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Review Article

Movement-based mind-body interventions for cardiac rehabilitation: An updated systematic review of randomized controlled trials

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Abstract

This study aimed to assess evidence for the effect of movement-based mind-body interventions (MMBIs) for cardiac rehabilitation (CR). Six databases were searched from January 1995 to September 2020. All randomized controlled trials (RCTs) evaluated the effect of MMBIs on heart disease (HD) patients' physical and psychological outcomes. Two reviewers independently assessed the quality of all the included studies using the revised Cochrane risk-of-bias tool for RCTs. Sixteen RCTs (5160 participants) published between 1996 and 2020 met all inclusion criteria. In total, these studies investigated the effect of MMBIs for CR. Outcome measures that emerged in these studies included physical and psychological, and/or biochemical parameters to comprehensively evaluate the effects of MMBIs on HD patients. Overall, these studies suggest that MMBIs seem to be an alternative with the optimal CR option.

Keywords: *Cardiac rehabilitation, Heart disease, Movement-based mind-body interventions*

Introduction

Heart disease (HD) persists as the leading cause of disability and death, accounting for 17.9 million deaths (31%) globally [1]. Cardiac events are common because of the complex interaction between physical, social, environmental, and psychological health components, which are often not treated with the same priority as physical symptoms [2]. Cardiac rehabilitation (CR) consists of supervised exercise training in conjunction with other secondary prevention interventions. It is designed to help patients recover from acute cardiovascular events, such as myocardial infarction (MI), myocardial revascularization, heart transplantation, and heart failure [3]. Studies have shown that active and effective CR can save medical costs, shorten hospital stays, and reduce per capita drug treatment [4]. The benefits of CR are realized through multiple mechanisms, such as the reversal of atrial remodeling, improvement in diastolic function [5], increase in functional capacity, and improvement in the patient's quality of life (QOL) [6].

In a recent meta-analysis, researchers found that CR, mainly of the exercise type, including aerobic exercise, inspiratory muscle training, and resistance exercise, effectively alleviated clinical symptoms associated with cardiovascular disease (CVD) and improved the patients' capability to live and work [7,8]. A CR exercise program prescribed moderate- to the high-intensity exercise of at least 20 min and preferably 30–45 min of continuous or discontinuous aerobic activity three to five times per week for 8-12 weeks [9,10]. However,

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CR is not widely used [11] because of distance, financial resources, work and other time constraints, gender, age, social support, illness perceptions, and psychiatric problems [12]. Other types of exercise, such as movement-based mind-body interventions (MMBIs) including Tai Chi, Baduanjin, and yoga, are a form of traditional practice designed to promote physical and psychological health, manage symptoms, and relieve stress during illness and have been used frequently by patients with HD [13-16]. Tai Chi, as a moderate-intensity exercise, could improve the parasympathetic nervous degree, inhibit sympathetic activity, increase the coronary collateral circulation and cardiac output, it achieved the purpose of effects of HD [17,18]. Baduanjin is an ancient Qigong exercise that involves eight sections of relaxing movements. It can systematically enhance cardiopulmonary functions and concurrently modulate mind and spirit, ultimately achieving the mind and body's integration. However, the mechanisms behind the therapeutic modulation remain less understood and warrant future exploration [19]. Yoga is a traditional Indian mind-body practice; it may be associated with vascular and mental health benefits through other pathways, such as the stimulation of the parasympathetic nervous system, reduction in stress and its downstream vascular and endocrine effects, and changes in neurotransmitters affecting heart function [20,21].

Previously published meta-analyses have focused on the use of Tai Chi exercise for CVD. However, these studies differed widely in design, type of intervention, follow-up time, exercise prescription, and outcome measurements. Furthermore, there was a high risk of bias (ROB) in most of the included studies [15,16]. Accordingly, in recent years, several new trials have been published regarding the use of MMBIs for HD. The purpose of the current study was to undertake an updated systematic review that applies current Cochrane methodological standards [22] to evaluate available evidence related to the impact of MMBIs and provide guidance and reference for future treatment of patients with HD.

Systematic search strategy

Reviewing the literature and reporting comply with the Preferred Reporting Items for Systematic Reviews and Meta-analyses guidelines [23]. The study was completed at the end of September 2020.

Two reviewers performed a systematic literature review to identify all potentially relevant peer-review studies. There were no limitations applied regarding the language used, and the search was limited to randomized controlled trials (RCTs). We conducted a thorough search of PubMed, Medline, Embase, CINAHL, Cochrane Library, and Chinese databases such as Electronic Periodical Services. The search terms were as follows: (1) participants: "HDs" including cardiac arrhythmias, carcinoid HD, cardiac tamponade, cardiomyopathy, heart failure, heart valve disease, MI, rheumatic HD, coronary artery bypass, myocardial ischemia, percutaneous coronary intervention, or coronary artery disease (CAD); (2) intervention and comparison: MMBIs including Tai Chi, Baduanjin, yoga compared with a control group (CG), they did not undergo any MMBIs; (3) outcome measures: Studies used physical and/or psychological and/or biochemical parameters for the comprehensive evaluation of the effects of MMBIs (Tai Chi, Baduanjin, and yoga) on patients with HD.

Data extraction and quality appraisal

Data were extracted twice by the two authors (Huang and Peng) for study characteristics (e.g., author, year, and location), participant characteristics (e.g., diagnoses, gender, and mean age), exercise, and control interventions, including the type, duration, frequency, intervention timing, and intensity. When information was not reported clearly, criteria were considered as not fulfilled. Any discrepancies in the extracted data were discussed, and a third reviewer was consulted to settle the disagreement when necessary. The two authors independently assessed trials using the Cochrane ROB tool assessment for RCTs [22]. The trials were graded as low ROB, some-concern of ROB, or high ROB.

Outcomes in systematic search

Our search identified 1203 potentially relevant articles, of which 614 were duplicated articles. A total of 614 records remained, which were assessed based on title and abstract. We then excluded 455 studies that did not meet our criteria. After full-text articles assessed and excluded. Finally, 16 studies were eligible for quality assessment [Figure 1]. Additional details for each individual study are provided in Supplementary Table 1.

Quality assessment

The methodological quality of the 16 RCTs was appraised using ROB version 2 [22], as follows: (1) Allocation bias domain: We determined that ten studies [24-26,28,29,31-35] had a some-concern for the ROB because the authors failed to report adequate information about the allocation concealment. We rated the remaining studies as having a low risk of allocation bias. (2) Performance bias domain: It was not practical to blind participants to the randomization (i.e., exercise intervention vs. control intervention). Because of other algorithms used to

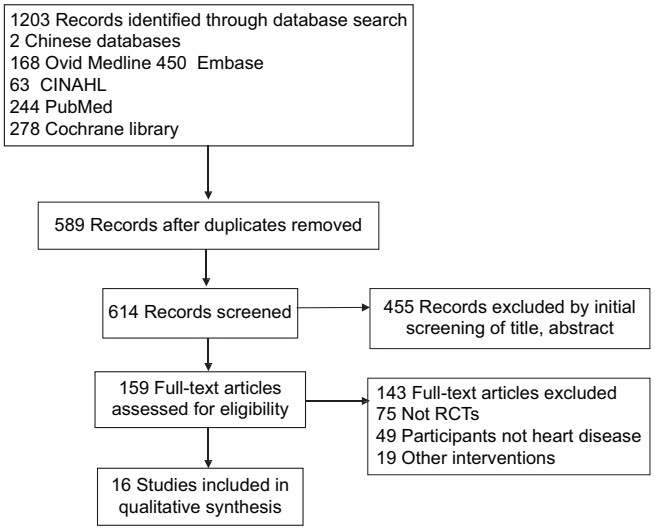

Figure 1: PRISMA flow diagram showing the number of studies identified and selected for inclusion in the literature review

affect adherence intervention, we assessed all studies as being at some-concern for the risk of performance bias. (3) Attrition bias domain: We rated two studies as having a high risk of attrition bias [24,25]. This judgment was based on disparities or a dropout rate of >20% between the intervention and the CG. Moreover, without an appropriate sensitivity analysis of the withdrawal rate, these studies may result in unobserved compliance status, affecting the true value. We classified one study [20] as having some-concern for the risk of attrition bias, and rated the remaining studies as having a low risk of attrition bias. (4) Detection bias domain: We found that three studies had some-concern of detection bias [13,20,28]. Because the assessor was not blinded to all measurement outcomes, the results were subjective and might have been influenced by an intervention's knowledge. (5) Reported bias domain: We judged all studies to be at a low risk of reported bias. (6) Overall bias domain: Four of the reviewed studies were rated as having some-concern of overall ROB [21,27,28,30], whereas the remaining 11 studies were rated as having a high overall ROB [Table 1].

Characteristics of the included studies

Details of the included studies are found in Table 1 (supplementary content). We included 16 studies in this review [13,19-21,24-35], all of which were published between 1996 and 2020. The studies included a total of 5160 participants with HD, including CAD [31], CAD after coronary artery bypass graft surgery [20,28], MI with or without percutaneous coronary intervention [13,19,21,26,29,30], and heart failure [24,25,27,32-36]. The mean age of the participants ranged from 51.5 TO 74.1 years, and three study did not mention the patients' ages [20,24,26]. The sample size of the included studies ranged from 16 [35] to 3959 [13], and women accounted for <15% of the study population. One study included only men [20]; one study listed inconsistent patient numbers between the table and article text [32]. Of the 16 included studies, 14 were published in peer-review journals in English, and two were published in Chinese academic journals [28,32]. The MMBIs included in the studies consisted of Tai Chi in eight studies [24-26,30,31,33-35], Baduanjin in five studies [19,27-29,32], and yoga in two studies [13,21]. The frequency and duration of the MMBIs ranged from two to five times per week for 12 weeks to 1 year of Tai Chi, two times per day for one week to five times per week for 12 weeks of Baduanjin, and three to four times per week for 12 weeks to 1 year of yoga. Most of the included studies were conducted using a two-armed parallel-group design; one study used a three-armed group design [26]. In general, the comparison was between patients who received MMBIs and a CG that received usual medical treatment, except for five studies [25,26,28,29,35], that exercise prescribed Tai Chi or Baduanjin were compared with low-impact aerobic exercise or resistance exercise. The outcome measures included biochemical indicators, physiological outcomes, physical function, and QOL.

Across all studies, all levels of exercise intensity used different target measurements, including 60%–70% of maximal heart rate [25], 40%–50% of heart rate reserve [31], gentle to moderate intensity using the Borg rating scale [30], 45%–60% of peak VO2 [29], or not reported [13,19-21,24,26-28,32-35]. The difference in exercise timing was prescribed MMBI exercise and clinical situation. Outcomes were evaluated based on biochemical indicators: Two studies used N-terminal pro-brain natriuretic peptide (NT-pro BNP) [19,25], and all studies found a significant improvement in the intervention group (IG). In terms of physiological outcomes, six studies used systolic blood pressure (SBP) [24-26,30,31,35], and two studies reported a significant improvement in IG [25,26]. For physical function outcomes, five studies used the 6-min walking test (6MWT) [25,32-35], and four studies found a significant improvement in IG [25,32-34] for most physical function outcomes. For QOL outcomes, the most applied using Minnesota Living with Heart Failure questionnaire (MLHFQ) [24,27,33-35], designed to measure both physical and emotional dimensions of QOL in patients with heart failure. Four studies found a significant improvement in the physical or emotional state of IG [24,27,33,34]. In these 16 of included studies, dropout rates rangedfrom 0% [30] to 32% [20] in the IG and from 0% [30] to 36.6% [20] in the CG, none of the studies reported adverse events related to the exercise interventions.

Physical performance, psychological status, and biochemical marker

This systematic review of 16 RCTs investigated the impact of Tai Chi, Baduanjin, and yoga on the physical, psychological, and/or biochemical parameters of patients with HD receiving CR training. The available evidence suggests that MMBIs have great potential to become an integral part of CR programs because of their safety and efficiency of enhancing physical health and QOL among patients with HD. In this review study, we found that Tai Chi practice was associated with an improvement in QOL [24,25,33-35] and functional capacity [25,30-32], an augmentation of reflex vagal regulation [28], effects on CVD risk factors such as SBP [26], an increase in VO_2 peak [35], and a decrease in heart failure predictors such as NT-pro BNP[25] in patients with a recent MI [26,30], heart failure [24,25,33-35], or CAD [31]. Baduanjin practice was associated with an improvement in QOL [19,27,28], functional capacity [32], angina symptoms [28], and body composition[19] in patients with MI [19,29,32], heart failure [27], or CAD under coronary artery bypass graft [28]. Yoga practice was associated with an improvement in QOL [13,20], a reduction in depression and anxiety[21], and return to pre-infarction activities [13].

Typically, a complete course of CR is considered the attendance of ≥36 supervised sessions over a period of about 12 weeks. However, data collected during a 2016–2017 study within the Centers for Medicare and Medicaid Services Chronic Conditions Warehouse database for fee-for-service beneficiaries aged ≥65 years found that only one in four CR-eligible Medicare beneficiaries participated in CR (89327/366103, 24.4%), of whom 26.9% completed CR [11]. An excellent participation rate (76.2%) among patients referred to a CR place nearly their homes has been reported [36]. In addition, our review found that women's participation inclusion rate is hugely less than that of men. This finding is consistent

Table 1: Risk of bias summary: review author's judgements about each risk of bias item for each included study

Study, year	Allocation bias	Performance bias	Attrition bias	Detection bias	Reporting bias	Overall bias
Barrow *et al*., 2007 [24]	S	S	H	L	L	H
Caminiti *et al*., 2011 [25]	S	S	H	L	L	H
Channer *et al*., 1996 [26]	S	S	L	L	L	H
Chen *et al*., 2018 [27]	L	S	L	L	L	S
Chen *et al*., 2020 [19]	L	S	L	L	L	S
Eraballi *et al*., 2018 [20]	L	S	S	S	L	H
Lin *et al*., 2012 [28]	S	S	L	S	L	H
Mao *et al*., 2021 [29]	S	S	L	L	L	H
Nery *et al*., 2015 [30]	L	S	L	L	L	S
Prabhakaran *et al*., 2020 [13]	L	S	L	S	L	H
Sato *et al*., 2010 [31]	S	S	L	L	L	H
Sharma *et al*., 2020 [21]	L	S	L	L	L	S
Tang *et al*., 2019 [32]	S	S	L	L	L	H
Yeh *et al*., 2008 [33]	S	S	L	L	L	H
Yeh *et al*., 2004 [34]	S	S	L	L	L	H
Yeh *et al*., 2013 [35]	S	S	L	L	L	H

L: Low risk of bias, S: Some-concern, H: High risk of bias

with previous reports, in which the enrollment of women was 11%–20% lower than men [37] and women were found to be more likely to withdraw from a program than men were (35% vs. 29%, $P < 0.001$) [38]. Furthermore, Supervía et al. identified solutions to facilitate women's participation in CR, including home-based programs [39]. This is intriguing given that women with and without HD consistently report shared barriers to physical activity, such as lack of time due to family and work commitments and lack of motivation [39,40]. A Cochrane review [8] of exercise-based CR for coronary HD (CHD) included 63 trials that randomized 14,486 people with CHD, mainly of the exercise type, including aerobic exercise or resistance exercise (only four of these trials using Tai Chi, one trial using yoga). The main results highlight the effect of CR, compared with the absence of physical exercise, in the reduction in cardiovascular mortality, with no reduction, however, in total mortality. However, this review of losses to follow-up and dropouts was relatively high (ranging from 21% to 48%). Hence reinforcement of current effective exercise strategies and new strategies will be critical for addressing the noted disparities.

MMBIs have no special requirements in the field and are therefore more easily accepted by patients. In our review of MMIBs of CR, dropout rates ranged between 0 [30] and 32% [20] in the IGs and between 0 [30] and 36.6% [20] in the CGs. The dropout rates intervention arms, including Tai Chi [30] and yoga [20], the control arm was usual care. There were no reports of exercise-related adverse events in the review studies. However, other studies have indicated that irregular exercise and insufficient leg strength are likely to cause knee joint pain, which often occurs in the initial learning stage of Tai Chi [41]. Some antijoins activities of yoga are beyond the range of normal joints, which can result in sports injuries [42], affecting patient compliance. Baduanjin exercise is moderate in intensity and short in duration (a set of Baduanjin takes about 12 min). Baduanjin consists of the sitting and standing practicing form. The sitting Baduanjin exercise conforms to the aspects of low-intensity and long-term aerobic activity, which is suitable for the rehabilitation training of patients who are in stable condition during hospitalization. The standing Baduanjin is more suitable for patients with sequential rehabilitation after discharge [19] and can be adjusted based on the patient's condition, which has certain advantages for CR of patient with HD. In addition, as compared with Tai Chi, qigong, and yoga, the Baduanjin is easier to learn.

Two out of three studies that analyzed left ventricular ejection fraction (LVEF) indicators after patients performed Baduanjin and showed a significant increase in LVEF [19,29]. LVEF is a powerful predictor of cardiac mortality, and in patients with HD, a lower percentage of LVEF is associated with an unfavorable long-term prognosis. The results of more recent clinical trials have also indicated that exercise training led to a decrease in LV dilatation and improved LVEF [43,44]. In patients with HD, the 6MWT is the most commonly applied assessment of functional capacity and can predict morbidity and mortality [45]. The Borg Scale is recommended for use at the end of the 6MWT to determine the level of effort. Some studies have also suggested that the addition of peripheral oxygen saturation measurements and heart rate response might improve prognostic relevance [46].

A variety of QOL questionnaires were used in this systematic review. The MLHFQ, a disease-specific QOL score, was the most frequently applied measure in this review. That showed that MMIBs led to improvement in QOL as compared with baseline results. Revascularization and drug therapy could improve HD patients' symptoms and reduce their mortality rate. However, even among survivors of reperfusion therapy, the ability to perform daily activities is affected, resulting in decreased independence and the ability to perform societal roles, thus negatively affecting psychosocial health [6,12]. The QOL of patients with HD is considered an important parameter for both clinical and hard outcomes, such as mortality, and should be included in determining the effect of an exercise intervention.

This overview of systematic review has several limitations. First, this systematic review did not include grey literature or trial/study registries. Second, this overview included only three types of MMIBs. However, other types (e.g. Pilates [47], Qigong [48]) were identified for CR because this review focused on more convenience and easier to practice with meditation and breathing techniques. Third, although we conducted a systematic review of the evidence for MMBIs in CR, a meta-analysis in estimating the effects of interventions was not performed because the included studies showed low methodological quality and heterogeneity in the methods and clinical outcomes, which would affect the findings of this overview.

Conclusion

MMBIs program can improve functional capacity, disease-specific QOL, and adjusted endogenous neurohormones. Alternate approaches to traditional supervised group interventions, including community-and home-based programs, appear to be safe and effective for HD. Although this systematic review applied a rigorous quality appraisal, which showed that only four studies had some-concern of ROB [19,21,27,30]. Although high-quality research should be performed to standardize MMBIs practice (e.g. different exercise branches). The outcome evaluation indicators in the same area to understand how the interventions work and ensure these results are replicable. Moreover, novel elements, such as program offerings, convenient settings, and socialization opportunities, should be considered when designing CR programs for enhanced by the specific needs of individualizing.

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Conflicts of interest

There are no conflicts of interest.

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Supplementary Table 1: Summary of included studies of movement-based mind-body interventions for cardiac rehabilitation

Study	Country	Population	Intervention group	Control group	Outcomes	Results	Dropout rates	Adverse events
Barrow *et al*., 2007 [24]	England	*n*=65, stable symptomatic chronic heart failure (NYHA class II-III)	*n*=32, male/female: 26/6, mean age was not reported Exercise type: Tai Chi Length: 110 min Frequency: 2 times/ week Duration: 16 weeks Intensity: Not reported Timing: Not reported	*n*=33, male/female: 27/6, mean age was not reported Usual care	SBP DBP ISWT MLHFQ SCL-90-R	SBP, DBP: No significant differences were found between the groups ISWT: Significant increase in the IG MLHFQ: Significant decrease in the IG SCL-90-R: Significant decrease in depression and anxiety of SCL-90-R in the IG	IG: 21.8% CG: 18.1%	No adverse events
Caminiti *et al*., 2011 [25]	Italy	*n*=60, heart failure (NYHA class II)	*n*=30, male/female: 26/4, mean age 73.4±2 years Exercise type: Tai Chi and AE Length: 80 min (Tai Chi 40 min and AE 40 min) Frequency: Each exercise 2 times/week Duration: 12 weeks Intensity: AE at 60%-70% of estimated VO_2 max Timing: Not reported	*n*=30, male/female: 25/5, mean age 74.1±6 years Exercise type: AE Length: 40 min Frequency: 3 times/ week Duration: 12 weeks Intensity: AE at 60%-70% of estimated VO_2 max Timing: Not reported	6MWT SBP DBP Muscle strength NT pro-BNP MacNewQLMI	6MWT: Significant increase in the IG Muscle strength: Significant increase in the IG SBP and NT pro-BNP: Significant decrease in the IG DBP: No significant differences were found between the groups MacNewQLMI: Significant improvement in the IG	Not reported	No adverse events
Channer *et al*., 1996 [26]	United Kingdom	*n*=126, acute myocardial infarction	*n*=38, mean age was not reported Exercise type: Tai Chi Length: 60 min Frequency: 3 times/ week Duration: 12 weeks Intensity: Not reported Timing: 3 weeks after discharge	Study 1 *n*=41, mean age was not reported Exercise type: AE Length: Not reported Frequency: Not reported Duration: Not reported Intensity: Not reported Timing: 3 weeks after discharge Study 2 *n*=47, mean age was not reported Exercise type: cardiac support group Length: 60 min Frequency: Once a week Duration: Not reported Intensity: Not reported Timing: 3 weeks after discharge	SBP DBP HR	HR: Significant decrease in resting HR in the IG SBP and DBP: Significant decrease in SBP between the both groups and significant decrease in DBP	Not reported	Not reported

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Supplementary Table 1: Cont.

Study	Country	Population	Intervention group	Control group	Outcomes	Results	Dropout rates	Adverse events
Chen *et al*., 2018 [27]	Taiwan	*n*=80, heart failure (NYHA class I and II)	*n*=39, male/female: 18/21, mean age 69.08±13.48 years Exercise type: Baduanjin Length: 35 min Frequency: 3 times/ week Duration: 12 weeks Intensity: Not reported Timing: 3 weeks after discharge	*n*=41, male/female: 24/17, mean age 71.44±13.65 years Usual care	PFS MLHFQ	PFS: Significant decrease in the IG MLHFQ: Significant improvement in the IG	IG: 23% CG: 19.5%	No adverse events
Chen *et al*., 2020 [19]	China	*n*=82, acute myocardial infarction, performed PCI	*n*=43, male/female: 29/14, mean age 59.98±10.86 years Exercise type: Baduanjin Length: 30 min Frequency: 2 times/ week Duration: 24 weeks Intensity: Not reported Timing: Post-OP 2 days	*n*=39, male/female: 30/9, mean age 61.49±11.54 years Usual care	NT pro-BNP LVEF BMI Abdominal circumference SF-36	NT pro-BNP: Significant decrease in the IG LVEF: Significant decrease in the CG BMI and abdominal circumference: Significant decrease in the IG SF-36: Significant increase in physical functioning, role physical, bodily pain, general health, vitality, social function, role emotional, mental health, and health transition of SF-36 in the IG	Dropouts: IG: 10.4% CG: 18.7%	No adverse events
Eraballi *et al*., 2018 [20]	India	*n*=300, CAD, CABG	*n*=150, Male: 150, mean age not reported Exercise type: Yoga Length: 20 min Frequency: 4 times/day Duration: 12 months Intensity: Not reported Timing: Pre-OP	*n*=150, Male: 150, Mean age not reported Usual care	WHOQOL-BREF	WHOQOL-BREF: Significant improvement in IG after 1 year and nonsignificant change in CG	IG: 32% CG: 36.6%	Not reported
Lin *et al*., 2012 [28]	China	*n*=60, CAD, CABG	*n*=30, male/female: 24/6, mean age 66.47±8.26 years First phase Exercise type: Routine exercise Length: 30 min Frequency: 5-6 times/ day Duration: 21 days Intensity: Not reported Timing: 1st day after OP	*n*=30, male/female: 22/8, mean age 64.90±8.87 years First phase Exercise type: Routine exercise Length: 30 min Frequency: 5-6 times/day Duration: 21 days Intensity: Not reported Timing: 1 day after OP Second phase	QOL SAQ	QOL and SAQ: Significant increase in the IG	Not reported	No adverse events

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Supplementary Table 1: Cont.

Study	Country	Population	Intervention group	Control group	Outcomes	Results	Dropout rates	Adverse events
			Second phase Exercise type: Baduanjin Length: 30 min Frequency: 4-5 times/ week Duration: 1 month Intensity: not reported Timing: 8th day after OP Third phase Exercise type: Baduanjin + weight training Length: 12-15 times (no reported length) Frequency: 3 times/week Duration: 12 weeks Intensity: Not reported Timing: 9th day after discharge	Exercise type: Routine exercise Length: 45-60 min Frequency: 2-3 times/day Duration: 1 month Intensity: Not reported Timing: 8th day after discharge Third phase Exercise type: Routine exercise + weight training Length: 12-15 times (no reported length) Frequency: 3 times/ week Duration: 12 weeks Intensity: Not reported Timing: 9th day after discharge				
Mao *et al*., 2021 [29]	China	*n*=110, myocardial infarction	*n*=56, male/female: 37/19, mean age 60.43±10.21 years Exercise type: Baduanjin Length: 45 min Frequency: 2 times/ week Duration: 12 weeks Intensity: 45%-60% of peak VO_2 Timing: Not reported	*n*=54, male/female: 36/18, mean age 61.30±11.21 years Exercise type: AE Length: 30 min Frequency: 2 times/ week Duration: 12 weeks Intensity: not reported Timing: Not reported	LVEDVi LVESVi LVEF BNP peak	LVEDVi, LVESVi, LVEF, BNP peak: No significant differences between two groups	IG: 3.5% CG: 5.5%	No adverse events
Nery *et al*., 2015 [30]	Brazil	*n*=61, myocardial infarction, performed PCI	*n*=31, male/female: 25/6, mean age 56±9 years Exercise type: Tai Chi Length: 60 min Frequency: 3 times/ week Duration: 3 months Intensity: Exertion as expressed on the Borg Rating of Perceived Exertion Scale Timing: Post-OP	*n*=30, male/female: 19/11, mean age 60±9 years Usual care	VO_2 peak SBP DBP VE peak VE/VCO_2 slope	VO_2 peak: Significant increase in the IG SBP, DBP, VE peak, VE/VCO_2 slope: No significant differences were found between the two groups	IG: 0% CG: 0%	No adverse events
Prabhakaran *et al*., 2020 [13]	India	*n*=3959, acute myocardial infarction within the past 14 days	*n*=1970, male/female: 1699/271, mean age 53.4±11 years Exercise type: Yoga Length: 75 min	*n*=1989, male/female: 1709/280, mean age 53.4±10.8 years Usual care	Preinfarct activities score Self-rated health MACE	Preinfarct activities score: Significant improved in the IG Self-rated health: Significant difference between the two groups	Total 1%	No adverse events

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Supplementary Table 1: Cont.

Study	Country	Population	Intervention group	Control group	Outcomes	Results	Dropout rates	Adverse events
			Frequency: Not reported Duration: 12 weeks Intensity: Not reported Timing: Not reported			MACE: No significant differences were found between the two groups		
Sato *et al*., 2010 [31]	Japan	*n*=20, CHD, was not reported	*n*=10, male/female: 6/4, mean age 68±5 years Exercise type: Tai Chi Length: 60 min Frequency: At least 3 times/week Duration: 1 year Intensity: 40-50% of HR reserve Timing: Not reported		BRS HRV HF power LF power LF/HF power ratio Peak oxygen uptake SBP	BRS: Significant improvement in the IG HRV, HF power, LF power, LF/HF power ratio, peak oxygen uptake, SBP: No significant differences were found between the groups	Not reported	
Sharma *et al*., 2020 [21]	India	*n*=66, recent MI, without involving any revascularization or CABG, left ventricular dysfunction (NYHA class Ⅰ and Ⅱ), LVEF between 30% and 50%	*n*=33, male/female: 31/2, mean age 53.15±11.59 years Exercise type: Yoga Length: 60 min Frequency: 3 times/week Duration: 12 weeks Intensity: Not reported Timing: Not reported	*n*=33, male/female: 26/7, mean age 51.51±8.15 years Usual care	HDL LDL LVEF METs CDS HAM-A DASI	HDL, LDL, LVEF: No significant differences were found between the groups METS: Significant increase in the IG CDS, HAM-A: Significant reduction in the IG DASI: Significant increase in the IG	CG: 3% IG: 3%	No adverse events
Tang *et al*., 2019 [32]	China	*n*=60, after PCI, NYHA Ⅰ-Ⅱ, age 40-75, patients has stable condition after PCI	*n*=30, male/female: (error number reported), mean age 60.11±8.54 years Exercise type: Baduanjin Length: 14 min Frequency: 5 times/week Duration: 3 months Intensity: Not reported Timing: Not reported	*n*=30, male/female: (error number reported), mean age 59.51±8.93 years Usual care	6MWT RPE	6MWT: Significant increase in the IG RPE score: Significant decrease in the IG	IG: 8% CG: 6%	Not reported
Yeh *et al*., 2008 [33]	United States	*n*=18, chronic stable heart failure, left ventricular ejection fraction ≤40%	*n*=8, male/female: 4/4, mean age 64.2±16.2 years Exercise type: Tai Chi Length: 60 min in class, practice 35 min at home Frequency: 5 times/week Duration: 12 weeks Intensity: Not reported Timing: Not reported	*n*=10, male/female: 5/5, mean age 54.7±11.8 years Usual care	6MWT Peak oxygen uptake Plasma norepinephrine BNP MLHFQ	6MWT, BNP, MLHFQ: Significant improvement in the IG Peak oxygen uptake, plasma norepinephrine: No significant improvement was found in the IG	Not reported	No adverse events

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Supplementary Table 1: Cont.

Study	Country	Population	Intervention group	Control group	Outcomes	Results	Dropout rates	Adverse events
Yeh *et al*., 2004 [34]	United States	*n*=30, chronic stable heart failure, left ventricular ejection fraction ≤40%	*n*=15, male/female: 10/5, mean age 66±12 years Exercise type: Tai Chi Length: 60 min Frequency: 5 times/ week Duration: 12 weeks Intensity: Not reported Timing: Not reported	*n*=15, male/female: 9/6, mean age 61±14 years Usual care	6MWT BNP Catecholamine samples Peak VO_2 HFC and LFC HRV Stable sleep MLHFQ	6MWT, MLHFQ: Significantly improved in the IG BNP, peak VO_2, catecholamine samples: No significant different between the two groups HFC, LFC: Significant increase in HFC and significant reduction in LFC in the IG HRV, stable sleep: No significant differences were found between the groups	Not reported	No adverse events
Yeh *et al*., 2013 [35]	United States	n=16, heart failure with preserved ejection fraction (NYHA class I-III), left ventricular ejection fraction ≥50%	*n*=8, male/female: 4/4, mean age 68±11 years Exercise type: Tai Chi Length: 60 min Frequency: 5 times/ week Duration: 12 weeks Intensity: Not reported Timing: Not reported	*n*=8, male/female: 4/4, mean age 63±11 years Exercise type: AE Length: 60 min Frequency: 3 times/ week Duration: 12 weeks Intensity: Not reported Timing: Not reported	6MWT Peak oxygen uptake BNP HR SBP DBP MLHFQ POMS	BNP, HR, SBP, DBP: No significant differences were found between the groups 6MWT: Significant increase in the IG Peak oxygen uptake: Significant decrease in the CG MLHFQ, POMS scores: Significantly improved in the IG	Not reported	Not adverse events

NYHA: New York Heart Association, SBP: Systolic blood pressure, DBP: Diastolic blood pressure, ISWT: Incremental shuttle walk test, MLHFQ: Minnesota living with heart failure questionnaire, SCL-90-R: Symptom checklist-90-revised, AE: Aerobic exercise, VO_2: Oxygen consumption, 6MWT: 6 minutes walking test, NT pro-BNP: N-terminal pro-brain natriuretic peptide, MacNewQLMI: MacNew quality of life after myocardial infarction questionnaire, IG: intervention group, CG: control group, HR: Heart rate, PFS: Piper Fatigue Scale, PCI: percutaneous coronary intervention, CAD: Coronary artery disease, CABG: Coronary artery bypass graft, OP: Operation, LVEF: Left ventricular ejection fraction, BMI: Body mass index, SF-36: Self-assessment of health status questionnaire, WHOQOL-BREF: World Health Organization quality of life- brief form questionnaire, QOL: Quality of life, SAQ: Seattle angina questionnaire, , LVEDVi: Left ventricular end-diastolic volume index, LVESVi: Left ventricular end-systolic volume index, LVEF: Left ventricular ejection fraction, BNP: B-type natriuretic peptide, VE peak: Minute ventilation peak, VE/Vco2 slope: Minute ventilation/carbon dioxide production slope, MACE: Major adverse cardiac event, CHD: Coronary heart disease, BRS: Baroreflex sensitivity, HRV: Heart rate variation, LF power: Low-frequency power, HF power: High-frequency power, MI: Myocardial infarction, LDL: Low- density lipoprotein, HDL: High- density lipoprotein, METs: Metabolic equivalents, CDS: Cardiac Depression Scale, HAM-A: Hamilton Anxiety Rating Scale, DASI: Duke activity status, RPE: Rating of Perceived Exertion Scale, HFC: High-frequency coupling, LFC: Low-frequency coupling, POMS: Profile of Mood States