.6–88.8
	Role-physical	88.24 (22.30)	65.55 (29.58)	2.84	0.01	22.69	0.88	84.8–85.6
	Bodily pain	67.06 (17.24)	55.12 (21.81)	2.01	0.05	11.94	0.61	79.2–80.4
	General health	75.00 (15.31)	50.00 (22.36)	4.21	0.00	25.00	1.33	71.7–76.3
	Vitality	60.88 (22.59)	45.12 (25.75)	–1.98	0.05	15.76	0.59	62.8–63.5
	Social functioning	94.12 (18.81)	78.13 (25.44)	2.33	0.02	15.99	0.72	83.7–86.3
	Role-emotion	91.91 (13.93)	80.49 (26.08)	1.70	0.09	11.42	0.57	79.7–84.5
	Mental health	55.15 (9.94)	55.18 (12.49)	–0.01	0.99	–0.04	0.003	72.8–74.4
	Physical summary score	78.16 (18.29)	58.52 (21.75)	3.27	0.00	19.64	0.98	
	Mental summary score	68.01 (5.58)	64.25 (12.02)	1.23	0.22	3.76	0.43	
	Body mass index	24.64 (4.43)	29.14 (7.87)	–3.888	<0.001	–4.50257	0.73	
	Systolic blood pressure	125.44 (15.17)	135.34 (15.51)	–2.779	0.01	–9.90029	0.64	
Physiological effect	Diastolic blood pressure	73.97 (8.00)	75.80 (10.05)	–0.861	0.392	–1.83429	0.20	

^aData in bold are transformed due to non-normal distribution of the data. Age and gender as confounding factors were controlled in the analyses. ^bSignificant result: $p < 0.05$. ^cd refers to effect size. ^dAustralian Bureau of Statistics, 1997.

Table 3 Comparisons between the Tai Chi group and the control group for the Resilience Scale^a.

	Tai Chi Mean (SD) n=28	Control Mean (SD) n=42	F-value	p-Value ^b	Mean difference	Effect size
1. Family relationship	41.05 (7.45)	38.61 (8.94)	1.27	0.21	2.44	0.29
2. Self-efficacy	35.19 (4.32)	31.64 (6.86)	2.65	0.01	3.55	0.63
3. Social skills	37.78 (6.30)	35.78 (7.52)	1.22	0.23	2.00	0.29
4. Friend support	36.70 (4.67)	34.61 (7.00)	1.50	0.14	2.09	0.36
5. Planning and goal aspiration	14.95 (1.86)	14.14 (6.96)	0.68	0.50	0.81	0.19
6. Self-esteem	15.51 (1.61)	14.17 (2.56)	2.70	0.01	1.35	0.65

^aAge and gender as confounding factors were controlled in the analyses. ^bSignificant result: $p < 0.05$.

was registered, with the exception of mental health (see Table 2), with Tai Chi participants having higher scores. Moreover, each SF-12 subscale showed clinically relevant differences of more than five points (again with the exception of the mental health subscale and mental summary scores) between the groups. Tai Chi group participants had three components of HRQoL below the Australian national average, whereas control group participants had seven components of HRQoL below the Australian national average. Participants in the Tai Chi group showed a much higher score in role-physical, bodily pain, general health, and social functioning than did those in the control group, and they had a lower vitality score than did the control group participants.

Comparison of the differences in the GHQ30 between the Tai Chi and control groups revealed small to medium magnitude differences in symptoms of psychological distress (mean d values between 0.20 and 0.60, see Table 2). As shown in Table 2, psychological distress assessment demonstrated marked functional limitations, life dissatisfaction, and psychological morbidity in control group participants as compared with participants in the Tai Chi group.

Tai Chi group participants had a much lower BMI than did control group participants, with a 4.5 point difference (mean effect size $d = 0.73$). Tai Chi participants had average BMI in the normal level (24.64 ± 4.43), whereas control participants had a mean BMI of 29.14 (standard deviation is 7.87), which is in the overweight to obese level. A considerable proportion of control group participants were overweight and obese (77.1%, see Table 3) as compared with the Tai Chi group (44.8%, see Table 3). The 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. Tai Chi participants also had a much lower SBP than did control group participants (125.44 ± 15.17 vs. 135.34 ± 15.51 mm Hg,

Tai Chi vs. control groups, $p = 0.007$, $d = 0.63$). However, there was no significant difference in DBP between the groups (73.97 ± 8.00 vs. 75.80 ± 10.05 mm Hg, Tai Chi vs. control groups, $p = 0.39$, $d = 0.20$).

Table 3 presents a comparison in resilience between participants in the two groups. Significant differences were found in self-efficacy and self-esteem, with a $p < 0.01$. Tai Chi participants had higher resilience scores across six subscales with small to medium magnitude effects (d values between 0.19 and 0.65).

Table 4 shows that there were further significant differences between Tai Chi group and control group participants in the percentage of people having clinical level BMI scores and psychological distress. Specifically, 33.3% ($n = 10$) of control group participants, as compared with 13.7% ($n = 4$) of Tai Chi group participants, had clinical level psychological distress using a cut-off score of 13 [24]. Moreover, significantly less people in the Tai Chi group were overweight (24.1%) or obese (20.7%) when compared with control group participants (34.3% and 42.9%, respectively).

In summary, as there were significant differences between participants in Tai Chi and control groups with regard to health-related quality of life, psychological health, resilience, blood pressure, and BMI, the research hypothesis is accepted for this study.

Discussion

This study revealed significant differences between participants in Tai Chi and control groups with regard to role-physical, bodily pain, general health, vitality and social functioning, and psychological distress. These results are consistent with the findings of previous studies on chronic CVD patients [22].

Table 4 Comparisons between the Tai Chi group and the control group for BMI and psychological distress.

	Tai Chi group n=28 n (%)	Control group n=42 n (%)	χ^2	p-Value ^a
Body mass index				
Normal	15 (55.2)	9 (22.9)	9.14	0.01
Overweight	7 (24.1)	14 (34.3)		
Obese	6 (20.7)	18 (42.9)		
Psychological distress				
Normal	29 (87.9)	21 (67.7)	5.38	0.06
Abnormal	4 (12.1)	10 (32.3)		

^aSignificant result: $p < 0.05$.

All participants with chronic CVD in the Tai Chi group reported clinically meaningful higher scores in HRQoL, although the degree of difference varied across the components of HRQoL. They had higher scores in general health, bodily pain, role-physical, and social functioning, as compared with control group participants.

There were significant differences between Tai Chi and control group participants in blood pressure and BMI. These are the first Australian findings to demonstrate that Tai Chi may be an effective adjunct of secondary prevention in treating chronic CVD at the community level. Lower blood pressure in the Tai Chi group than the CVD control group indicates that Tai Chi is effective in reducing blood pressure in CVD patients, and this result is consistent with results reported for cardiovascular patients who received Tai Chi intervention at clinics [20].

All participants in the Tai Chi group reported meaningful lower scores in psychological distress and higher resilience scores than did control group participants. Patients in the Tai Chi group reported medium magnitude differences in functioning ability, satisfaction of life, and overall psychological distress. Further, they all demonstrated a higher level of self-efficacy and self-esteem of resilience than did those in the control group. This is consistent with previous studies demonstrating the health benefits of Tai Chi in reducing depression and anxiety and promoting self-efficacy and self-esteem of resilience [30, 31]. 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 significant differences between the two groups in psychological distress, BMI, SBP, and quality of life

measured by SF-12 may be due to the benefits of regular exercise in Tai Chi in preventing or ameliorating the metabolic and psychological comorbidities induced by CVD. Although both Tai Chi group participants and control group participants had moderate exercise (2 h/day), which had exceeded the required exercise standard in Australia, and control group participants had regular exercise, such as walking or jogging, Tai Chi adds more health benefits than conventional forms of exercise.

The primary effect of Tai Chi on psychological health and resilience may be due to the training capacity of Tai Chi to stimulate the neural system by: (i) influencing increased grey matter density in the hippocampus, known to be important for learning, memory, and the regulation of emotions [32]; (ii) decreasing grey matter density in the amygdale, known to be important in reducing stress and anxiety; (iii) establishing more neural connections involving the anterior cingulate, which is a brain area related to the regulation of emotions and behaviour [33]; and (iv) increasing connections in the cerebella, which is known to be important for balance and flexibility of body movements [32]. Finally, Tai Chi training can improve metabolic function by influencing insulin sensitivity and the partitioning of fuels towards oxidation rather than storage [34], and by raising the heart rate [35]. This suggests that the integrated psychological and physiological benefits of Tai Chi could be due to the effect of regular and long-term practice of this form of exercise [36], and it produces additional effects and health benefits more than what participants had been exercising, for example, walking.

The limitations of this study are: firstly, there was no baseline assessment in resilience and mental health, thus making it unclear how much change had occurred in both groups of patients over the past 2–5 years in the two measures. Secondly, the study was unable to obtain data in examining the neural response to Tai Chi exercise, thus it is not clear if differences between the Tai Chi group and the control group in psychological health and resilience are due to the effect of Tai Chi exercise on stimulating the neural system. Despite these limitations, the study ensured that there was no difference in physiological measures including blood pressure and BMI between the two groups based on medical records, and furthermore this study is the first to explore the long-term benefit of Tai Chi on health in chronic cardiac patients in Australia.

In conclusion, this study found that there were significant differences between Tai Chi CVD participants and control group CVD patients. This is exemplified by lower BMI (in normal range), comparable SBP, and higher

quality of life in the Tai Chi group as compared with cardiac patients who had not undertaken Tai Chi exercise. 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. Further research will use a randomised control trial to confirm the effects of Tai Chi on promoting the health

of cardiovascular disease patients and to inform effective early prevention and intervention program development so that the prevalence of chronic CVDs at the community and population level can be reduced.

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