The American Journal of Chinese Medicine, Vol. 40, No. 2, 255–267

Institute for Advanced Research in Asian Science and Medicine
DOI: 10.1142/S0192415X12500206

A Systematic Review of the Effectiveness of Qigong Exercise in Cardiac Rehabilitation

Cecilia Lai-Wan Chan,* Chong-Wen Wang,*
Rainbow Tin-Hung Ho,* Andy Hau-Yan Ho,* Eric Tat-Chi Ziea,†
Vivian Chi-Woon Taam Wong† and Siu-Man Ng*

**Centre on Behavioral Health*
University of Hong Kong, HKSAR, China

†The Chinese Medicine Department
Hospital Authority, HKSAR, China

Abstract: The objective of this study was to assess evidence for the efficacy and effectiveness of Chinese qigong exercise in rehabilitative programs among cardiac patients. Thirteen databases were searched through to November 2010, and all controlled clinical trials on Chinese qigong exercise among patients with chronic heart diseases were included. For each included study, data was extracted and validity was assessed. Study quality was evaluated and summarized using both the Jadad Scale and the criteria for levels of evidence. Seven randomized controlled trials (RCTs) and one non-randomized controlled clinical trial (CCT) published between 1988 and 2007 met the inclusion criteria. In total, these studies covered 540 patients with various chronic heart diseases including atrial fibrillation, coronary artery disease, myocardial infarct, valve replacement, and ischemic heart disease. Outcome measures emerged in these studies included subjective outcomes such as symptoms and quality of life; and objective outcomes such as blood pressure, ECG findings, and exercise capacity, physical activity, balance, co-ordination, heart rate, and oxygen uptake. Overall, these studies suggest that Chinese qigong exercise seems to be an optimal option for patients with chronic heart diseases who were unable to engage in other forms of physical activity; however, its efficacy and effectiveness in cardiac rehabilitation programs should be further tested.

Keywords: Qigong; Exercise; Cardiac; Heart; Rehabilitation.

Correspondence to: Dr. Chong-Wen Wang, Centre on Behavioral Health, The University of Hong Kong, 5 Sassoon Road, Pokfulam, Hong Kong. Tel: (+852) 2831-5218, Fax: (+852) 2816-6710, E-mail: wangcw@hku.hk

Introduction

Cardiovascular diseases (CVDs) are the leading cause of morbidity and mortality throughout the globe (WHO, 2011). In 2006, they accounted for 34.3% of all deaths in the United States (American Heart Association, 2010). In China, CVDs accounted for one-third of all deaths in 2003 (Xiao and Chen, 2010). Generally, cardiac diseases including coronary artery disease and chronic heart failure are life-threatening conditions needing lifetime secondary prevention measures to decrease morbidity and mortality, as well as to improve quality of life. Moreover, it has been reported that secondary prevention through cardiac rehabilitation is effective for improving functional status, relieving symptoms, and modifying coronary risk factors (Wenger *et al.*, 1995, 1999). Exercise training is the core component of cardiac rehabilitation, which has been demonstrated to yield a range of benefits for patients with chronic heart diseases, including improvements in exercise capacity, left ventricular hemodynamics, health-related quality of life, a decreased risk of hospitalization and death (Belardinelli *et al.*, 1999; Flynn *et al.*, 2009), as well as improvements in various measures of psychological status and functioning (Franklin, 2001; Newton *et al.*, 1991; Pollock *et al.*, 2000).

Qigong, a mind-body integrative exercise, is a form of ancient martial arts that originated in China and is widely practiced to improve physical fitness and enhance overall wellbeing (Vincent *et al.*, 2010). The slow movements synchronized with meditation and regulated breathing are designed to achieve a harmonious flow of energy (qi) in the body. With regular practice and rehearsal of the physical movements as well as the atonement of mind and breath, practitioners can experience greater stress management and emotional control. Long-term practice of qigong exercise may also help to prevent illness, maintain good health, and heal the body from diseases. It is an easily adaptable form of exercise that can be practiced in anyplace, and anytime, without any special equipment. Basically, there are two categories of qigong: internal qigong and external qigong. Internal qigong or qigong exercise is self-directed and involves the use of movements, meditation and control of breathing pattern, whereas external qigong or emitted "qi" is usually performed by a trained practitioner using their hands to direct "qi" energy onto the patient for treatment. The underlying mechanism of its potential effects is different for internal and external qigong. Generally, internal qigong is more commonly practiced.

There are increased reports of the effectiveness of qigong exercise in enhancing individuals' physical health. Several systematic reviews have critically examined the effects of qigong exercise on the risk factors of cardiac diseases including hypertension (Guo *et al.*, 2008; Lee *et al.*, 2007) and diabetes mellitus (Chen *et al.*, 2009; Lee *et al.*, 2009), and demonstrated encouraging evidence for lowing blood pressure. However, no systematic review to date has examined the scientific evidence on the health benefits of qigong exercise for patients with cardiac diseases. Hence, the aim of this systematic review is to examine the overall efficacy and effectiveness of qigong exercise in cardiac rehabilitation programs.

Methods

Data Sources and Search Strategies

The following electronic databases were searched through to November 2010 in this systematic review: the Cochrane Central Register of Controlled Trials (CENTRAL), PubMed/MEDLINE, The Cumulative Index to Nursing and Allied Health Literature (CINAHL), Excerpta Medica Database (Embase), Allied and Complementary Medicine (AMED), Qigong and Energy Medicine Database, China Journals Full-text Database-Medicine/Hygiene Series, China Proceedings of Conference Full-text Database, Chinese Master Theses Full-text Database, China Doctor Dissertations Full-text Database, Electronic Theses and Dissertation System (Taiwan), Taiwan Electronic Periodical Services, and Index to Taiwan Periodical Literature System. The search terms used in this systemic review included: qigong, qi-gong, qi gong, chi chung, chi gong, qi chung, cardiac, heart, coronary, myocardial, and atrial fibrillation. Both traditional and simplified Chinese translations of these terms were used in Chinese databases. No limits were imposed on characteristics of participants, study design, intervention, and language. Reference lists of all located articles such as included studies, existing reviews and other archives were hand-searched for further relevant articles.

Selection of Studies

All controlled clinical trials with cardiac patients who received qigong training alone or combined with other treatments were included. Randomized controlled clinical trials (RCTs) were preferred, but given the limited number of randomized controlled trials in the field, any other studies with a parallel control group were also included to provide alternative evidence. Conference proceedings with an abstract alone were also included but studies with no detailed information were excluded. Any non-controlled studies and studies of the effects of qigong exercise on cardiovascular functions among healthy subjects were excluded to reduce bias. Studies among patients with hypertension or diabetes but no cardiac diseases were also excluded. Cases reporting health benefits of qigong exercise were excluded, but cases reporting on adverse effects of qigong with regards to cardiac symptoms were included to assess the safety of qigong practice among cardiac patients. For all included studies, the primary data from the original sources were reviewed and analyzed.

Data Extraction and Quality Assessment

All available evidence of the health benefits of qigong exercise among patients with cardiac diseases were considered, and the main outcome measures for the current review were perceived symptoms, heart rate, blood pressure, manifestation of electrocardiogram (ECG), and exercise capacity; while the secondary outcome was quality of life. For each included study, data was extracted by one main researcher in duplication and verified by another researcher. Any discrepancies were resolved by discussion. The quality and validity of all included studies were evaluated and summarized using the Jadad Scale (Jadad *et al.*, 1996) based on three criteria: description of randomization and allocation concealment; double-blinding; and patient attrition (the score ranges from 0 to 5), which has been used in previous systematic reviews and is applicable across the range of included study designs. The strength of evidence for all included studies was also evaluated using the criteria for levels of evidence (Oxford Centre for Evidence-based Medicine, 2009). Risk of bias for all included studies, including selection bias, performance bias, detection bias, and attrition bias, was assessed using the framework for methodological quality recommended by Juni *et al.* (2001).

Results

Included Studies

Our searches identified 327 potentially relevant articles, of which 304 articles were excluded because they were: (1) not related to qigong, (2) not a clinical trial, (3) not related to CVDs, (4) related only to external qigong, (5) related only to risk factors of coronary artery diseases such as hypertension and diabetes, and (6) only case reports. Full reports of the remaining 23 citations were acquired and 14 were further excluded due to the fact that they were uncontrolled observational studies ($n = 8$), fully duplicate publications ($n = 3$), and studies with unparallel comparison ($n = 2$). Moreover, one RCT was also excluded because the relevant outcome measures did not meet the criteria of this review (Zhou, 1988).

In sum, seven RCTs (Hu *et al.*, 1987; Liu *et al.*, 1998; Pippa *et al.*, 2007; Qiu *et al.*, 1992; Stenlund *et al.*, 2005; Sun *et al.*, 1988; Wang *et al.*, 1988) and one non-randomized controlled clinical trial (CCT) (Hui *et al.*, 2006) published between 1988 and 2007 met the inclusion criteria of this review. Four of these studies were conducted in mainland China (Hu *et al.*, 1987; Qiu *et al.*, 1992; Sun *et al.*, 1988; Wang *et al.*, 1988), while the remaining three were carried out in Hong Kong (Hui *et al.*, 2006), Sweden (Stenlund *et al.*, 2005), and Italy (Pippa *et al.*, 2007). Of the eight included studies, three were published in peer-review journals in English (Hui *et al.*, 2006; Pippa *et al.*, 2007; Stenlund *et al.*, 2005), four were published in academic journals in Chinese (Hu *et al.*, 1987; Qiu *et al.*, 1992; Sun *et al.*, 1988; Wang *et al.*, 1988), and one was a conference proceeding (Liu *et al.*, 1998).

Outcome measures emerged in these studies included subjective outcomes such as symptoms relevant to heart diseases (Hu *et al.*, 1987; Liu *et al.*, 1998; Qiu *et al.*, 1992; Wang *et al.*, 1988) and quality of life (Hui *et al.*, 2006); and objective outcomes such as blood pressure (Hu *et al.*, 1987; Hui *et al.*, 2006; Liu *et al.*, 1998; Qiu *et al.*, 1992; Wang *et al.*, 1988), ECG (Hu *et al.*, 1987; Liu *et al.*, 1998; Qiu *et al.*, 1992; Wang *et al.*, 1988), exercise capacity (Pippa *et al.*, 2007), estimated level of physical activity, balance, and coordination (Stenlund *et al.*, 2005), as well as heart rate and oxygen uptake (Sun *et al.*, 1988). A summary of the outcome measures of all included studies examined in this systemic review is presented in Table 1.

Table 1. Summary of Both Randomized and Non-Randomized Controlled Clinical Trials of Qigong Exercises Among Patients with Cardiac Diseases

Studies/ Regions	Design	Subjects (Age)	*n*	Intervention (Frequency)	Control	Follow-Up Period	Outcome Measures	Intergroup Difference	Jadad Score	Level of Evidence
(Pippa *et al.*, 2007) Italy	RCT	Inpatient with atrial fibrillation (68 ± 8 yr.)	QG: 22 CG: 21	Qigong (static) exercise (90 min, 2 sessions per week)	Waiting list	16 weeks (32 sessions)	Exercise capacity (6-min walking test)	$p < 0.001$ at the end of training $p = 0.008$ 16 weeks after	3	A (1b)
(Stenlund *et al.*, 2005) Sweden	RCT	Inpatient with CAD (≥ 73 yr.)	QG:48 CG:47	Qigong (dynamic) plus usual care (1 h qigong plus 2 h group discussion)	Usual medical care	3 months (12 groups sessions)	(1) Physical activity (2) One-leg stance test (R) (3) Co-ordination (4) Box-climbing test (R)	(1) $p = 0.011$ (2) $p = 0.029$ (3) $p = 0.021$ (4) $p = 0.035$	2	A (1b)
(Liu *et al.*, 1998) China	RCT	Patients with CAD resulted from hypertension (n.r.)	QG:60 CG:60	Qigong (dynamic) plus drugs (n.r.)	Drugs only	1 year	(1) Symptoms (2) Blood pressure (3) ECG	(1) $p < 0.01$ (2) $p < 0.05$ (3) $p < 0.01$	1	B (3b)
(Qiu *et al.*, 1992) China	RCT	Community older adults with CAD (61.4 ± 7.6 yr.)	QG:22 CG:15	Qigong (dynamic) (3 times per week)	Placebo	12 weeks	(1) Symptoms (2) Blood pressure (3) CM5 ST/HR slope	(1) $p < 0.05$ (2) $p < 0.05$ (3) $p < 0.05$	2	B (2b)
(Sun *et al.*, 1988) China	RCT	Outpatient with cardiovascular disease (64.1 ± 1.4 yr.)	QG:11 CG: 9	Qigong/Tai chi (30 min, 3 times per week)	Treadmill or cycle ergometer	8 weeks	(1) Symptoms (2) Blood pressure (3) Heart rate (4) ECG (5) Oxygen uptake (6) Serum cholesterol	$p > 0.05$ for all tests	1	B (2b)
(Wang *et al.*, 1988) China	RCT	Male with CAD resulted from hypertension (45–66 yr.)	QG:50 CG: 48	Qigong (dynamic) plus drug (30 min, 1–2 times per day)	Drug only	1 year	(1) Symptoms (2) Blood pressure (3) ECG (4) HDL-C	(1) 62.5% vs. 28.1% ($p < 0.01$) (2) 86.0% vs. 64.2% ($p < 0.05$) (3) 52.2% vs. 21.6% ($p < 0.01$) (4) $p < 0.001$	1	B (2b)

Table 1. (*Continued*)

Studies/ Regions	Design	Subjects (Age)	*n*	Intervention (Frequency)	Control	Follow-Up Period	Outcome Measures	Intergroup Difference	Jadad Score	Level of Evidence
(Hu *et al.*, 1987) China	RCT	Outpatient with CAD (40–60 yr.)	QG:31 CG:31	Medical qigong (1 h each day)	Drugs	3 months	(1) Symptoms (2) Blood pressure (3) ECG	(1) $p < 0.01$ (2) $p < 0.01$ (3) $p < 0.01$	1	B (2b)
(Hui *et al.*, 2006) Hong Kong	CCT	Outpatients with different cardiac disease (42–76 yr.)	65 (total)	Qigong (dynamic) (20 min each session)	Progressive relaxation	8 sessions	(1) Blood pressure (2) Quality of life (SF-36, STAI, GHQ)	Progressive relaxation was more effective in reducing BP compared to qigong, whereas qigong group demonstrated greater improvement in psychological measures in addition to reduction in systolic BP	0	B (2b)

Notes: RCT: Randomized controlled trial; CCT: Non-randomized controlled clinical trial; QG: Qigong group; CG: Control group; yr.: Years old; n.r.: Not reported; CAD: Coronary artery disease; R: Right leg; BP: Blood pressure; ECG: Electrocardiogram; CM5 ST/HR slope: CM5 ST segment/heart rate slope; HDL-C: High-density lipoprotein-C; SF-36: 36-item short form Health Survey; STAI: State-Trait Anxiety Inventory; GHQ: General Health Questionnaire.

Sample sizes among the included studies ranged from 20 to 120. In total, this review covered 540 patients with chronic heart diseases such as atrial fibrillation (Pippa *et al.*, 2007), coronary artery disease (Hu *et al.*, 1987; Stenlund *et al.*, 2005; Qiu *et al.*, 1992; Sun *et al.*, 1988), coronary artery disease with comorbid hypertension (Liu *et al.*, 1998; Wang *et al.*, 1988), myocardial infarct, valve replacement, and ischemic heart disease (Hui *et al.*, 2006). Durations of intervention ranged from two to four months for most studies except for two RCTs, which lasted a full year. All of the included studies were conducted with a two-armed parallel group design. Generally, the group with qigong exercise was compared to a waitlist control group or a control group with usual medical treatment, except for two studies where qigong exercise was compared to a conventional form of cardiac rehabilitation exercise (Sun *et al.*, 1988) or progressive relaxation (Hui *et al.*, 2006).

Randomized Clinical Trials

Pippa *et al.* (2007) conducted a RCT to evaluate the effect of rehabilitative Chinese medical qigong training on the functional capacity among patients with chronic atrial fibrillation and preserved left ventricular function. Forty-three patients were randomized either to the intervention group who received two 90-minute sessions of static qigong training per week for 16 weeks ($n = 22$), or to a waitlist control group ($n = 21$). Functional capacity variation was measured using the six-minute walk test at baseline, immediately post-intervention and 16-weeks post-intervention. Compared to the baseline, patients in the qigong group walked an average of 114 meters more (27%) at the end of the intervention ($p < 0.001$) and 57 meters more (13.7%) 16 weeks later ($p = 0.008$). There is no significant variation in function capacity in the control group.

Stenlund *et al.* (2005) carried out an RCT to investigate the effect of a cardiac rehabilitation program combining Chinese qigong with group discussions on physical ability among elderly patients with coronary artery disease in a hospital. One hundred and nine participants were divided randomly into an intervention group ($n = 56$) and a control group with usual medical care only ($n = 53$). Patients in the intervention group met weekly for one hour of qigong exercise (a series of graceful movements) and two hours of group discussion over three months. Physical ability was assessed at baseline and immediately post-intervention. 48 patients in the intervention group and 47 in the control group successfully completed the three months follow-up. Compared to the control group, patients in the intervention group demonstrated a significant increase in self-estimated level of physical activity ($p = 0.011$), and actual performance in the one-leg stance test for the right leg ($p = 0.029$), coordination ($p = 0.021$) and the box-climbing test for right leg ($p = 0.035$).

Qiu *et al.* (1992) evaluated the effect of qigong exercise on the CM5 ST segment/heart rate (ST/HR) slope in patients with coronary artery disease. Thirty-seven patients were randomized either into an intervention group who received dynamic group qigong training three times per week over 12 weeks ($n = 22$), or a wait-list control group ($n = 15$). CM5 ST/HR slope was measured with a submaximal treadmill graded exercise test at baseline and immediately post-intervention for each participant. Compared to those in the control group, CM5 ST/HR slope was decreased significantly for patients in the intervention group ($p < 0.05$), suggesting that myocardial ischemia had improved.

Liu *et al.* (1988) examined the effects of qigong exercise in patients with coronary artery disease and hypertension. One hundred and twenty patients were divided randomly into an intervention group receiving dynamic qigong training plus routine anti-hypertension drugs ($n = 60$) for one year, and a control group with anti-hypertension drugs only ($n = 60$). Compared to the control, significant improvements were observed in symptoms relevant to the heart disease ($p < 0.01$), blood pressure ($p < 0.05$), and ECG ($p < 0.01$) in the intervention group.

Sun *et al.* (1988) conducted a study to assess the effect of a cardiac rehabilitation program with dynamic qigong exercise. Twenty outpatients with coronary artery disease were randomly divided into two groups who practiced either treadmill-ergometer bicycling exercise ($n = 9$) or qigong-taiji exercise ($n = 11$) for 30 minutes, three times per week over two months. The peak oxygen uptake and the peak heart rate were measured with a graded treadmill test at baseline and immediate post-intervention for each patient. It was found that outcomes had improved significantly for all patients, but no significant difference was observed between the two groups.

Wang *et al.* (1988) also carried out a study to examine the effect of qigong on cardiac function and risk factors for cardiovascular disease in patients with coronary artery disease and hypertension. Ninety-eight patients were divided randomly into an intervention group who received dynamic qigong training plus routine anti-hypertension drugs ($n = 50$) for one year and a control group with anti-hypertension drugs only ($n = 48$). Compared to the control group, significant improvements were observed among patients of the intervention group in symptoms ($p < 0.01$), blood pressure ($p < 0.05$), electrocardiogram ($p < 0.01$), and high-density lipoprotein-C (HDL-C) ($p < 0.001$).

Hu *et al.* (1987) tested the effect of medical qigong on patients with coronary artery disease. Sixty-two participants were divided randomly into an intervention group who received one hour medical qigong training daily for three months plus usual medical treatment ($n = 31$), and a control group who only received usual medical treatment ($n = 31$). The main outcomes were symptoms, blood pressure, and ECG manifestation. The differences in the improvement of symptoms, blood pressure, and ECG between the two groups were statistically significant ($p < 0.01$) where desirable outcomes were observed in the intervention group.

Non-Randomized Controlled Trials

Hui *et al.* (2006) carried out a study to evaluate the effect of two behavioral rehabilitation programs, qigong exercise versus progressive relaxation, in improving the quality of life among patients with cardiac diseases. Sixty-five patients with cardiac diseases such as myocardial infarct, post-coronary intervention, valve replacement, and ischemic heart disease were alternatively allocated into two groups receiving either qigong exercise training (gentle movements) or progressive relaxation training. A total of eight sessions were provided to each group and each session lasted 20 minutes. The major outcome measures were blood pressure and quality of life assessed by the 36 items Short Form Heath Survey (SF-36), the State-Trait Anxiety Inventory, and the General Health Questionnaire. Results indicated that progressive relaxation was more effective in reducing blood pressure (BP) including both systolic and diastolic BP compared to qigong exercise, whereas the qigong group demonstrated greater improvement in psychological measures in addition to reduction in systolic BP.

Safety

Although no adverse effect was reported in any of the included clinical trials, two case reports of the adverse cardiac effect of qigong exercise were identified during the process of literature search. Wang (1991) reported that a healthy male person aged 25 years complained symptoms of increased heart rate and palpitations after quiescent qigong exercise for nine days. The symptoms disappeared after stopping qigong exercise for one week. Wang (1991) speculated that the symptoms were resulted from abnormal sympathetic nerve activity related to inappropriate practice of qigong exercise. Zhao *et al.* (1985) reported that a female aged 34 years with an artificial cardiac pacemaker complained of chest tightness and a sense of swelling around the neck as well as decreased pulse and heart rate after qigong exercise (50 minutes) twice daily for three months. The patient was equipped with an artificial cardiac pacemaker half a year before due to complete atrioventricular block resulting from viral myocarditis. Dynamic ECG showed ventricular arrhythmia with a heart rate of around 40 beats per minute plus sporadic cardiac arrest over ten minutes within half an hour. The phenomena occurred irregularly for three days and disappeared by the fourth day after the patient ceased practicing qigong. The symptoms did not appear during the six month follow-up period. Zhao *et al.* (1985) argued that the signals of the artificial pacemaker were disturbed by the electromagnetic spectrum of the internal "qi" or contraction of muscles during qigong exercise.

Discussion

This systematic review indicates that the effectiveness of Chinese qigong exercise in cardiac rehabilitation is still very much under-investigated with the scarcity of scientific studies in the field. Nonetheless, the available evidence seems to suggest that qigong exercises have great potential to become an integral part of cardiac rehabilitation programs for enhancing physical health and promoting overall quality of life among patients with chronic heart diseases. Specifically, four studies (Hu *et al.*, 1987; Liu *et al.*, 1998; Qiu *et al.*, 1992; Wang *et al.*, 1988) in our review found that qigong exercises help to improve physical symptoms in patients with coronary artery diseases. With regard to objective outcomes of cardiac function and relevant health measurement, two recent studies (Pippa *et al.*, 2007; Stenlund *et al.*, 2005) reported that qigong exercises help to improve cardiac patients' functional capacity; while four studies (Hu *et al.*, 1987; Liu *et al.*, 1998; Qiu *et al.*, 1992; Wang *et al.*, 1988) observed that qigong helps to reduce blood pressure and improve ECG. One study (Sun *et al.*, 1988) suggested that the effects of qigong exercise were comparable to conventional cardiac rehabilitation exercise like the treadmill/cycle-ergometer.

Despite such promising results, a careful examination of the eight studies included in this review uncovers some methodological flaws in the existing investigations on qigong intervention. First, a risk of bias may exist in most of the studies examined; of seven included RCTs, only one (Pippa *et al.*, 2007) described the method of randomization and allocation concealment while the others did not describe their methods of sequence generation or allocation concealment, and are rated as "unclear" for those domains. Although three RCTs (Pippa *et al.*, 2007; Qiu *et al.*, 1992; Stenlund *et al.*, 2005) and one CCT (Hui *et al.*, 2006) reported details of drop-outs and withdrawals, none of them adopted intention-to-treat analysis; this might lead to the exclusion of some particular patients, causing attrition biases which in turn weaken the quality of studies. Moreover, the one CCT was subject to selection bias. In terms of sample size, most of the studies included in this had a very small size and therefore their results are prone to type II errors. Also, none of the studies justified their sample size through power analysis calculations. In addition, the proceedings did not go through a formal peer review process and thus carry a high risk of bias.

Secondly, there was a great disparity in the dosage and intensity of qigong exercise across the studies examined, which may make it difficult to compare and synthesize the results of these studies. It is recommended that the prescribed exercise intensity should be above a certain level to induce an effective training effect, yet below the metabolic load that evokes abnormal clinical signs and symptoms (Franklin *et al.*, 1992). Wenger *et al.* (1999) stated that exercise intensity of 50 to 70% of the predicted maximum heart rate is safe and appropriate for coronary patients. Therefore, a standardized style or format of qigong exercise should be followed while the dosage or quality of qigong exercise should be addressed and measured in future studies so as to increase the comparability of the results across different studies. It may also be useful to transform the intensity of qigong exercise to metabolic equivalents (METs) in future studies, as METs are a scientific and standardized measure of physical exercise intensity (Jette *et al.*, 1990).

More generally, internal qigong can be divided into different types including meditative qigong (quiescent qigong or jing gong), dynamic qigong (active qigong or dong gong), and a combination of the two (jing dong gong). The intensity of exercise is often different across these forms of qigong. Results from one CCT (Hui *et al.*, 2006) comparing the effects of dynamic qigong with progressive relaxation, which is similar to quiescent qigong, suggested that there seems to be a difference in the health benefits between the two behavioral rehabilitation programs. It is still unclear whether a difference in health benefits exists between quiescent qigong and dynamic qigong, as the other studies examined in this review focused on dynamic qigong or other combined forms of qigong exercise.

Finally, there is great variability in outcome measures across the all qigong studies. Functional capacity was measured only in two studies and quality of life was only measured in one. Of the five studies in which ECG findings were employed as outcome measures, detailed information related to electrocardiographic anomalies was generally not provided; except for one study (Qiu *et al.*, 1992) where heart rate adjustment of the ST-segment depression, a key indicator of myocardial ischemia and significant coronary artery disease, was adopted as a major outcome measure. Targeted measures of ECG anomalies such as premature ventricular contractions (PVCs), bundle branch block (BBB), sustained relative incompetence, or recovery heart rate (Franklin, 2010) should be reported in future studies so as to increase the strength of evidence and comparability of results across research.

Overall, the quality of research was poor for most of the studies examined. Jadad scores for the included RCTs ranged from 1 to 3, with a value of 3 for only one study. With regard to levels of evidence, only two studies could be rated as A and other studies were rated as B. Additional higher quality studies are needed.

Assuming that qigong exercise is potentially beneficial for patients with chronic heart diseases, possible mechanisms may be of interest. Physical activity can have important health effects in cardiac rehabilitation programs, yet qigong is a lower intensity activity than other forms of physical movements previously studied. Some studies have also reported benefits of meditation and relaxation techniques in patients with heart failure. Due to the fact that qigong integrates body movement with concentration and regulated breathing, it is unclear what component of qigong is responsible for the observed benefits.

Several limitations may exist in this review. Similar to any systematic review, one of the limitations is the potential incompleteness of the evidence reviewed. We aimed to identify all controlled clinical trials in the field. A large number of databases were queried with almost all relevant terms in title, abstract, and keywords. We are confident that our search strategy has located all relevant studies, however, a degree of uncertainty remains. Another limitation may be related to selective publishing and reporting in the literature, which is also a major cause of bias. In addition, we were unable to perform meta-analyses due to heterogeneity of study designs and outcome measures in the included studies. Despite these limitations, this review was the first to provide a comprehensive synthesis of the evidence on the effectiveness of qigong exercise in cardiac rehabilitation programs.

Conclusions

Qigong exercise seems to be an alternative option for patients with chronic heart diseases who are unable to engage in other forms of physical activity that are more intensive and physically demanding. However, with the scarcity of scientific evidence in the field, the efficacy and effectiveness of the use of qigong exercise in cardiac rehabilitation program should be further tested. As illuminated in this systematic review, the multiple components of qigong exercise pose significant challenges to research design, while the heterogeneous nature of outcome measures used by different researchers pose great difficulties in the interpretation of findings across studies. In sum, it is evident that further well-designed studies with larger sample size, clear reporting standards and carefully chosen outcome measures that assess both mechanisms of effect and clinical efficacy of qigong exercise in cardiac rehabilitation are warranted.

Acknowledgments

This review was supported by the Hospital Authority of Hong Kong. The funding sources had no further role in the design; in collection, analysis and interpretation of data; in the writing of the report; and in the decision to submit the paper for publication.

References

American Heart Association. Cardiovascular Disease Statistics. Available at: http://www.americanheart.org/presenter.jhtml?identifier=4478. Accessed 11 November 2010.

Belardinelli, R., D. Georgiou, G. Cianci and A. Purcaro. Randomized, controlled trial of long-term moderate exercise training in chronic heart failure: effects on functional capacity, quality of life, and clinical outcome. *Circulation* 99: 1173–1182, 1999.

Chen, K.W., T. Liu, H. Zhang and Z. Lin. An analytical review of the Chinese literature on Qigong therapy for diabetes mellitus. *Am. J. Chin. Med.* 37: 439–457, 2009.

Flynn, K.E., I.L. Pina, D.J. Whellan, L. Lin, J.A. Blumenthal, S.J. Ellis, L.J. Fine, J.G. Howlett, S.J. Keteyian, D.W. Kitzman, W.E. Kraus, N.H. Miller, K.A. Schulman, J.A. Spertus, C.M. O'Connor and K.P. Weinfurt. Effects of exercise training on health status in patients with chronic heart failure: HF-ACTION randomized controlled trial. *JAMA* 301: 1451–1459, 2009.

Franklin, B.A. Exercise in the primary and secondary prevention of coronary artery disease: an update. *J. HK Coll. Cardiol.* 9: 31–37, 2001.

Franklin, B.A. Interpretation of exercise test responses: recent advances. *J. HK Coll. Cardiol.* 18: A31–36, 2010.

Franklin, B.A., S. Gordon and G.C. Timmis. Amount of exercise necessary for the patient with coronary artery disease. *Am. J. Cardiol.* 69: 1426–1432, 1992.

Guo, X., B. Zhou, T. Nishimura, S. Teramukai and M. Fukushima. Clinical effect of qigong practice on essential hypertension: a meta-analysis of randomized controlled trials. *J. Altern. Complement. Med.* 14: 27–37, 2008.

Hu, H.F., T.D. Wang, L. Meng, H.D. Yao, J. Lu, H.X. Dai and D.C. Zhu. The effect of medical qigong exercise on coronary artery disease. *Fujian J. Tradit. Chin. Med.* 01: 11–13, 1987.

Hui, P.N., M. Wan, W.K. Chan and P.M.B. Yung. An evaluation of two behavioral rehabilitation programs, Qigong versus progressive relaxation, in improving the quality of life in cardiac patients. *J. Altern. Complement. Med.* 12: 373–378, 2006.

Jadad, A.R., R.A. Moore, D. Carroll, C. Jenkinson, D.J. Reynolds, D.J. Gavaghan and H.J. McQuay. Assessing the *quality* of reports of randomized clinical trials: is blinding necessary? *Control. Clin. Trials* 17: 1–12, 1996.

Jette, M., K. Sidney and G. Blumchen. Metabolic equivalents (METS) in exercise testing, exercise prescription, and evaluation of functional capacity. *Clin. Cardiol.* 13: 555–565, 1990.

Juni, P., D.G. Altman and M. Egger. Systematic reviews in health care: assessing the quality of controlled clinical trials. *Br. Med.* 323: 42–46, 2001.

Lee, M.S., K.W. Chen, T.Y. Choi and E. Ernst. Qigong for type 2 diabetes care: a systematic review. *Complement. Ther. Med.* 17: 236–242, 2009.

Lee, M.S., M.H. Pittler, R. Guo and E. Ernst. Qigong for hypertension: a systematic review of randomized clinical trials. *J. Hypertens.* 25: 1525–1532, 2007.

Liu, J., J. Shen and S. Jia. Clinical observation of the effects on hypertension complicated by coronary artery disease treated by China informative qigong. In: *4th World Conf. Acad. Exch. Med. Qigong*, 1998, pp. 151–152.

Newton, M., N. Mutrie and J.D. McArthur. The effects of exercise in a coronary rehabilitation programme. *Scott. Med. J.* 36: 38–41, 1991.

Oxford Centre for Evidence-based Medicine. *Levels of Evidence (March 2009).* URL: http://www.cebm.net/index.aspx?0=1025. Accessed 10 November 2010.

Pippa, L., L. Manzoli, I. Corti, G. Congedo, L. Romanazzi and G. Parruti. Functional capacity after traditional Chinese medicine (qi gong) training in patients with chronic atrial fibrillation: a randomized controlled trial. *Prev. Cardiol.* 10: 22–25, 2007.

Pollock, M.L., B.A. Franklin, G.J. Balady, B.L. Chaitman, J.L. Fleg, B. Fletcher, M. Limacher, I.L. Piña, R.A. Stein, M. Williams and T. Bazzarre. AHA Science Advisory. Resistance exercise in individuals with and without cardiovascular disease: benefits, rationale, safety, and prescription: an advisory from the Committee on Exercise, Rehabilitation, and Prevention, Council on Clinical Cardiology, American Heart Association; position paper endorsed by the American College of Sports Medicine. *Circulation* 101: 828–833, 2000.

Qiu, J.F., S.F. Zhou, Y. Jin, H.C. Li, T. Li, M.X. Yu and Q. Chen. The effect of Qigong on SM5 ST segment/heart rate slope in patients with coronary artery disease. *Chin. J. Sports Med.* 11: 79–84, 1992.

Stenlund, T., B. Lindstrom, M. Granlund and G. Burell. Cardiac rehabilitation for the elderly: Qi Gong and group discussions. *Eur. J. Cardiovasc. Prev. Rehabil.* 12: 5–11, 2005.

Sun, Y.X., N. Zhou, X.P. Wang, X.Z. Yu, J.Y. Yang and X.Y. Bai. The exercise procedures of cardiac rehabilitation and the assessment of the effect on 20 patients. *Chin. J. Rehabil. Med.* 3: 2–5, 1988.

Vincent, A., J. Hill, K.M. Kruk, S.S. Cha and B.A. Bauer. External qigong for chronic pain. *Am. J. Chin. Med.* 38: 695–703, 2010.

Wang, C.X., D.H. Xu, Y.S. Qian, M.L. Huang and G.S. Zhao. Effects of Chinese Qigong on cardiac function among patients with hypertension complicated with coronary artery disease. *J. Gerontol.* 8: 83–88, 1988.

Wang, J.H. A case report of electrocardiographic anomaly related to qigong exercise. *Chin. J. Integr. Tradit. West. Med.* 4: 230, 1991.

Wenger, N. K., E.S. Froelicher, L.K. Smith, P.A. Ades, K. Berra and J.A. Blumenthal. *Cardiac Rehabilitation*: *Clinical Practice Guideline No. 17*. In: US Dept Health and Human Services, Public Health Service, Agency for Health Care Policy and Research USA and the National Heart, Lung, and Blood Institute, AHCPR Pub No. 96–0672, Rockville, 1995.

Wenger, N.K., L.K. Smith, E.S. Froelicher and P.M. Comoss. *Cardiac Rehabilitation: A Guide to Practice in the 21st Century.* Marcel Dekker, New York, 1999.

World Health Organization. *Cardiovascular Diseases* (*CVDs*). January 2011. Accessed at http://www.who.int/mediacentre/factsheets/fs317/en/index.html. on 17 May 2011.

Xiao, J. and Y. Chen. Prevalence of cardiovascular diseases in China. *Front. Med. China* 4: 16–20, 2010.

Zhao, L.S., S.Y. Wang and X.M. Zhang. A case report of pacemaker malfunction induced by qigong exercise. *Acta Acad. Med. Weifang* 1: 78, 1985.

Zhou, S. Effects of qigong on the rostacyclin thromboxane balance in patients with coronary heart diseases. In: *1st World Conf. Acad. Exch. Med. Qigong*, 1988, pp. 117.