Complementary Therapies in Clinical Practice 36 (2019) 49–55

Contents lists available at ScienceDirect

Complementary Therapies in Clinical Practice

journal homepage: www.elsevier.com/locate/ctcp

Effectiveness of Yoga Interventions in Breast Cancer-Related lymphedema: A systematic review

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ARTICLE INFO

Keywords:
Yoga
Breast cancer-related lymphedema
Intervention
Symptoms
Quality of life

ABSTRACT

Objectives: To synthesize recent empirical evidence on yoga-based interventions for patients with breast cancer-related lymphedema.
Methods: We searched the PubMed/MEDLINE, Cochrane Central Register of Controlled Trials and EMBASE databases for studies published between October 2007 and September 2018 in any language. Risk of bias and methodological quality were evaluated using the PRISMA statement and checklist and the Cochrane Collaboration tool.
Results: There was significant improvement in lymphedema status, range of shoulder motion and spinal mobility after an 8-week yoga intervention, whereas there was no consistency in quality of life following yoga intervention. Additionally, there was no difference in lymphedema status, extracellular fluid and tissue resistance outcomes in the affected arm following a long-term yoga practice.
Conclusion: The current findings could not be clearly demonstrated that yoga programme intervention as an addition to usual care is superior to along usual care, and keep yoga exercise does not provide significant added benefits.

1. Introduction

1.1. The concepts of breast cancer-related lymphedema

Lymphedema is a condition in which excessive, protein-rich extracellular fluid stagnates in soft tissue, causing inflammation, edema and fibrosis in the lymphatic system. It is difficult to treat and progression causes disfigurement and significant disruption of function and mobility in the affected region [1]. Lymphedema can be an isolated phenomenon or may be linked to mobility, certain diseases or life-threatening systemic syndromes [2]. The incidence of breast cancer-related lymphedema (BCRL) was recently reported to be about 6%–20% [3], which suggests that despite changes in medical treatment there has been no improvement in incidence of this complication of malignancy compared with the 15%–20% incidence rate of BCRL in 2000 [3].

There are two types of lymphedema: primary lymphedema caused by nature factors and secondary lymphedema caused by nurture factors. Secondary lymphedema is due to malfunction of the lymphatic system after lymph node removal, it is characterized by fibrotic change around the affected region caused by radiation therapy and is common in breast cancer survivors [4]. In clinical practice the International Society of Lymphology (ISL) staging system is the standard instrument for classification of a lymphedematous limb. Stage zero represents a latent or subclinical condition with no apparently swelling under an impaired

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https://doi.org/10.1016/j.ctcp.2019.05.004
Received 1 April 2019; Received in revised form 2 May 2019; Accepted 23 May 2019

lymph transport. In stage one limb swelling is visible, but the condition can be reduced by elevation of the affected limb. In stage two there is edema in the affected region and manifest pitting and limb elevation produces little reduction in swelling. Stage three lymphedema is characterized by overgrowth of skin, fat and tissue fibrosis, causing trophic skin change such as thickening and extensive edema, and the affected limb deforms to lymphostatic elephantiasis (Inte [2]. Breast cancer survivors with lymphedema suffer negative physical, mental and spiritual consequences and inconveniences in everyday daily life due to the intractable, irreversible nature of the condition and the fact that the resulting deformities attract attention [5].

1.2. The administrative methods for yoga used in breast cancer-related lymphedema

Yoga, which originated in India, is a practice with a 3000-year history and is used to bring about balance and management of physical, mental, psychological and emotional needs. It contains yama, niyama, asana, pranayama, pratyahara, dharana, dyana, and samadhi. Fluency in the physical postures of yoga can promote positive ethics, good posture, control, concentration, meditation and bliss [6,7]. Combining the muscle and joint training of yoga with breathing techniques and stretching to increase range of movement (ROM) can improve physical functioning, reduce swelling or limb volume and decrease tissue fibrosis and pain in the affected region [8,9].

The yoga program, once to twice-weekly 60-minute for a maximum 8-week, based on patients' physical condition and the severity of BCRL, was practiced on the patients of BCRL, and it included a warm-up, meditation and breathing exercise, yoga exercises, and then a cool-down exercise as final [10,11]. Moreover [8], discovered that there was physical restriction for BCRL using trandtional yoga and developed other protocol for better improvement in limb movement. For instance, the posture of Gomukha asana is to raising the left hand over the head and bend the left elbow, and then reaching behind the back with the right hand and clasping the fingers of both hands. There is difficulty for clasping the fingers of both hands on BCRL due to restricted shoulder movements of affected side, therefore, the alternate way to do gomukha asana is by holding the cloth for extending the shoulder movements slowly. Additionally, the posture of Tada asana is to standing with both feet touching from the heel to the big toe, keeping the back straight and the arms pressed slightly against the sides, and then inhaling through the nostrils, lifting the body and maintaining a firm posture from ears, shoulders, buttocks and ankles. However, it is difficult to balance the weight evenly due to limb lymphedema of BCRL, and standing against a wall with passive exercise with the support of unaffected limb were the alternative measure for practicing yoga.

Management of lymphedema should involve integrated care in order to promote effective self-management and maximize range of movement for the remainder of breast cancer survivors' lives. The 2015 Clinical Oncology Breast Cancer Survivorship Care Guideline of the American Cancer Society states that care for breast cancer survivors should be coordinated, multidisciplinary and include a personalized exercise program to prevent or reduce the progression of lymphedema in order to maintain good body image and quality of life (QOL) [12]. There has been no review of the effects of yoga interventions in BCRL patients, so the purpose of this systematic review was to compare whether the addition of yoga practice to usual care improves lymphedema status and QOL in breast cancer survivors.

2. Materials and methods

We carried out a systematic review of randomized control trials (RCTs) of the effects of yoga interventions in BCRL patients.

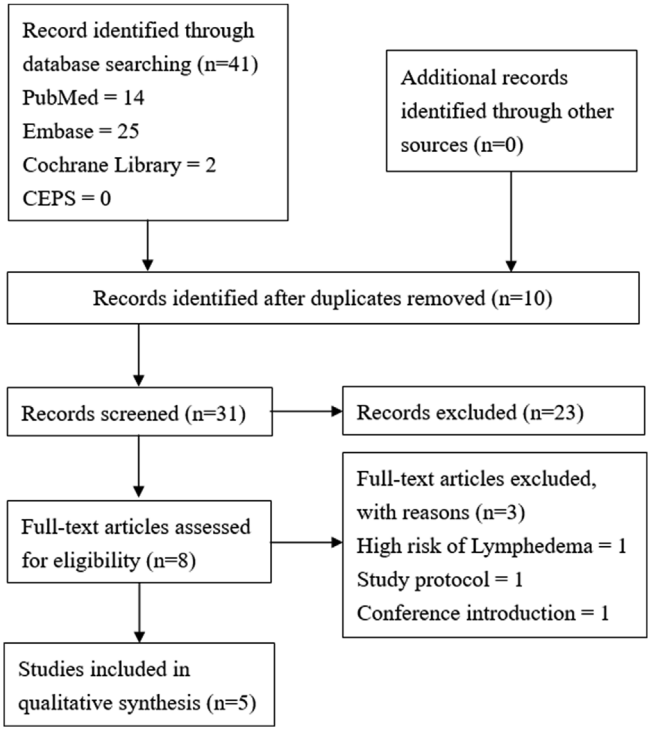

Fig. 1. RPISMA study flow chart.

2.1. Literature search

We searched PubMed/MEDLINE, the Cochrane Central Register of Controlled Trials (CENTRAL) and EMBASE for relevant publications added up to and including September 30th, 2018. We did not impose any language restrictions. The search strategy is shown in the Supplement.

2.2. Data sources and searches

The inclusion criteria were (a) subjects were breast cancer survivors of any age, gender or ethnicity; (b) the design was a RCT or quasi-experimental design; (c) outcomes included upper arm measurement; (d) yoga was the only intervention. The search strategy identified 41 publications. Ten duplicates were removed using the Endnote software, leaving 31 studies of which 23 were excluded following screening of the abstract as they did not meet the eligibility criteria. The full texts for the remaining studies were assessed for eligibility, resulting in exclusion of a further 3 studies (1 patients at high risk of lymphedema, 1 study protocol and 1 conference introduction.). Thus 5 studies were included in the systematic review. The PRISMA study flow chart is shown in Fig. 1.

2.3. Study selection

Three studies were RCTs comparing yoga with routine care [13–15]. The other two studies were quasi-experimental designs measuring outcome variables before and after a yoga intervention in a single group [16,17]. Four studies reported inclusion and exclusion criteria clearly. The exception was the study by Ref. [13]; which was designed to examine the long-term effects of yoga in BCRL patients and all participants had lymphedema at baseline.

All included studies reported the design, context, time and duration of the yoga intervention. The inclusion criteria applied in all studies were that participants had completed breast cancer treatment, including surgical and chemical therapy, at least six months previously, had more than one arm with stage one lymphedema status or were at

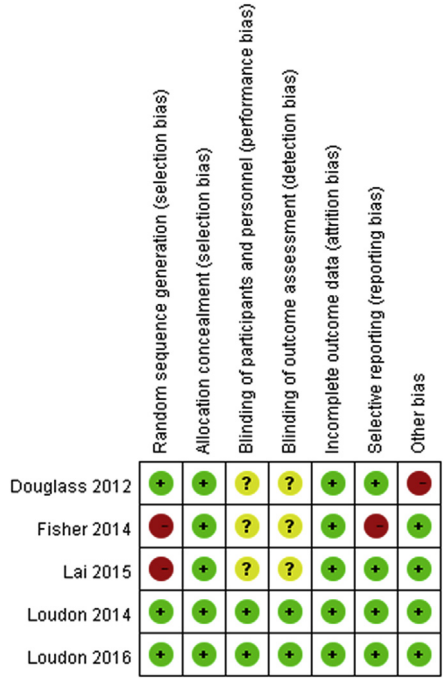

Fig. 2. Risk of bias summary.

high risk of BCRL of the upper arm. Diagnosis of lymphedema was based on the staging system of International Society of Lymphology or assessment by a professional lymphedema therapist.

2.4. Data extraction and quality assessment

The first author extracted data on study design, level of evidence, type of participants, intervention type and frequency, period, outcome measures and tools and main findings. Studies were initially assessed for eligibility by two independent reviewers on the basis of the title and abstract; conflicts were resolved through discussion.

The methodological quality of the studies was appraised independently by two authors on the basis of four criteria: method of random assignment, description of blind design, dropout rate and reasons for dropping out, and follow-up time points. Differences of opinion were resolved through discussion. The appraisal of study quality was based on the Systemic Reviews and Meta-Analyses (PRISMA) checklist and the Cochrane Collaboration tool was used to assess risk of bias in all studies [18].

The risk of bias assessments shown in Fig. 2. We used the Cochrane Collaboration tool to assess the risk of bias of the included the trials, and evaluated the following 7 domains associated with bias of intervention: random sequence generation, allocation concealment, blinding of participant and personnel, blinding of outcome assessment, incomplete outcome data (Attrition bias, it refers to systematic differences between groups in withdrawals from a study lead to incomplete outcome data. Exclusions refer to situations in which some subjects are omitted from reports of analyses, despite outcome data being available to the trial lists.), selective reporting, and other biases (bias due to problems not covered elsewhere). In the inclusive studies [13], did not report inclusion and exclusion criteria, so we assumed that there was a high risk of other bias [16]. did not report the occurrence of adverse effects during the yoga intervention, which may indicate a high risk of selective outcome reporting bias. Two quasi-experiment design studies were at high risk of selection bias due to the study design [16,17].

2.5. Data synthesis and analysis

There were four broad outcome variables: 1. Lymphedema status, assessed in terms of limb girth, limb circumference and extracellular fluid; 2. Strength, assessed as upper extremity muscle strength, grip strength, shoulder muscle strength and tissue resistance; 3. ROM and mobility of upper extremity, shoulder and spine; 4. Subjective assessments of pain, fatigue and QOL. Outcome variables were assessed at baseline, on completion of the yoga intervention, 8 or 12 weeks after intervention and 12 weeks or 6 months after intervention.

3. Results

3.1. Characteristics of the included trials

Three of the included studies were conducted in Australia, one in the United States and one in Taiwan. Sample size ranged from 6 to 23, with a total of 85 participants across all studies. All participants were women aged between 42 and 72 years old. All participants had undergone mastectomy, axillary lymph node removal, and/or chemical and radiation therapy before enrollment. In two studies the eligibility criteria were that participants had completed breast cancer treatment at least 6 months ago and were suffering from lymphedema, in two studies the sample suffered from lymphedema and in one study the sample comprised patients at high risk of lymphedema. In four studies the exclusion criteria were pregnancy, having a pacemaker, severe medical comorbidities, diagnosis of heart failure or chronic obstruction pulmonary disease, being in receipt of chemotherapy or radiotherapy, already engaged in a yoga program and history of severe psychological illness [17]. excluded patients with metastatic breast cancer [13]. did not report their exclusion criteria. In addition, two studies we included used one sample database and then analyzed it into different outcomes. Due to the different results both related to lymphedema they concluded, we took them into consideration as two independent research for further discover.

The sample included three double-blind RCTs and in which two were between participants and outcome assessors, and the other was between participants and key researcher. The other two studies were quasi-experimental designs involving pre and post-intervention measurements in a single group setting, without blinding. All participants in all studies were volunteers. Four studies reported that no adverse events occurred during the trial and there was no statement about adverse events in the studies of [16,17]. The level of evidence in the studies was between Ic and IIb. The characteristics of the studies are summarized in Table 1.

3.2. Yoga intervention program

The sample comprised three RCTs and three quasi-experimental studies. The three RCTs used very similar types of yoga intervention class and trial durations. In all cases the yoga intervention involved breathing exercises, physical postures, meditation and relaxation skills. In the [13] study the intervention included education about lymphedema and self-management of lymphedema-related symptoms and promotion of personalized self-care skills, with an emphasis on the need to avoid heavy loading exercise and to restrict static postures of the affected arm. The yoga program consisted of weekly 90-minute yoga classes with a professional trainer, and a 45–50-minute CD- or DVD-based program to perform at home on the remaining 6 days [13–15].

In two of the studies the yoga intervention lasted eight weeks and in the others it lasted four weeks [14,15]. compared a yoga intervention group with a control group that received standard care [13]. compared a group who had continued practicing yoga regularly for six months after completing a four-week yoga program with a group that had not continued regular yoga after the end of the four-week program. The three RCTs used Satyananda yoga-based yoga programs. The yoga

Table 1
Characteristics of breast cancer-related lymphedema studies.

Author/Country/ year	Research Design (Level of Evidence)	Sample (*N*)/Age (M ± SD)	Type of participants	Intervention Type	Frequency	Period	Outcome Measure	Measurement Tool	Main findings
Douglass et al. Australia 2012	RCT (Ic)	Con(9/60.4 ± 11.1) Ex(9/65.0 ± 12.4)	Breast cancer with BCRL	Group classes (education, asanas, breathing exercises, meditation) Home programme (based on practices in class)	Once/week, 90-min yoga class Home programme with CD use remaining 6 days	4 weeks	Extracellular fluid Arm volume and circumference Tissue tonometry Symptoms QOL	Perometer software Tissue tonometer SRL, VSA (Self-reported Questionnaire)	Lymphoedema status, tissue tonometry, all symptoms, and QOL were no significant difference between groups
Loudon et al. Australia 2014	RCT (Ic)	Con(11/60.5 ± 3.6) Ex(12/55.1 ± 2.5)	Breast cancer with BCRL	Group classes (breathing, postures, meditation, relaxation) Home programme (based on practices in class)	Once/week, 90-min yoga class Home programme with 45-min DVD use in daily	8 weeks	Arm circumference Extracellular fluid Tissue induration Subjective experience QOL	Tape BIS Digital tonometer VSA, LYMQOL (Self-reported Questionnaire)	Significant difference in lymphedema status, and symptom subscale of QOL of arm volume between groups
Fisher et al. United States 2014	Quasi-experimental (IIb)	6/57	Breast cancer with BCRL	Yoga studio sessions Home session	Two classes per week, lasting 60-min each class Home session with 45-min DVD use in daily	8 weeks	Arm function Arm volume Grip strength QOL	Handhold grip dynamometer Volumeter DASH, FACT-B (Self-reported Questionnaire)	Significant decrease in volume of affected arm Grip strength, QOL, DASH were no significant change
Lai et al. Taiwan 2015	Quasi-experimental (IIb)	15/range: 42-72	Breast cancer	Yoga sessions (warm-up, aerobics, muscle training, and cool-down)	Three times per week, 60-min session	12 weeks	Arm volume Lymphoedema status	Water-expelling method Visual edema score (Self-reported Questionnaire)	Lymphoedema status and arm volume were no significant change
Loudon et al. Australia 2016	RCT (Ic)	Con (11/60.5 ± 3.6) Ex (12/55.1 ± 2.5)	Breast cancer with BCRL	Yoga class (pranaysma, asana,meditation, relaxation) Home practice session by DVD	Once/week, 90-min yoga class Home programme with 45-min DVD use in daily	8 weeks	ROM Muscle strength Grip strength Spine mobility	Two-arm goniometer Handheld dynamometer Handheld grip dynamometer Video analysis	Significant difference in shoulder ROM, separate muscle strength, spine mobility, and grip strength of affected arm between groups

BCRL, breast cancer-related lymphoedema; BIS, bioimpedance spectroscopy; BMI, body mass index; CD, compact disc; Con, control group; DASH, disabilities of the arm, shoulder, and hand; DVD, digital video disk; Ex, yoga intervention group; FACT-B, functional assessment of cancer therapy-breast; LYMQOL, lymphoedema quality of life; RCT, randomized clinical trials; ROM, range of motion; SRL, self-reported lymphodedma; QOL, quality of life; VSA, visual analogue scale.

program used in the study of [13] was devised by a group consisting of a lymphedema practitioner and yoga teachers with experience of yoga for breast cancer survivors [13]. The other studies did not report how their yoga interventions had been developed.

The two quasi-experimental studies measured lymphedema status, arm volume and function, muscle and grip strength, and QOL before and after the yoga intervention [16]. used a yoga program based on hatha yoga, which consisted of twice-weekly 60-minute yoga classes and a 45-minute DVD-based program for home practice. The aim of the program was to get the participants to practice low-impact exercise, modified stretching and isometric exercises, and breathing and poses designed to improve lymphatic drainage [16]. In the study of [17] used a yoga program developed by an exercise trainer that was based on aerobic yoga training; it included a warm-up, aerobic exercise, posture-related resistance exercise, stretching exercises, breathing exercises, meditation and a cool-down and was delivered via thrice weekly 60-minute classes. The two studies the yoga intervention lasted eight weeks.

3.3. Outcome measurement

As shown in Table 2 the methods used to measure outcomes were upper extremity volume from bioimpedance spectroscopy (BIS), water-expelling method, tissue tonometer and tape [13,15,17]. Upper extremity or shoulder strength was measured with a handheld dynamometer in Loudon et al. study, and who used a two-armed goniometer to measure ROM of the shoulder [14]. Grip strength was measured with a hand-held grip dynamometer in two studies [14,16]. [14] analyzed video data to assess spinal mobility. Extra-cellular fluid from BIS, perometer software, visual edema score, and digital tonometer were used in the studies of [13,15,17] and QOL, subjective experience and symptoms were assessed using self-report questionnaires in three studies [13,15,16].

3.3.1. Effect of yoga on lymphedema status

Four studies reported change in lymphedema status. Two studies reported measurements made with non-stretch tape and the others used perometer software, BIS, volumeter or the water expulsion method. These studies indicated that the results of lymphedema were inconsistent. Two studies found no change in lymphedema status immediately after the yoga intervention initially or at a six-month follow-up [13,17], whereas [15,16] reported was a dramatic improvement in lymphedema status after an eight-week intervention.

Table 2
The instructment of outcome measurement

	[13]	[15]	[16]	Lai et al., 2015	[14]
Upper extremity volume from BIS Water-expelling method Tissue tonometer Tape	v	v		v	
Upper extremity or shoulder strength from MicroFet dynamometer Handheld dynamometer					v
Shoulder ROM from two-armed goniometer					v
Grip strength from hand-held grip dynamometer			v		v
Spinal mobility from video analysis					v
Extra-cellular fluid from BIS Perometer software Visual edema score Digital tonometer	v	v		v	
Quality of life Subjective experience Symptoms from self-reported questionnaire	v	v	v		

3.3.2. Effect of yoga on muscle strength

The strength of different regions of the affected arm was assessed in all six studies. Grip strength was assessed using a grip dynamometer in two studies [14,16]. Tonometer measurements showed no change in tissue tonometry after the intervention in two studies [13,15]. [14] used a handheld dynamometer (HHD) to measure the strength of the shoulder and other muscles and found that there was no statistically significant of the change on strength of all variables following an 8-week program between groups, whereas there was an increase in pectoralis minor strength in the affected arm after a 4-week follow-up of an 8-week intervention program [14].

3.3.3. Effect of yoga on ROM and mobility

One study reported change in ROM and mobility after the intervention. Shoulder ROM was measured with a two-arm goniometer by Ref. [14]; who reported improvements in the range of internal rotation of the affected arm and the range of abduction and flexion of the unaffected arm after four and eight weeks of intervention, respectively. They also reported an improvement in spine mobility after eight weeks of intervention.

3.3.4. Effect of yoga on subjective experience

Three studies used self-report questionnaires to measure QOL and symptoms of discomfort and limitations of the affected limb. Self-reported lymphedema (SRL), a visual analogue scale (VAS) and the Disabilities of the Arm, Shoulder and Hand questionnaire (DASH) were to measure symptoms in the study of [13,15,16] respectively; the intervention had no effect on any of these outcomes. QOL was evaluated using a VAS [13] Lymphedema Quality of Life questionnaire (LYMQOL) [15] and the Function Assessment of Cancer Therapy-Breast (FACT-B) [16]. [15] reported that the intervention group showed a reduction in QOL subscale score compared with the control group, but neither Douglass et al. (2102) nor [16] observed any effect of the yoga intervention on QOL.

4. Discussion

4.1. Clinical implication

The aim of this systemic review was to synthesize empirical evidence on yoga interventions for breast cancer survivors with BCRL. Three RCTs in which a yoga intervention was compared with standard care and two quasi-experimental studies based on pre-post comparisons in a single group. There is no consistency in results of these five studies. In summary, one pre-post quasi-experimental study and two RCTs concluded that 8-week yoga intervention improved lymphedema, spine mobility, but which were no consistency in QOL. One study showed no change. Others found that there was significant improvement of muscle strength after a 4-week follow up post yoga intervention completed. However, there is no significant outcome following a long-term (6-month) yoga practice.

Improvements in lymphedema status and symptoms, and long-term QOL following yoga have been reported in many studies [19–21]. About one third of breast cancer survivors suffer from lymphedema after surgery [22]. Edema of the affected limb is associated with excessive stagnant fluid, limited mobility, deformation of the arm, shoulder, chest and spine, poor respiratory and lymphatic drainage and reduced long-term QOL in breast cancer survivors [23,24]. At present there is no effective treatment. There has been increased clinical interest in yoga exercises based on breathing and limb extension and yoga has been used as a complementary therapy alongside conventional therapy for BCRL [8,25,26].

A literature review by Ref. [27] concluded that yoga intervention reduced lymphedema status and improved disability in breast cancer

survivors. A review of 138 clinical trials involving a total of 10,660 participants who had breast cancer, colorectal cancer, leukemia, lymphoma, lung cancer, pediatric cancer, prostate cancer and hematopoietic stem cell transplants concluded that yoga improved physical and psychological symptoms and QOL in patients regardless of type of cancer, age, country and intervention protocol [25].

Our results are similar to those of previous studies. Two differences lie is that they concluded that yoga intervention reduced breast cancer-related lymphedema only. However, the exercise information of appropriate pattern, start time, intervention period and benefit risk for breast cancer-related lymphedema were not available and lacked of evidence in clinical practice. It is necessary to bring the attention about the risk of lymphedema and importance of timing of exercise intervention in breast cancer survivor routine care. Our study discussed the effect on yoga intervention, and had a comparison between start time, intervention period, and outcome on affected limb, therefore, the result we conducted were more fit the need in caring breast cancer survivor and be provided by care team member.

4.2. Clinical practice

This systemic review found that despite there is no consistency in duration, practice times, assessment and outcome measure of yoga intervention, there is significant improvement of lymphedema, disease-related musculoskeletal condition, and quality of life following yoga intervention. Based on the results, medical teams should develop the yoga protocol to prevent or reduce BCRL, and the yoga protocol should include meditation and breathing exercise, yoga exercises, and cool-down exercises as three main components. For better BCRL improvement, the program should contain 60-minute, more than 8-week, once or twice weekly class session and daily home practice with video use remaining 5–6 days with progressive and alternative strategies.

4.3. Methodological considerations

This systematic review is controversial in clinical practices due to the five studies' results would be affected by small sample size of a less than 30 in each. Additionally, all the participants in the studies we reviewed were female, so the results may not generalize to men, due to the physical differences between the sexes. The age of participants ranged from 42 to 72 years and there may be age-related differences in family and societal responsibilities, energy and environment that affected the results. Finally, the results might not be generalizable to breast cancer survivors in other cultures, as the studies we reviewed were conducted in just three countries, Australia, the United States and Taiwan.

5. Conclusion

Yoga is an exercise, in which there is no restriction in equipment, age and gender, has a significant improvement of quality of life in physical and mental. Compared with clinical BCRL routine care, yoga intervention could reduce disability, lymphedema and fibrotic change of joint and muscle, increase the range of ROM and mobility, and improve quality of life. There is no standard protocol for yoga practice in BCRL. This study makes a contribution that nurses and clinicians who care of breast cancer survivors need to design appropriate yoga interventions to promote a good quality of life based on individual needs.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ctcp.2019.05.004.

Financial support

The authors have no proprietary interest in any aspect of this study. There was no additional financial support from public or private sources.

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