Yoga for secondary prevention of coronary heart disease

(Review)

Lau HLC, Kwong JSW, Yeung F, Chau PH, Woo J

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[Intervention Review]

Yoga for secondary prevention of coronary heart disease

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ABSTRACT

Background

Coronary heart disease (CHD) is the major cause of early morbidity and mortality in most developed countries. Secondary prevention aims to prevent repeat cardiac events and death in people with established CHD. Lifestyle modifications play an important role in secondary prevention. Yoga has been regarded as a kind of physical activity as well as stress management strategy. Growing evidence suggests the beneficial effects of yoga on various ailments.

Objectives

To determine the effectiveness of yoga for secondary prevention of mortality, morbidity, and health related quality of life of patients with CHD.

Search methods

We searched the Cochrane Central Register of Controlled Trials (CENTRAL) on The Cochrane Library (2012, Issue 1), MEDLINE (1948 to January 2012), EMBASE (1980 to January 2012), ISI Web of Science for conference proceedings (1970 to January 2012), China Journal Net (CJN) (1994 to March 2012), WanFang Data (1990 to March 2012), and HKInChiP (from 1980). Ongoing studies were identified in the metaRegister of Controlled Trials (April 2012) and the World Health Organization (WHO) International Clinical Trials Registry Platform (April 2012). No language restrictions were applied.

Selection criteria

We included randomized controlled trials (RCTs) investigating the influence of yoga practice on CHD outcomes. We included studies that had at least a six months follow-up period. Men and women (aged 18 years and above) with a diagnosis of acute or chronic CHD were included. We included studies with one group practicing a type of yoga compared to the control group receiving either no intervention or interventions other than yoga.

Data collection and analysis

Two authors independently selected studies according to the pre-specified inclusion criteria. Disagreements were resolved by consensus or discussion with a third author.
Main results
We found no eligible RCTs that met the inclusion criteria of the review and thus we were unable to perform a meta-analysis.

Authors’ conclusions
The effectiveness of yoga for secondary prevention in CHD remains uncertain. Large RCTs of high quality are needed.

PLAIN LANGUAGE SUMMARY
Yoga for secondary prevention of coronary heart disease
Coronary heart disease (CHD) is a major cause of early morbidity and mortality in most developed countries. Individuals with CHD are at the highest risk of coronary events and death, yet effective secondary prevention can reduce their risk of repeat events or death. Lifestyle modifications play an important role in secondary prevention. Yoga has been regarded as both a kind of physical activity and a stress management strategy. The physical and psychological benefits of yoga have been well accepted, yet inappropriate practice of yoga may lead to musculoskeletal injuries, such as muscle soreness and strain. The aim of this systematic review was to determine the effectiveness of yoga for secondary prevention in CHD in terms of mortality, morbidity, and health related quality of life. The authors found no randomized controlled trials which met the inclusion criteria for this review. Therefore, the effectiveness of yoga for secondary prevention in CHD remains uncertain. High-quality RCTs are needed.

BACKGROUND

Description of the condition
Cardiovascular disease (CVD), including coronary heart disease (CHD) and stroke, remains a major cause of early morbidity and mortality in most developed countries, and is one of the major non-communicable diseases burdening healthcare systems and causing great socioeconomic harm within all countries (Hobbs 2004; USHHS 1996; WHO 2011a). CVD is the world’s largest killer, an estimated 17.3 million people died from CVDs in 2008 representing 30% of all global deaths. Of these deaths, an estimated 7.3 million were due to CHD (WHO 2011b). Numerous risk factors of CVD have been identified including hypertension, hyperlipidaemia, hyperglycaemia, unhealthy diet, physical inactivity, tobacco use, harmful use of alcohol, obesity, and psychosocial stress (Hobbs 2004; Rozanski 2005; WHO 2011b). These behavioural risk factors are responsible for about 80% of CHD and cerebrovascular disease (WHO 2011b). Moreover, psychosocial stress induces adverse changes in autonomic tone accounting for significant but modifiable cardiovascular risks (Larzelere 2008; O’Keefe 2009; WHO 2011b); it also adversely affects recovery after major CHD events (Lavie 2009; Rozanski 2005). The INTERHEART study assessed the importance of risk factors for CHD (Yusuf 2004). Psychosocial stress accounted for 28.8% (99% confidence interval (CI) 22.6 to 35.8) of the population’s attributable risk of acute myocardial infarction, comparable to risk factors such as hypertension and smoking. People with established CHD are at the highest risk of coronary events and death, yet effective secondary prevention can reduce their risks of repeat events or death (Hobbs 2004; Lindholm 2007; Murchie 2003). Evidence-based guidance for secondary prevention of CHD includes pharmaceutical interventions (for example aspirin, antiplatelet agents, angiotensin converting enzyme inhibitors, statins, and β blockers), surgical revascularization (for example coronary artery bypass grafting, percutaneous coronary intervention), and lifestyle modifications (for example dietary modification, physical activity, smoking cessation, stress management) (AHA 2011a; Hall 2010; Leon 2005; Murchie 2003; O’Keefe 2009; Schnell 2012; Smith 2011; WHO 2007; Williams 2002). Since yoga, as a lifestyle modification which involves both physical activity and stress management it may have beneficial effects on CHD (Frishman 2005).

Description of the intervention
Yoga originated from India more than 5000 years ago. Its principle is to achieve the integration and balance of body, mind, and spirit (Barnes 2008; Kappmeier 2006). The three basic components, namely ‘Asana’ (posture), ‘Pranayama’ (breathing), and ‘Dhyana’ (meditation), are integrated with one another (Riley 2004). Pract-
ticing yoga postures improves flexibility and strength in a controlled fashion. Controlled breathing helps the mind to focus and is an important component of relaxation, a modulator of autonomic nervous system function. Meditation aims to calm the mind. Due to the long history of yoga, one finds different opinions amongst scholars in classifying the systems of yoga. Hatha yoga is the most widely practiced Yoga in the West (Hewitt 2001). Hatha yoga is the physical aspect of yoga and includes the aforementioned Asana and Pranayama (Hewitt 2001; YA 2011). Yoga can be practiced and taught in various styles such as Ananda, Ashtanga, Bikram, Iyengar, Integral, Kripalu, Kandalini, Power, Sivananda, and Vinyasa, and each style has unique characteristics (YA 2011). Yoga is increasingly popular as a form of recreation or physical activity, and the physical and psychological benefits of yoga are well accepted (Saper 2004). A growing body of evidence has demonstrated that yoga has positive influences on various conditions. For example, yoga has been found to manage and reduce the symptoms of urological disorders (Ripoll 2002), pulmonary tuberculosis (Visweswariah 2004), osteoarthritis (Bukowski 2007), and menopause (Booth-LaForce 2007); and to have physical benefits with decreased distress and relief of perceived pain for individuals with rheumatoid arthritis (Bosch 2009), chronic obstructive pulmonary disease (Donesky-Curenco 2009), and chronic back pain (Groessl 2008; Tekur 2008). Evidence also suggests that yoga has beneficial effects on various psychological states on different populations such as the mood state of individuals undergoing inpatient psychiatric treatment (Lavey 2005); decreased symptoms of depression, trait anxiety, negative mood, and fatigue in mildly depressed young adults (Woolery 2004); reduced stress and improved psychological outcomes in women suffering from mental distress (Michalen 2005); and improved sleep quality in a chronic insomnia population. Furthermore, there is increasing research interest in examining yoga intervention for healthy seniors and cancer patients. Existing findings demonstrate that yoga helps improve physical fitness and quality of life of older adults (Chen 2008; Oken 2006). Yoga may also assist cancer patients in improving sleep quality, mood, stress, and quality of life, and in reducing fatigue (Culos-Reed 2006; DiStasio 2008; Vadiraja 2009).

**How the intervention might work**

A high level of physical activity plays a major role in preventing obesity, diabetes mellitus, and CVDs (Mendelson 2008; Mittal 2008). Regular physical activity decreases the risk of CVD mortality in general and CHD mortality in particular (O’Keefe 2009; USHHS 1996). It is beneficial to include exercise in the treatment of CVD patients as exercise has favourable effects on CVD risk factors, symptoms, functional capacity, physiology, and quality of life (ACSM 2010; AHA 2011b; Leon 2005). A previous Cochrane review examined the effectiveness of exercise-based cardiac rehabilitation of patients with CHD; the results suggested that medium to longer term (that is 12 or more months follow-up) exercise-based rehabilitation reduced overall mortality (relative risk (RR) 0.85, 95% CI 0.75 to 0.99) and cardiovascular mortality (RR 0.74, 95% CI 0.63 to 0.87) (Heran 2011). Yoga is a relatively safe and gentle physical activity for promoting general health and a state of emotional well-being for sedentary individuals who have special health concerns such as established CVD, obesity, and musculoskeletal problems that can limit their mobility and tolerance to highly demanding physical exercises. An individual may experience different kinds and degrees of physical health benefits and improvements in functional capacity depending on how they practice yoga. For example, if the individual practices a single yogic posture separately, improvements in muscular strength, flexibility, and posture may be achieved, whereas improved cardiorespiratory fitness may be found when the individual practices poses continuously and intensively. Thus, the effectiveness of yoga on health related physical fitness components, especially cardiorespiratory endurance, remains questionable. Hagins et al (Hagins 2007) conducted an observational study with 20 intermediate-to-advanced level yoga practitioners. Their findings suggested that the metabolic costs of Hatha yoga averaged across the entire session represent a low level of physical activity (for example walking on a treadmill at 3.2 km/h), which does not meet the recommendations for the physical activity level required for improving or maintaining health or cardiovascular fitness; yet incorporating sun salutation, a sequence of yoga postures, and exceeding the minimum bout of 10 minutes may contribute some portions of an adequately intense physical activity to improve cardiorespiratory fitness in unfit or sedentary individuals. Moreover, results of a study of older men with established CHD suggested that light and moderate levels of physical activities (for example walking, gardening, and recreational activity) are associated with significant reductions in the risk of all-cause and cardiovascular mortality rates (Wannamethee 2000). Therefore, yoga can help sedentary CHD patients become more physical active in a comparatively gentle and all-round fashion. Yoga is not only a physical activity but also a stress management strategy. Exercise training has been associated with a reduction in psychosocial stress (O’Keefe 2009), whereas stress management strategies can improve subjective and objective measures of psychosocial stress (AHA 2011b; Larzelle 2008; O’Keefe 2009). A previous Cochrane review determined the effects of psychological interventions in patients with CHD, suggesting that psychological interventions produced a modest positive effect in the reduction of cardiac mortality (RR 0.80, 95% CI 0.64 to 1.00) (Whalley 2011). The potential mechanisms of yoga-induced physio-psychological changes include reducing the activation and reactivity of the sympathoadrenal system and the hypothalamic-pituitary-adrenal (HPA) axis (Innes 2007), and countering the aroused autonomic nervous system activity and reversing it back to the relaxed state (Levine 2000; Michalsen 2005). A growing body of research has explored the yoga-induced changes. For example, findings have suggested significantly decreased cortisol levels (Bosch
improved sympathetic and parasympathetic reactivity with Pranayama practice in hypertensive patients (Mourya 2009); and reduced stress and an improved adaptive autonomic response to stress in healthy pregnant women (Satyapriya 2009). Furthermore, significant reductions in noradrenline and self-rated stress and stress behaviour were found in a randomized controlled study which investigated the effects of yoga on healthy individuals (Granath 2006).

Adverse effects
Potential adverse effects have to be considered. The major adverse effects of physical activities such as yoga include musculoskeletal injuries (Jayasinghe 2004; USHHS 1996). Injuries may be due to overtraining, overuse of the muscles, and incorrect movements. The common injuries found when practicing yoga include strains as a result of falling down when executing balancing poses; muscle or tendon tears due to overstretching the muscle when executing stretching poses; and muscle soreness, muscle stiffness, and even bone fractures caused by spinal misalignment when performing weight-bearing poses repeatedly and incorrectly. Even though regular physical activity improves cardiorespiratory fitness, it can also increase the risk of serious cardiac events (for example sudden death) for sedentary individuals who suddenly exercise vigorously (USHHS 1996). Yoga can be considered as a safe form of physical activity if practiced under the guidance and supervision of qualified instructors (Jayasinghe 2004).

Why it is important to do this review
To the best of our knowledge, few randomized controlled trials have determined the effectiveness of yoga for secondary prevention in CHD. A few existing reviews examined the efficacy of yoga in the primary and secondary prevention of CVD and the related risks (Innes 2005; Jayasinghe 2004), yet they identified studies regardless of the type of study. Therefore, an exhaustive systematic review is needed which examines available evidence based on randomized controlled trials, and determines whether yoga is an effective measure for patients with CHD to reduce their mortality and morbidity, and improve quality of life.

OBJECTIVES
To determine the effectiveness of yoga for secondary prevention of mortality and morbidity, and health related quality of life of patients with CHD.

METHODS

Criteria for considering studies for this review

Types of studies
We included randomized controlled trials (RCTs) investigating the influence of yoga on patients with CHD. The length of follow-up had to be six months or more for the trial to be eligible for inclusion.

Types of participants
Men and women aged 18 years and above with a diagnosis of acute or chronic CHD (acute or previous myocardial infarction, stable or unstable angina) according to the definitions of the individual studies and irrespective of setting.

Types of interventions
We included trials investigating any types of yoga compared to a control group receiving no intervention or interventions other than yoga. We excluded multifactorial intervention trials (including other kinds of stress management strategies and physical activities) from this review to avoid confounding.

Types of outcome measures

Primary outcomes
1. All-cause mortality
2. Cardiovascular mortality
3. Composite cardiovascular events (cardiovascular death, non-fatal myocardial infarction, unstable angina pectoris, resuscitated cardiac arrest, stroke, and cardiac revascularization procedures)
4. Cardiovascular related hospital admissions
5. Health related quality of life

Secondary outcomes
1. Adverse effects
2. Costs

Search methods for identification of studies

Electronic searches
We searched the Cochrane Central Register of Controlled Trials (CENTRAL) on The Cochrane Library (2012, Issue 1), MEDLINE (1948 to January 2012), EMBASE (1980 to January 2012), ISI Web of Science for conference proceedings (1970 to January 2012).
2012), China Journal Net (CJN) (1994 to March 2012), Wan- Fang Data (1990 to March 2012), and HKInChiP (from 1980). The MEDLINE and EMBASE searches used the Cochrane sensitivity-maximizing RCT filters (Lefebvre 2011). These filters were adapted for use in other databases, where appropriate. The electronic databases were last searched on 23 January 2012 with the exception of CJN, WanFang Data, and HKInChiP, which were last searched on 23 March 2012.

No language or publication status restrictions were applied. See: the appendices for details of search strategies for CENTRAL (Appendix 1), MEDLINE (Appendix 2), EMBASE (Appendix 3), ISI Web of Science for conference proceedings (Appendix 4), CJN (Appendix 5), WanFang Data (Appendix 6), HKInChiP (Appendix 7)

Searching other resources

We contacted the authors of ongoing or unpublished studies for further information. Known experts in this field were contacted for relevant data in any ongoing or unpublished study. We hand-searched both Journal of Yoga and Physical Therapy and International Journal of Yoga Therapy for additional studies. These two sources were last searched on 25 April 2012. We searched for potentially eligible studies in the reference lists of included studies. Ongoing studies were identified in the metaRegister of Controlled Trials (mRCT) (www.controlled-trials.com/mrct) (April 2012) and the World Health Organization (WHO) International Clinical Trials Registry Platform (apps.who.int/trialsearch) (April 2012). These two sources were last search on 27 April 2012. See: the appendices for details of search strategies for mRCT (Appendix 8) and the WHO International Clinical Trials Registry Platform (Appendix 9)

Data collection and analysis

Selection of studies

One author (HLCL) performed the initial screening of titles and abstracts generated by the electronic searches. Full-text papers were retrieved for further assessment. Two authors (HLCL, FY) independently assessed the full-texts for eligibility for inclusion against the pre-specified inclusion and exclusion criteria. Disagreements were resolved by consensus or discussion with a third author (JK). As we did not identify any trials that met our inclusion criteria, we did not perform data collection and synthesis or assessment of risk of bias. We will perform the following methods with available data in our subsequent updates of the review.

Data extraction and management

In future updates, two authors (HLCL, JK) will independently extract data using a standardized data extraction form. All relevant data on study design and settings, types of participants, interventions, and outcome measures will be extracted and recorded in the data extraction form. We will resolve disagreements by consensus or discussion with a third author (FY).

Assessment of risk of bias in included studies

In future updates, two authors (HLCL, JK) will independently assess risk of bias in the included studies as per the Cochrane Collaboration’s tool for assessing risk of bias (Higgins 2011). We will assess six specific domains: sequence generation, allocation concealment, blinding, incomplete outcome data, selective outcome reporting, and other sources of bias.

Dealing with missing data

In future updates, we will contact the original trial investigators in the case of missing or insufficient data to obtain further information. Available data will be analysed and missing data discussed as potential limitations of our review.

Data synthesis

We will calculate dichotomous data as risk ratios (RRs) and continuous data as mean difference (MD) or standardized mean difference (SMD). We will use a random-effects model and fixed-effect model to perform meta-analysis.

Subgroup analysis and investigation of heterogeneity

With sufficient data, we will explore subgroup analyses for gender, age, types of yoga, and trial duration. We will investigate statistical heterogeneity across the included studies using the I² statistic. We will apply a fixed-effect model where there is no heterogeneity. Where substantial heterogeneity is observed (I² > 50%), we will conduct meta-analyses using a random-effects model (Higgins 2011).

Sensitivity analysis

We will compare trials at low risk of bias with those at high risk of bias in a sensitivity analysis in order to explore the impact of bias on the treatment effects.

RESULTS
Description of studies
See: Characteristics of excluded studies; Characteristics of studies awaiting classification; Characteristics of ongoing studies.
See: Characteristics of excluded studies; Characteristics of studies awaiting classification; Characteristics of ongoing studies.

Results of the search
Our study selection process was illustrated as a PRISMA flowchart in Figure 1 (Moher 2009). We identified 237 citations with our search strategy, of which 54 were published in languages other than English (Mandarin citation, German, Dutch, and Russian). Those publications written in German and Dutch were translated by native speakers, but we failed to get a Russian translator. Titles and abstracts were first screened by one author (HLCL) and then independently screened by two authors (HLCL, FY). A total of 215 irrelevant records (for example program descriptions, review articles, case studies, or studies using a combination of treatments (such as aerobic exercise, music therapy, progressive muscular relaxation)) were excluded and the full-text of 18 records (17 studies) were obtained for full assessment as they appeared to meet the inclusion criteria. They were excluded upon further examination (see Characteristics of excluded studies). Three studies were categorized as studies awaiting classification and one study was categorized as an ongoing study; we are awaiting additional information from the study investigators on study details and data. Further details on these trials are provided in the Characteristics of studies awaiting classification and Characteristics of ongoing studies tables respectively.

Excluded studies
We excluded 17 studies that first appeared to be eligible for this review because: they were not randomized, they investigated patients suffering from CVDs other than CHD, or data on the outcome measures included in this review were not available. Reasons for exclusion are listed in the Characteristics of excluded studies table.

Risk of bias in included studies
None of the trials that were identified met the inclusion criteria for this review.

Effects of interventions
In the absence of any suitable RCTs, we were unable to perform any analyses.

**DISCUSSION**

There were insufficient data to determine the effectiveness of yoga for secondary prevention in CHD. This might be due to a lack of research interest in this topic and a low prevalence in the use of yoga for treating chronic health problems. Previous systematic reviews (Innes 2005; Jayasinghe 2004) studied the efficacy of yoga in primary and secondary prevention of CVD. The majority of the identified studies focused on primary prevention, and only a few identified studies investigated secondary prevention. This may reflect under-researching in this topic. A population-based survey (Barnes 2008) suggested a significant increase in the use of yoga as a kind of complementary and alternative medicine (CAM). However, the participants had a tendency to use CAM to treat musculoskeletal problems rather than chronic diseases such as cholesterol problems. The low prevalence in the use of yoga might limit exploration of the therapeutic potential of yoga.

**Potential biases in the review process**

Our search was comprehensive and we identified both studies in languages other than English and several unpublished studies through the trial registration platforms. The chief investigators of some identified studies were contacted to obtain additional methodological information to inform our decision whether those studies should be included, however most investigators did not reply to our enquiry emails. Therefore, we cannot rule out the possibility that some studies may have been missed.

**AUTHORS’ CONCLUSIONS**

**Implications for practice**

At present there is no evidence to evaluate the effectiveness of yoga for secondary prevention in CHD, and hence no reliable conclusions can be drawn to support the use of yoga for secondary prevention in CHD. Increasing evidence has accumulated that yoga has therapeutic effects on various ailments and conditions, and thus the potential effects of yoga in preventing CHD may be warranted.

**Implications for research**

We identified one ongoing trial (CTRI/2012/02/002408) which may meet our inclusion criteria, however we still need high-quality RCTs to obtain a definitive answer to the question of the effectiveness of yoga for secondary prevention in CHD. Better methodological quality should be emphasized in future studies, the design of trials, random sequence generation, allocation concealment and blinding, estimating sufficient sample sizes to achieve adequate power, thus bias could be avoided and methodological quality improved. Trials should include relevant outcomes such as morbidity, composite cardiovascular events, and quality of life. Evaluation of cost, cardiovascular related hospital admissions, and adverse events are also needed. Participants from different ethnic groups and in different countries could be considered as part of more widespread research.

**ACKNOWLEDGEMENTS**

We would like to thank the editorial staff, editors and peer reviewers from the Cochrane Heart Group for their helpful advice, Prof Shah Ebrahim and the editorial team for constructive suggestions in the review development, Jo Abbott for revising and running the search strategy, providing the search results from English databases, and seeking translation services, and Nicole Martin and Haroen Shahak for translating articles written in German and Dutch, respectively.

**REFERENCES**

References to studies excluded from this review

**Boxer 2010**  *(published data only)*


**Casey 2009**  *(published data only)*


**Cheung 2009**  *(published data only)*


**Cui 2011**  *(published data only)*

Edelman 2006 (published data only)

Hipp 1998 (published data only)

Jatuporn 2003 (published data only)

Kulshreshtha 2011 (published data only)

Langosch 1982 (published data only)

Ma 2010a (published data only)

Manchanda 2000 (published data only)


Nyklicek 2008 (published data only)

Pal 2011 (published data only)

Robert-McComb 2004 (published data only)

Rutledge 1999 (published data only)

Schneider 1995 (published data only)

Yogendra 2004 (published data only)

References to studies awaiting assessment

Ma 2010b (published data only)

Olivo 2009 (unpublished data only)
Olivo EL. Usefulness of Integrative Medicine Tools As Adjunctive Care for Women After Coronary Artery Bypass Grafting. clinicaltrials.gov/show/NCT01020227 (accessed 27 April 2012).

Sheps 2007 (unpublished data only)
Sheps D. Mindfulness-Based Stress Reduction and Myocardial Ischemia. clinicaltrials.gov/show/ NCT00224835 (accessed 27 April 2012).

References to ongoing studies

CTRI/2012/02/002408 (unpublished data only)
CTRI/2012/02/002408. A study on effectiveness of YOGA based cardiac rehabilitation programme in India and United Kingdom. ctri.nic.in/CTRIRepositorystudyid=3992 (accessed 27 April 2012).

Additional references

**Frishman 2005**


**Granath 2006**


**Groessl 2008**


**Hagins 2007**


**Hall 2010**


**Heran 2011**


**Hewitt 2001**


**Higgins 2011**


**Hobbs 2004**


**Innes 2005**


**Innes 2007**

Innes KE, Vincent HK, Taylor AG. Chronic stress and insulin resistance-related indices of cardiovascular disease

Jayasinghe 2004
Jayasinghe SR. Yoga in cardiac health (a review). The European Society of Cardiology 2004;11(5):369–75.

Kappmeier 2006

Larzelere 2008

Lavey 2005

Lavie 2009

Lefebvre 2011

Leon 2005

Levine 2000

Lindholm 2007

Mendelson 2008

Michalsen 2005

Mittal 2008

Moher 2009

Mourya 2009

Murchie 2003

O’Keefe 2009

Oken 2006

Riley 2004

Ripoll 2002

Rozanski 2005

Saper 2004

Satyapriya 2009
Schnell 2012

Smith 2011

Tekur 2008

USHHS 1996

Vadiraja 2009

Visweswaraiah 2004

Wannamethee 2000

West 2004

Whalley 2011

WHO 2007

WHO 2011a

WHO 2011b

Williams 2002

Woolery 2004

YA 2011

Yusuf 2004

* Indicates the major publication for the study
### Characteristics of excluded studies [ordered by study ID]

<table>
<thead>
<tr>
<th>Study</th>
<th>Reason for exclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boxer 2010</td>
<td>Participants were not coronary heart disease patients.</td>
</tr>
<tr>
<td>Casey 2009</td>
<td>The study was not a randomized controlled trial. <em>(Quote: &quot;this analysis did not include a control group for comparison.&quot;)</em></td>
</tr>
<tr>
<td>Cheung 2009</td>
<td>It was a descriptive study.</td>
</tr>
<tr>
<td>Cui 2011</td>
<td>The study was not a randomized controlled trial. <em>(The subjects were randomly assigned to intervention and control groups, but the intervention consisted of various kinds of treatments, and the subjects were able to choose the treatments based on personal preference)</em></td>
</tr>
<tr>
<td>Edelman 2006</td>
<td>The study investigated participants with cardiovascular risk factors without cardiovascular diseases. <em>(Quote: &quot;We excluded subjects with active cardiovascular disease, defined as a history of myocardial infarction (MI), congestive heart failure, or cerebrovascular accident (CVA).&quot;)</em></td>
</tr>
<tr>
<td>Hipp 1998</td>
<td>The study was not a randomized controlled trial, and the outcomes in this review were not available.</td>
</tr>
<tr>
<td>Jatuporn 2003</td>
<td>The outcomes we examined in this review were not available.</td>
</tr>
<tr>
<td>Kulshreshtha 2011</td>
<td>No full-text could be found, the follow-up period and other outcome measures of the study were uncertain (we cannot contact the authors for the details)</td>
</tr>
<tr>
<td>Langosch 1982</td>
<td>The study was not a randomized controlled trial. <em>(Quote: &quot;Subjects here assigned to one of the treatment groups according to personal preference.&quot;)</em></td>
</tr>
<tr>
<td>Ma 2010a</td>
<td>The follow-up period was shorter than six months (data were available for four periods: eight hours, one week, three weeks, and five weeks after percutaneous coronary intervention). The outcomes examined in this review were unavailable</td>
</tr>
<tr>
<td>Manchanda 2000</td>
<td>The intervention of the study consisted of a combination of treatments (i.e. yoga lifestyle methods, stress management, dietary control, and moderate aerobic exercise) We excluded multifactorial intervention trials from this review to avoid confounding</td>
</tr>
<tr>
<td>Nyklicek 2008</td>
<td>Participants were not coronary heart disease patients.</td>
</tr>
<tr>
<td>Pal 2011</td>
<td>The outcomes examined in this review were not available.</td>
</tr>
<tr>
<td>Robert-McComb 2004</td>
<td>The follow-up period was shorter than six months. <em>(Confirmed by contacting the author by email. Quote: &quot;We did not have a follow-up period other than the pre-post test following the intervention which was 8 weeks.&quot;)</em></td>
</tr>
<tr>
<td>Rutledge 1999</td>
<td>The study was not a randomized controlled trial, no control group was available.</td>
</tr>
</tbody>
</table>
Schneider 1995 | The outcomes examined in this review were not available, and patients suffered from hypertension
---|---
Yogendra 2004 | The study was not a randomized controlled trial. (Confirmed by contacting the author by email. Quote: “Our original study was prospective controlled open trial and not randomized.”)

### Characteristics of studies awaiting assessment [ordered by study ID]

#### Ma 2010b

<table>
<thead>
<tr>
<th>Methods</th>
<th>Randomized controlled trial</th>
</tr>
</thead>
</table>
| Participants | Ethnic: Chinese  
280 patients hospitalized in the previous month for ACS (ST segment elevation myocardial infarction, 31.7%; non-ST segment elevation myocardial infarction, 50.5%; unstable angina, 17.8%)  
Setting: outpatients  
Diagnostic criteria: depressive disorder for three months after the acute cardiac event  
Exclusion criteria: not stated |
| Interventions | Patient specific treatment group: exercise training, relaxation training, diet change, weekly counselling and monthly health education on the base of usual medicine treatment of coronary artery disease  
Control group: placebo - received usual outpatient care  
Treatment duration: 12 months |
| Outcomes | QOL was measured using the Medical Outcomes Study Short Form-36 (SF-36, Chinese version). Patient specific intervention resulted in greater improvement than placebo in the SF-36 physical function (70.25 ± 21.90 versus 63.09 ± 18.15, P = 0.015), role limitations (50.10 ± 12.59 versus 42.23 ± 18.63, P = 0.042), bodily pain (70.18 ± 18.03 versus 64.01 ± 16.57, P = 0.015), vitality (73.89 ± 13.49 versus 68.12 ± 11.34, P = 0.002), and mental health (79.93 ± 12.44 versus 76.33 ± 11.37, P = 0.038) factors |
| Notes | The detail of the relaxation training was not described in this abstract, therefore it was uncertain if the relaxation training included yoga. We sent an email to the author for details regarding the intervention (relaxation training). However, no response had been received from the author at the time of writing this review |

#### Olivo 2009

| Methods | Allocation: randomized  
Endpoint classification: safety/efficacy study  
Intervention model: parallel assignment  
Masking: single blind (outcome assessor)  
Primary purpose: supportive care |
| --- | --- |
| Participants | Inclusion criteria: female patients 18 years old or above who were undergoing CABG or valve surgery  
Exclusion criteria: non-English speaking and no home phone |
| Interventions | Intervention group: integrative therapies  
Patients in the intervention group were given a cardiac yoga video, a guided imagery audiotape, instruction in...
diaphragmatic breathing, and an educational booklet outlining recommendations for dietary change. Patients were followed for six months by a health educator who provided ongoing education and encouragement. **Control group: standard care**

Patients were given no intervention but were contacted at six weeks and six months for data collection purposes.

<table>
<thead>
<tr>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall mood as measured by the Profile of Mood States, perception of stress as measured by a single-item, Likert stress scale, psychological and mental health status as measured by the SF-36, and the occurrence of major adverse cardiac events (cardiovascular disease death, non-fatal myocardial infarction, myocardial revascularization procedure, stroke, non-coronary arterial revascularization, cardiovascular hospitalizations)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>The above information extracted from: <a href="http://www.clinicaltrials.gov/show/NCT01020227">www.clinicaltrials.gov/show/NCT01020227</a></td>
</tr>
</tbody>
</table>

According to the information extracted from the above website, the trial has been completed. However, the results of the trials were unavailable on this website and elsewhere. Therefore, we sent an email to the authors of this trial for details regarding the results. However, no response had been received from the author at the time of writing this review.

---

**Sheps 2007**

**Methods**
- Allocation: randomized
- Intervention model: factorial assignment
- Masking: open label
- Primary purpose: treatment

**Participants**
- Inclusion criteria
  - At least 18 years old
  - Confirmed CAD, the clinical diagnosis of coronary disease was defined by the presence of at least one of the following:
    - Abnormal coronary angiogram
    - Abnormal intravascular ultrasound (IVUS)
    - Abnormal flow reserve and documentation of one of the following: elevated troponin laboratory values typical for myocardial infarction; electrocardiogram (ECG) that shows W-wave abnormalities; nuclear scan that demonstrates a fixed wall motion abnormality consistent with an old myocardial infarct; greater than 95% probability of coronary disease according to the criteria of Diamond and Forrester.102; radionuclide study, dobutamine, or exercise echocardiographic study consistent with stress-induced ischaemia (development of segmental wall motion abnormalities or reversible perfusion defects on radionuclide imaging or wall motion, or on both radionuclide imaging or wall motion, or systolic thickening abnormalities on stress echocardiographic examination)

- Exclusion criteria
  - Current pregnancy or probability of pregnancy during the duration of the 12-week study
  - Diagnosis of unstable angina in the prior two months
  - Presence of other severe, complicating medical problems that significantly shortened the patients' life expectancy such that they were not expected to live for the 12 weeks of this study
  - Presence of serious psycho-pathology evidenced by BDI scores that indicate a clinically critical level of depression (score of 24 or above) with suicidal ideation; previous diagnosis of an organic mental disorder, schizophrenia, or any psychotic disorder; or psychiatric inpatient at any time during the last five years (if patients were excluded on the basis of depression scores indicating severe depression or suicidal ideation, referral for psychological services were offered)
  - Post-traumatic stress disorder (PTSD) greater than the 30% VA disability assignment (patients with less severe
PTSD were encouraged to participate
- Existing meditation practice
- Weight more than 400 pounds

Interventions
To test the efficacy of MBSR, patients were randomly assigned to one of three groups:
The MBSR condition was provided training in mindfulness meditation methods.
The patient education control group was provided with information about CAD in a didactic format. This condition controlled for the non-specific effects of contact in a therapeutic setting.
Excluding intervals spent in personal meditation practice in the mindfulness meditation condition, the length of sessions in the two intervention conditions were approximately equal.
The third group, a stress-monitoring usual care control condition, controlled for the effects of symptom measurement reactivity in patients receiving routine medical care.

Outcomes
Primary outcomes
1. Psychological stress-induced ischemia (measured by radionuclide imaging at Week 9)
2. Heart rate variability (measured by AECG at Week 9)
3. Peripheral artery response (measured by finger plethysmography at Week 9)
4. Psychological functioning (degree of depression measured by Beck Depression Inventory (BDI), anxiety by STAI, hostility by Cook-Medley Index, anger by STAXI, optimism by LOT-R, and quality of life/functional status by SF-36 at Weeks 9 and 20)
5. Daily mood diaries (obtained at Weeks 7-8 and Weeks 20-21)

Notes
The above information extracted from: [www.clinicaltrials.gov/show/NCT00224835](http://www.clinicaltrials.gov/show/NCT00224835)
According to the information extracted from the above website, the trial has been expected to be completed in 2008. However, the results of the trials were unavailable in this website and elsewhere. We do not know if the trial has been completed as expected. Therefore, we sent emails to the authors of this trial for further details. However, their email addresses listed in the above website were invalid.

 Characteristics of ongoing studies  [ordered by study ID]

<table>
<thead>
<tr>
<th>CTRI/2012/02/002408</th>
</tr>
</thead>
</table>

**Trial name or title**
A study on effectiveness of YOGA based cardiac rehabilitation programme in India and United Kingdom

**Methods**
Randomised, parallel group trial
Method of generating random sequence: computer generated randomization
Method of concealment: on-site computer system
Blinding/masking: open label

**Participants**
Inclusion criteria
- Male and female patients 30 - 80 years old
- Patients with first or consequent acute myocardial infarction who survive to hospital discharge.
Myocardial infarction will be confirmed by standard definition (symptoms, cardiac enzymes and electrocardiographic changes). Those that have undergone a revascularization procedure during previous or current admission will also be eligible
- Willing and able to attend the complete hospital-based CR programme on their own
- Patients who are willing to consent

Yoga for secondary prevention of coronary heart disease (Review)
Copyright © 2012 The Cochrane Collaboration. Published by John Wiley & Sons, Ltd.
Exclusion criteria
Patients who are not willing to consent

Interventions

<table>
<thead>
<tr>
<th>Intervention group: yoga-based cardiac rehabilitation programme</th>
</tr>
</thead>
<tbody>
<tr>
<td>The intervention being assessed will be Yoga-CaRe, a yoga-based cardiac rehabilitation programme, delivered at the hospital in 13 sessions spread over three months after enrolment, complemented by audio-video material for self-supervised sessions at home. All Yoga-CaRe sessions will be provided by the Yoga-CaRe instructor</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Control group: standard care</th>
</tr>
</thead>
<tbody>
<tr>
<td>The control arm will receive enhanced standard care involving a leaflet in the hospital before discharge (session one), followed by two sessions offering standard educational advice at weeks 5 and 12 (sessions two and three). The sessions will be delivered in groups (similar to the intervention). A different member of the team (i.e. not yoga instructor) will deliver these sessions to avoid contamination</td>
</tr>
<tr>
<td>Immediately after the last intervention session, an interview will be carried out in-person to collect data on quality of life, daily activities, smoking and compliance with medications, etc. Further follow-up will be carried out for hard end points (cardiac mortality and morbidity) through two-monthly telephone calls. The trial will last for two years, and all patients will be followed until the end of the trial (in order to ensure an average follow up of one year duration)</td>
</tr>
</tbody>
</table>

Outcomes

<table>
<thead>
<tr>
<th>Primary outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The primary outcome measure will be a composite of total mortality, non-fatal myocardial infarction and stroke</td>
</tr>
<tr>
<td>2. The co-primary outcome of quality of life outcome will be assessed by the EuroQol EQ-5D Health-Related Quality of Life (HRQOL) questionnaire</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Secondary outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Return to pre-infarct daily activities will be assessed by questionnaire</td>
</tr>
<tr>
<td>2. Data on smoking cessation and compliance with medication for secondary prevention will be based on self-reports</td>
</tr>
<tr>
<td>3. Cost-effectiveness will be assessed by the EuroQoL method</td>
</tr>
</tbody>
</table>

Starting date
September 2012

Contact information
Principal Investigator: Prof Dorairaj Prabhakaran
Email: dprabhakaran@ecdcindia.org

Notes
The above information was obtained by contacting the principal investigator by email, and was extracted from: www.ctri.nic.in/Clinicaltrials/pmaindet2.php?trialid=3992
DATA AND ANALYSES

This review has no analyses.

APPENDICES

Appendix 1. CENTRAL search strategy

#1 MeSH descriptor Yoga explode all trees
#2 MeSH descriptor Relaxation Therapy explode all trees
#3 yoga
#4 asana
#5 pranayama
#6 dhyana
#7 meditat*
#8 MeSH descriptor Meditation explode all trees
#9 hatha
#10 ananda
#11 ashtanga
#12 bikram
#13 iyengar
#14 integral near/5 yoga
#15 kripalu
#16 kundalini
#17 power near/5 yoga
#18 sivananda
#19 vinyasa
#20 (#1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11 OR #12 OR #13 OR #14 OR #15 OR #16 OR #17 OR #18 OR #19)
#21 MeSH descriptor Myocardial Ischemia explode all trees
#22 MeSH descriptor Coronary Artery Bypass explode all trees
#23 coronary near/2 disease*
#24 ischmi* next heart
#25 ischmi* next heart
#26 myocard* next ischmi*
#27 myocard* next ischaemi*
#28 myocard* next infarct*
#29 heart next infarct*
#30 coronary thrombo*
#31 coronary near/3 angioplast*
#32 angiina*
#33 coronary bypass*
#34 CABG
#35 PTCA
#36 MeSH descriptor Angioplasty explode all trees
#37 coronary next arterioscleroc*
#38 coronary next arterioscleros*
#39 (#21 OR #22 OR #23 OR #24 OR #25 OR #26 OR #27 OR #28 OR #29 OR #30 OR #31 OR #32 OR #33 OR #34 OR #35 OR #36 OR #37 OR #38)
Appendix 2. Ovid MEDLINE search strategy

Cochrane sensitive-maximising RCT filter applied (Handbook 2011)
1. Yoga/
2. Relaxation Therapy/
3. yoga.tw.
4. asana.tw.
5. pranayama.tw.
6. dhyana.tw.
7. meditat*.tw.
8. Meditation/
9. hatha.tw.
10. ananda.tw.
11. ashtanga.tw.
12. bikram.tw.
13. iyengar.tw.
15. kripalu.tw.
16. kundalini.tw.
17. (power adj5 yoga).tw.
18. sivananda.tw.
19. vinyasa.tw.
20. or/1-19
21. exp Myocardial Ischemia/
22. exp Coronary Artery Bypass/
23. (coronary adj2 disease*).tw
24. ischemi$ heart.tw
25. ischaemi$ heart.tw
26. myocard$ ischemi$.tw
27. myocard$ ischaemi$.tw
28. myocard$ infarct$.tw
29. heart infarct$.tw
30. coronary thrombo$.tw
31. (coronary adj3 angioplast*).tw
32. angina*.tw
33. coronary bypass*.tw
34. CABG.tw
35. PTCA.tw
36. Angioplasty, Transluminal, Percutaneous Coronary/
37. coronary arteroscleros*.tw.
38. coronary arterioscleros*.tw
39. or/21-38
40 20 and 39
41. randomized controlled trial.pt.
42. controlled clinical trial.pt.
43. randomized.ab.
44. placebo.ab.
45. drug therapy.fs.
46. randomly.ab.
47. trial.ab.
Appendix 3. EMBASE Ovid search strategy

Cochrane RCT filter (Handbook 2011)

1. Yoga/
2. Relaxation Therapy/
3. yoga.tw.
4. asana.tw.
5. pranayama.tw.
6. dhyana.tw.
7. meditat*.tw.
8. Meditation/
9. hatha.tw.
10. ananda.tw.
11. ashtanga.tw.
12. bikram.tw.
13. iyengar.tw.
15. kripalu.tw.
16. kundalini.tw.
17. (power adj5 yoga).tw.
18. sivananda.tw.
19. vinyasa.tw.
20. or/1-19
21. exp Myocardial Ischemia/
22. exp Coronary Artery Bypas
24. ischemi$ heart.tw.
25. ishaemi$ heart.tw.
26. myocard$ ischemi$.tw.
27. myocard$ ischaemi$.tw.
28. myocard$ infarct$.tw.
29. heart infarct$.tw.
30. coronary thrombo$.tw.
31. (coronary adj3 angioplast*).tw.
32. coronary bypass*.tw.
33. CABG.tw.
34. PTCA.tw.
35. Angioplasty, Transluminal, Percutaneous Coronary/
36. coronary arteroscleros*.tw.
37. coronary arterioscleros*.tw.
38. angina$.tw.
39. or/21-38
40. 20 and 39
41. random$.tw.
42. factorial$.tw.
43. crossover$.tw.
RCT filter adapted from Cochrane RCT filter.

# 26 #25 AND #24
# 25 Topic=((random* or blind* or allocat* or assign* or trial* or placebo* or crossover* or cross-over*))
# 24 #23 AND #7
# 23 #22 OR #21 OR #20 OR #19 OR #18 OR #17 OR #16 OR #15 OR #14 OR #13 OR #12 OR #11 OR #10 OR #9 OR #8
# 22 Topic="coronary arterioscleros*"
# 21 Topic="coronary arterioscleros*"
# 20 Topic=PTCA
# 19 Topic=CABG
# 18 Topic="coronary bypass*"
# 17 Topic=angina"
# 16 Topic=(coronary near/3 angioplast*)
# 15 Topic="coronary thrombo*"
# 14 Topic=heart infarct"
# 13 Topic="myocard* ischaemi*"
# 12 Topic="myocard* ischemi*"
# 11 Topic="myocard* infarct*"
# 10 Topic="ischaemi* heart"
# 9 Topic="ischemi* heart"
# 8 Topic=(coronary near/2 disease*)
# 7 #6 OR #5 OR #4 OR #3 OR #2 OR #1
# 6 Topic=(sivananda or vinyasa)
# 5 Topic=(kripalu or kundalini)
# 4 Topic=integral near/5 yoga
# 3 Topic=(hatha or ananda or ashtanga or bikram or iyengar)
# 2 Topic=(asana or pranayama or dhyana or meditat*)
# 1 Topic=(yoga)
Appendix 5. China Journal Net search strategy

(Apple 中国 OR 中国) AND (Apple 中文 OR 中文) AND (Apple 中文 OR 中文)

Appendix 6. WanFang search strategy

We used the following Chinese search terms:

1. 心脏病
2. 冠心病
3. 冠状动脉
4. 心血管
5. 心肌
6. 冠状动脉
7. 心脏病
8. 冠状动脉
9. 心肌

Appendix 7. HKInChiP search strategy

We used the following Chinese search terms:

1. 心脏病
2. 冠心病
3. 冠状动脉
4. 心血管
5. 心肌
6. 冠状动脉
7. 心脏病
8. 冠状动脉
9. 心肌

Appendix 8. The metaRegister of Controlled Trials

We used the following search terms: myocardial; angina; coronary heart; cardiovascular; each combined with the terms yoga, using the Boolean operator AND

Appendix 9. The WHO International Clinical Trials Registry Platform

We used the following search terms: myocardial; angina; coronary heart; cardiovascular; each combined with the terms yoga, using the Boolean operator AND

HISTORY

Protocol first published: Issue 12, 2011
Review first published: Issue 12, 2012
CONTRIBUTIONS OF AUTHORS

CHL Lau, J Kwong, and J Woo developed the original concept of the review and drafted the protocol. CHL Lau and F Yeung screened studies against the inclusion and exclusion criteria. PH Chau provided statistical advice. CHL Lau and J Kwong wrote the final review, and all authors read and approved it for publication.

DECLARATIONS OF INTEREST

None known

SOURCES OF SUPPORT

Internal sources

• The Chinese University of Hong Kong, Hong Kong.

External sources

• No sources of support supplied