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Review Article

Effects of Yoga Therapy on Pain, Quality of Life, and Functional Ability in Chronic Low Back Pain Patients: A Systematic Review

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Abstract

Chronic Low Back Pain (CLBP) is a common musculoskeletal condition that often results in significant physical and psychological impairments. Although conservative therapies are available for treatment, they don't always address the comprehensive nature of pain. Yoga is an ancient discipline that incorporates practices to develop mental and physical health, and may be an effective intervention for treating chronic pain conditions. The purpose of this systematic review is to determine the effectiveness of yoga therapy for the treatment of CLBP. A comprehensive search using a combination of the words "yoga" and "chronic low back pain", "yoga" and "back" and "yoga" and "chronic pain" was conducted, After meeting the selection criteria, articles were further analyzed and assessed for quality. Thirteen randomized control trials met the criteria for inclusion into the review. Post intervention, yoga therapy was highly effective treatment for reducing pain intensity and back related function, and moderately effective at improving quality of life, as compared to inactive controls. Limitations of this review include the high percentage of studies designed with inactive control groups and the use of non-study treatments, making it difficult to determine if the results are specifically attributable to yoga. This systematic review suggests that yoga therapy can have a positive effect on pain, functional disability, and quality of life in individuals with CLBP. Future research will need to be focused on establishing a dose response relationship that best treats CLBP.

Keywords: Chronic low back pain; Yoga; PEDro scale; Back related function

Introduction

Low back pain is a common musculoskeletal condition affecting approximately 70- 85% of adults at some point in their lifetime [1,2]. Low back pain is one of the leading causes of functional disability and the second most frequent reason for medical consultation [2]. It is a costly musculoskeletal condition that imposes a high economic burden on individuals, employers, and the health care system [3]. The annual economic cost of chronic pain is US $600 billion in the US alone [3]. Lost work productivity is the primary driver of this economic burden, with an estimated amount of 250 million workdays lost per year [2,4]. Approximately 85-90% of low back pain cases will resolve within 8 to 12 weeks, but the remaining I 0-15% will develop chronic symptoms leading to substantial loss of function [2]. Despite the low proportion of cases, chronic low back pain accounts for a majority of the disability and costs associated with low back pain [2]. In addition to the physical impairments, several studies have indicated a high prevalence of comorbidities such as depression, anxiety, and sleep disturbances among patients with Chronic Low Back Pain (CLBP), increasing the complexity of treatment [2]. Current recommendations for CLBP management consist of patient education, pharmacotherapy, psychosocial interventions, physical therapy, and alternative therapies: including chiropractic care and yoga, and surgical interventions [2]. Psychosocial interventions include different types of psychotherapy and social and vocational training to provide support, education and guidance to people with chronic pain. Despite the wide range of treatment options available for CLBP, a vast majority of patients fail to achieve adequate pain relief and restoration of function [5]. Randomized control trials have been conducted over the past years evaluating all types of conservative, complementary, and surgical treatments for LBP [6]. Conservative treatments often include opioids, antidepressants, NSAIDs, muscle relaxants, orthosis, exercise, spinal manipulation, traction, and trigger point injections while complementary treatments consist of acupuncture and massage therapy [7,8]. Surgical procedures most commonly consist of spinal fusion, laminectomy, interlaminar implant, foraminotomy, discectomy, and disc replacements [4,7]. Unfortunately, many of the interventions commonly utilized for LBP, lack sufficient evidence of long-term efficacy [6]. Current guidelines suggest that exercise is beneficial for management of low back pain, but exercise treatments have only demonstrated small and short term effects [6]. Pain is the most common reason for patients to seek health care settings. Pain also has psychological factor associated with it besides the pathological factor. The first psychological process that occurs with pain is attention. Attention is directed toward noxious stimuli which can serve as a warning signal. Attention is followed by interpretation of pain. Interpretation involves cognitive processes used to interpret what the noxious stimuli mean [9]. When a painful stimulus has been attended to and interpreted as being a threat, strategies for dealing with this threat are initiated. These coping strategies involve cognitive and behavioral techniques like

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relaxation, to reduce the threat of pain [9]. CLBP is also characterized by both pathological and psychological components. In order to manage CLBP both pathological and psychological components must be addressed. Yoga has shown its effectiveness in addressing the pathological and psychological components [10]. Yoga is an ancient discipline that was first described in detail nearly 2000 years ago. It incorporates practices to develop mental and physical health, overall well-being, and inner harmony [11]. Yoga consists of some crucial elements, including physical postures, breathing techniques, relaxation and meditation [12]. It has been introduced and practiced in Western cultures over the past century, and includes practices of meditation, respiratory exercises, physical exercises, and postures. This form of treatment can be included in the spectrum of Complementary and Alternative Medicine (CAM) interventions that are not part of conventional medicine, but are used either in place of or in conjunction with other forms of treatment to improve health and well-being [2]. Additional advantages of yoga include improving health outcomes in both diseased and healthy populations, including blood glucose [13], heart rate variability, blood lipids, oxidative stress, and salivary cortisol [14]. Yoga also improves subjective measures of fatigue, pain, and sleeps [15] and can also reduce blood pressure, cholesterol levels [16], and body weight [17]. Yoga helps in improving musculoskeletal functioning, and increase endorphin levels resulting in decreasing pain and stress [18]. Yoga has also helped with the management and treatment of conditions like diabetes, COPD, hypertension, chronic urologic conditions, and some forms of cancer [18-24]. Yoga has also shown to be effective in treating psychological conditions. Duraiswamy, et al. investigated the effects of yoga on psychopathology, quality of life and social functioning in patients with schizophrenia, as compared to physical exercise. Psychopathology was assessed using Positive and Negative Syndrome Scale, quality of life was assessed by WHO Quality of Life BREF version and social functioning was assessed using social and occupational functioning scale. Group receiving yoga therapy had less psychopathology, greater social and quality of life as compared to group receiving physical exercise [25]. Since yoga can address pathological and psychological components, researchers have begun investigating its effects on chronic pain. Yoga has shown its effectiveness in treating many chronic pain conditions, including low back pain [19,26-28]. The purpose of this systematic review was to appraise and synthesize the current evidence on the effectiveness of yoga therapy for the treatment of chronic low back pain, with a focus on pain, quality of life, and functional assessments as treatment outcomes. The hypothesis of this systematic review was that yoga therapy is effective treatment of chronic low pain.

Methods

Search strategy

A peer reviewed literature search was conducted in May 2014 using the following electronic databases: Pubmed/Medline, Cinahl, Cochrane and Physiotherapy Evidence Database (PEDro). Initial search was comprehensive using a combination of the words "yoga" and "chronic low back pain", "yoga" and "back" and "yoga" and "chronic pain". Additionally, reference lists of identified original and review papers were reviewed for any cited articles that fit the criteria of this review. The literature retrieval process in depicted in (Figure 1).

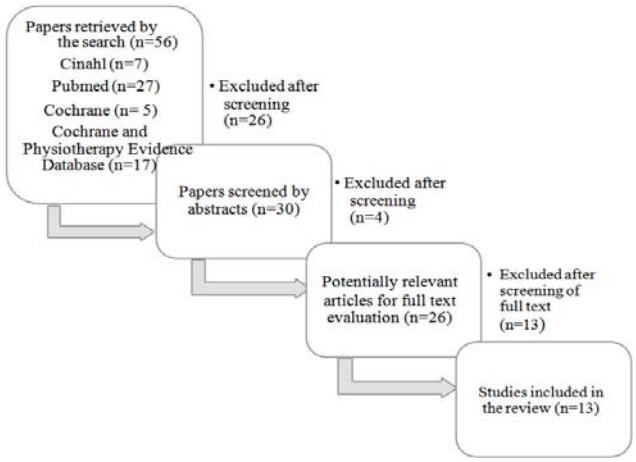

Figure 1: Literature retrieval process.

Study selection

Inclusion criteria

To be eligible for analysis, studies needed to meet the following conditions:

1. **Types of studies:** Randomized controlled trials (RCTs) that were published in peer reviewed journals were included.

2. **Types of participants:** Studies of community dwelling adult (≥18 years of age) patients with a history of chronic low back pain (≥3 months) were eligible.

3. **Types of interventions:** Studies that compared yoga with no treatment or any active treatment were eligible. No restrictions were made on the type of yoga, length, frequency, or duration of the program. Studies were excluded if yoga was not the main intervention.

4. **Types of outcome measures:** Studies were eligible if they assessed pain, quality of life, and/or included some form of functional assessment.

Exclusion criteria

1. Published before the year 2000.

2. Published in a language other than English.

Data extraction

Two authors independently extracted data on characteristics of the study (e.g. trial design, randomization, blinding), patient population (e.g. age, diagnosis), intervention and control (e.g. type, duration, frequency), outcome measures (e.g. type, assessment time points), and results. Discrepancies were discussed with a third reviewer until consensus was reached.

Quality assessment

The 13 included articles were assessed for quality by 2 of the authors using the PEDro scale, which evaluates the internal validity and statistical information of a study. There are 11 items included in the scale, and all but 2 are based on the Delphi list (a list of trial characteristics that is related to trial "quality"). One item on the PEDro scale interprets information regarding external validity, and is therefore not included in the final scoring, making the reported

Table 1: Study characteristics.

Author, year, n	PEDro scale score	Treatment	Outcomes	Results	Strengths & Limitations
Tekur, et al. 2012 (n=80)	7/10	Experimental group: Specific module of asana, pranayama, meditation, and lectures on yoga for 1 week (n=40)	Pain: 11point NPRS Primary assessment points: Post intervention	Both groups showed reductions in pain when compared to baseline, but the results were statistically significant in favor of the yoga group.	Strengths: Random allocation, adequate follow up conducted, groups similar at baseline, groups treated in similar manner Limitations: No blinding of subjects, therapists, or assessors, no report on medication usage, no
Tilbrook, et al. 2011 (n=313)	8/10	Experimental group: Unspecified yoga (n=156) 12 weekly, 75 minute classes plus home practice Control group: Usual Care (n=l 57)	Pain: ABPS, PSEQ Function: RMDQ QOL: SF-12 Primary assessment points: Post intervention, 3 month long term follow up	The yoga group had statistically significant improvements in function (RMDQ) at the post intervention and long term follow up assessments compared to usual care group. There were no significant differences found between back pain scores (ABPS) or general health Scores (SF-12) at any of the follow up points but the yoga group had higher pain self-efficacy scores at both post intervention and long term follow up.	Strengths: Participants were randomly assigned to groups, allocation was concealed, outcome assessors were blinded, groups were similar at baseline, follow up rates were high, intention to treat analysis was performed Limitations: Participants and therapists were not blinded, medication was documented at baseline but further data was not collected throughout the study, adherence to yoga intervention was poor, no description of how the usual care group managed low back pain
Sherman, et al. 2011 (n=228)	7/10	Experimental group: Viniyoga (n=92) 12 weekly, 75 minute classes plus home practice Control group: Self- care book group (n=45) - received *The Back Pain Help book,* Stretching group (n=9 l) - 12 weekly, 75 minute classes plus home practice	Pain: Bothersomeness of pain scale Function: RMDQ Primary assessment points: Post intervention, 14 week long term follow up	The yoga group reported superior function compared to the self-care group at the post intervention and long term follow assessments but not in comparison to the stretching group. There were no differences among the treatment groups for symptom bothersomeness except at post intervention; the yoga group was significantly less bothered by symptoms than the self-care group	Strengths: Participants were randomly assigned to groups allocation was concealed, outcome assessors were blinded, use of medication was reported throughout study, satisfactory adherence to treatment regimens, follow up rates were high, intention to treat analysis was performed Limitations: Participants and therapists were not blinded, characteristics were well balanced except the yoga group had greater back dysfunction, groups were not treated in the same way for example the self-care group was not contacted once throughout study and yoga and stretching groups received a lot of attention
Cox, et al. 2010 (n=20)	6/10	Experimental group: Unspecified yoga (n=10) 12 weekly,75 minute classes plus home practice Control group: Usual care (n=10)	Pain: ABPS,PSEQ Function: RMDQ QOL: SF-12 Primary assessment points: Post intervention	At the post intervention assessment, the usual care group reported a greater decrease in functional disability, and the yoga group reported a greater decrease in pain, neither of which were significantly or clinically different due to inadequate power. No statistically or clinically significant differences were found among general health status or pain self- efficacy.	Strengths: Participants were randomly assigned to groups, allocation was concealed, intention to treat analysis was performed, outcome assessors were blinded, medication use was reported throughout the study Limitations: Pilot study, inadequate power due to small sample size, participants and therapists were not blinded, no description of how the usual care group managed low back pain, no long term follow up, insufficient description of medication use, Poor yoga class attendance, poor follow up rates, groups were not similar at baseline
Saper, et al. 2009 (n=30)	7/10	Experimental group: Hatha yoga (n=15) 12 weekly,75 minute classes plus home practice Control group: Usual care (n=15)	Pain: 11-point NPRS Function: RMDQ QOL: Global improvement 7-point scale, SF-36 Primary assessment points: Post intervention	The yoga group demonstrated a statistically significant decrease in pain intensity compared to those who continued with their usual care post intervention. The yoga group also demonstrated a greater decrease in back related dysfunction than the usual care group but the results were not considered to be statistically Significant. There were no differences in health related quality of life scores between the groups.	Strengths: Participants were randomly assigned to groups, allocation was concealed, outcome assessors were blinded, groups were similar at baseline, sufficient data regarding medication was reported throughout the study, the yoga group demonstrated good adherence during the 12 week treatment period, follow up rates were high, intention to treat analysis was performed Limitations: Participants and therapists were not blinded, small sample size which limits the statistical power, post intervention participant retention was poor and use of non-study treatments were high so long term follow up data was not considered to be meaningful, no description of how the usual care group managed low back pain
Williams, et al. 2009 (n=90)	8/10	Experimental group: Iyengar yoga (n=43), 90 minute classes 2x/week with self-practice at home for 30 minutes/day Control group: Usual care (n=47)	Pain: VAS Function: ODI Primacy Assessment Points: Post intervention, 6 month long term follow up	The assessors Found statistically significant reductions for both the ODI and VAS in favor of the yoga group at both assessment Points.	Strengths: Random assignment, assessors blinded, adequate follow up conducted, intention to treat analysis performed, medication usage reported Limitations: Participants and therapists not blinded, groups not treated the same, attrition

Tekur, et al. 2008 (n=80)	7/10	Experimental group: Specific module of asana pranayama,, meditation, and lectures on yoga for I week (n=40) Control group: Matched schedule of physical movements, breathing exercises and lectures (n=40)	Pain: Section 1 of ODI Function: ODI Primary assessment points: Post intervention	The ODI scores decreased (signifying a reduction in both pain and functional disability) for both groups, but this difference was only significant for the yoga group.	Strengths: Random allocation, adequate follow up conducted, groups similar at baseline, groups treated in similar manner Limitations: No blinding of subjects, therapists, or assessors, no report on medication usage, no long term follow up conducted
Sherman, et al. 2005 (n=101)	8/10	Experimental Group: Viniyoga (n=36) 12 weekly, 75 minute classes plus home practice Control group: Self-care book group(n=30) - Received *The Back Pain Help book* conventional exercise group (n=35) 12 weekly,75 minute classes plus home practice	Pain: Bothersomeness of pain scale Function: RMDQ QOL: SF-36 Primacy assessment points: Post intervention, 14 week long term follow up	The yoga group had greater improvements in function at post intervention and long term follow up assessments compared to the self-care Book group. The yoga group had greater improvements in function compared to the exercise group post bothersomeness were found among the treatment groups post intervention, but at the long term follow up the yoga group experienced greater reductions in symptoms compared to the self-care book group. intervention but there were no differences at the long term Follow up. No significant differences in symptom	Strengths: Participants were randomly assigned to groups, allocation was concealed, outcome assessors were blinded, groups were similar at baseline, sufficient data on medication use was reported throughout the study, adherence to treatment regimens was good, high follow up rates, attention to treat analysis was performed Limitations: Participants and therapists were not blinded, groups were not treated in the same way for example the self- care group was not contacted once throughout study and yoga and stretching groups received a lot of attention, the self- care book group may have been more likely to report worse outcomes due to disappointment in treatment
Williams, et al. 2005 (n=60)	5/10	Experimental group: 1 hour lecture on physical therapy education for CLBP and Iyengar yoga (n=30, 1.5 hour session lx/1week for 16 weeks, plus home practice) Control group: Usual care (n=30)	Pain: SF-MPQ Function: PDI Primacy assessment points: Post intervention, 3 month long term follow up	The yoga group had less Functional disability and less pain at post intervention and at long term follow up; these results Were statistically significant.	Strengths: Random assignment, assessors blinded, medication usage provided Limitations: Subjects and therapists not blinded, no intention to treat analysis included, adequate follow up data not provided
Galantino, et al. 2005 (n=22)	4/10	Experimental group: Hatha yoga (n=l 1) 1hour session 2x/week for 6 weeks plus home practice Control group: Usual care	Function: ODI QOL: Qualitative assessment through journals and questionnaires Primary assessment points: Post intervention, 3 month long term follow up	Both groups reported themselves as less disabled post intervention, but a higher percentage of people reported from the yoga group. QOL assessment showed improvements in the yoga group at post intervention and long term. Follow up.	Strengths: Random assignment Limitations: No blinding, no information on participants' sociodemographics (including pain medication usage) was provided, which inhibited baseline comparability, adequate follow up data not provided
Saper, et al. 2013 (n=95)	7/10	Experimental Group: Once weekly Hatha yoga (n=49) Once weekly, 75 minute classes plus home practice over a 12 week period Control Group: Twice weekly Hatha yoga (n=46) Twice weekly, 75 minute classes plus home practice over a 12 week period	Pain: 11-point NPRS Function: RMDQ QOL: Global improvement 7- point scale, Patient satisfaction 5- point scale, SF- 36 Primary assessment points: Post intervention	Both yoga groups showed clinically meaningful and statistically significant decreases in pain intensity and back related function post intervention. However, there were no statistically significant differences between the two groups in pain or function. General health score changes were modest and did not differ between groups. There were no statistically significant between-group differences in overall improvement and satisfaction scores.	Strengths: Participants were randomly assigned to groups, allocation was concealed, outcome assessors were blinded, groups were similar at baseline, adequate data on medication use was reported throughout the study, high follow up rates Limitations: Participants and therapists were not blinded, allocation concealment was not mentioned, both groups attended classes together which increases risk for bias, adherence to treatment protocol was poor among both groups, the use of non-study treatments were high among both groups

Nambi, et al. 2014 (n=60)	6/10	Experimental group: 1 hour lecture on physical therapy education for CLBP and Iyengar yoga (n=30, 1 hour session lx/1 week for 4 weeks, plus Home practice) Control group: 1 hour lecture on physical therapy education for CLBP and home practice of abdominal and back exercises 3x/week for 4 weeks(n=30)	Pain: VAS QOL: HRQOL-4 Primary assessment points: Post intervention, 6 month long te1m follow up	Pain intensity and the three categories of unhealthy days for the QOL measure decreased in both groups from pretest to posttest, and from pretest to 6-month follow-up with Statistical significance: however, the decrease was greater in the yoga group and there was statistically significant between group differences in favor of the yoga group.	Strengths: Random assignment, adequate follow up data provided, attempt at matching groups Limitations: No blinding, no intention to treat analysis preformed, no report on pain medication usage
Tekur, et al. 2010 (n=80)	7/10	Experimental group: Specific module of asana, pranayama, meditation, and lectures on yoga for I week (n=40) Control Group: Matched schedule of physical movements, breathing exercises, and lectures (n=40)	QOL: WHOQOL BREF Primary assessment points: Post intervention	Both groups showed reductions Improvements in QOL when compared to baseline, but the results were statistically significant in favor of the yoga group.	Strengths: Random allocation, adequate follow up conducted, groups similar at baseline, groups treated in similar manner Limitations: No blinding of subjects, therapists, or assessors, no report on medication usage, no

score out of 10. Items assessed by this scale are: random allocation, concealed allocation, similarity at baseline, subject blinding, therapist blinding, assessor blinding, >85% follow up for at least one key outcome, intention-to-treat analysis, between group statistical comparison for at least one key outcome, and point and variability measures for at least one key outcome [29]. Scoring is interpreted using the following descriptive scale: 9-10 Excellent, 6-8 Good, 4-5 Fair, < 4 Poor. Eleven (85%) of the articles scored a 6-8/10 and 2 (15%) scored 4-5/10. Scores for the individual articles are listed in (Table 1).

Results

Selection of studies

The initial literature search revealed a total of 56 articles through electronic database and reference review. After removing duplicate studies and reviewing the articles based on the inclusion and exclusion criteria, 13 articles were selected for further analysis. Studies were primarily excluded because they were not RCTs, did not specifically relate to yoga or CLBP, and outcome measures did not adhere to inclusion criteria.

Efficacy of yoga for pain

Out of 11 studies that assessed pain, 9 [30-38] (82%) revealed greater reductions in pain intensity (n=495) at post intervention follow up than t hose who did not receive yoga intervention (n=450). Yoga intervention included pranayama, meditation, Vini yoga, hatha yoga and Iyengar yoga. Intervention period ranged from 1 week to 24 weeks. Pain was assessed in 11 studies using either a visual analog scale [34,38] using 11 point numerical pain rating scale [30,33,37], the Aberdeen Back Pain Scale [6,31], the pain intensity subscale of Oswestery Disability Index [35], the short form McGill Pain Questionnaire [36], or a numerical rating scale of pain botherness [32,39]. Six [31-39] of the eleven studies that assessed pain intensity included long term follow up data ranging from 12-24 weeks post intervention. At the long term follow up assessment, 5 [31,34,36,38,39] (83%) of the 6 studies revealed statistically significant greater reductions in pain intensity for those who received the yoga treatment. Most of the studies included this review used a control group following usual standard care. However, Tekur, et al. [30,35] matched daily schedules for all participants during their 1 week intensive program, and only varied on whether or not they received yoga [30,35]. The yoga intervention was a specific module for CLBP and included asanas and pranayama practices. Outcomes were only assessed post intervention, but there was a significant reduction in pain in favor of the yoga group. The studies, questioned the validity which may increase the risk of bias, since it lacked blinding and intention to treat analysis. Sherman, et al. [32,39] compared a Vini yoga intervention to a self-care book control group, and a conventional exercise control group. Yoga group failed to show significant improvements in pain as compared to conventional exercise group. Yoga group however showed statistically significant reductions in pain symptoms when compared to the self-care book group at post intervention. The validity of the results can be questioned since the participants were not blinded to allocation. This partial blinding could have resulted in bias towards the experiment al group. The statistical analysis of pain symptoms between the yoga groups, conventional exercise group, and stretching group did not differ significantly at long term follow up assessments. Four studies compared a form of yoga therapy to a usual care control group over a 12 to 16-week period [31,33,34,36]. All studies showed that the yoga group reported a statistically significant decrease in pain when compared to the control group at post intervention. Tilbrook, et al. and Williams, et al. also included long-term follow-up assessments, where the yoga groups continued to show greater reductions in pain [31,34,36]. Although the significant results from yoga intervention cannot be concluded using in active control group. Since the experimental groups in these studies received a lot more attention from the researchers. Therefore, one can argue that the significant results may be resulting from benefits of general physical exercises. Saper, et al. compared once weekly Hatha yoga to twice weekly Hatha

yoga [37]. The results indicated that both yoga groups had reductions in pain post-intervention, but the difference between the groups was not significant. However, the sample size was too small to conclude the benefits of yoga intervention. Nambiet, et al. had similar treatment and control groups during their 4 week study; both received lectures on CLBP and were instructed to practice their exercises at home [38]. The intervention group practiced Iyengar yoga and the control group was given abdominal and back exercises. At post-intervention and at a long-term follow-up, both groups reported decreased pain; however, the reduction was greater in the yoga group and the results were statistically significant in favor of the yoga group.

Efficacy of yoga for functional disability

Ten of 13 trials assessed functional disability using the Roland-Morris Disability Scale [6,31-33,37,39] the Oswestry Disability Index [34,35,40] or the Pain Disability Scale [36]. Of these 10 studies, 8 [31,32,34-37,39,40] (80%) revealed that those who received the yoga treatment (n=457) demonstrated statistically significant greater improvements in functional disability at the post intervention than those who did not receive yoga intervention (n=532). Intervention period ranged from 1 week to 24 weeks. Six [31,32,34,36,39,40] of the 10 studies that assessed functional disability included long term follow up data ranging from 12-24 weeks post intervention. All 6 (100%) of these studies revealed that those who received the yoga treatment had statistically significantly greater improvements in back related function at the long term follow up assessment. Galantino, et al, Tilbrook, et al. and studies by Williams, et al. compared a yoga intervention group to a usual care control group [31,34,40]. The post-intervention and long term follow assessments revealed that the yoga groups reported themselves as less disabled. However, using an inactive control group cannot conclude the benefits of yoga intervention for improving function disability since the benefits can come from general benefits of physical activity. The yoga groups in the studies of Sherman, et al. demonstrated statistically and clinically significantly greater improvements in back related function compared to the self-care book control group at the post intervention assessment [32,39]. Sherman, et al. showed that the yoga group had significantly greater function compared to conventional exercise control group at post- intervention, but not at long-term follow-up [39]. Sherman, et al. did not show any statistical differences between the yoga and stretching groups [32]. These mixed outcomes suggest a need for future research that compares yoga with physical activities. Saper, et al. demonstrated significant improvements in back-related function for both the once-weekly and twice-weekly yoga groups, however there was again no significant difference between the two groups [37]. However, the results were again compared between yoga group and control group following usual care. Additionally, the validity is questioned due to small sample size and lack of blinding, leading to increase in risk of bias. Lastly, the yoga group in a study by Tekur, et al. had significant improvements in their overall function at the end of the study as compared to a group following physical exercise [35]. The study gave us some evidence that yoga is better than physical exercise but still the validity can be questioned due to partial blinding and lack of intention to treat analysis increasing the risk of bias.

Efficacy of yoga for quality of life

Quality of life was assessed in 8 studies using a variety of tools, including the Physical and Mental Health Short Form-12, [6,31] the Global Improvement 7 Point Scale [33,37] the Physical and Mental Health Short Form-36 [33,37,39], the Patient Satisfaction 5 Point Scale [37], the Healthy Days Core Module (CDC HRQOL-4) [38], the WHO Quality of Life-BREF [41] and qualitatively through journals and questionnaires [40]. Out of the 8 studies that assessed quality of life, 4 (50%) [37,38,40,41], revealed that those who participated in yoga intervention (n=130) experienced statistically significantly greater improvements in quality of life at the post intervention follow up as compared to the control group (n=127). Intervention period ranged from 4 weeks to 12 weeks. Four out of the 8 [31,38-40] studies that assessed quality of life included long term follow up data ranging from 12-24 weeks post intervention. Two [38,40] (50%) of these studies revealed that those who received the yoga intervention achieved statistically significantly greater improvements in quality of life at the long term follow up assessment. However, yoga intervention was compared to an inactive control group. Therefore it becomes difficult to generalize the results, since the improvements can be explained due to benefits of physical activity only. In a study by Saper, et al. both the once- weekly and twice-weekly yoga groups demonstrated an improved quality of life after the intervention [37]; however, there was no significant difference between the two. Tekur, et al. compared a yoga intervention group and a matched activity control group in an intensive one week study; at post-intervention assessment, the researchers found that the yoga group had greater improved quality of life when compared to the control group [41]. However, the validity of the study is questioned due to lack of blinding and small size resulting in difficulty generalizing the results.

Discussion

To evaluate the effectiveness of yoga therapy for the treatment of CLBP, the present systematic review examined the post-treatment and follow-up results of 13 RCTs. The results of our review indicate that yoga is a highly effective treatment for improving pain and functional ability in individuals with CLBP with long term effects, and has moderate effectiveness for improving quality of life. Yoga focuses on physical movements and postures to develop physical health and mental- wellbeing. Mental focus induced by yoga may help individuals increase their awareness of maladaptive movement patterns making them more likely to engage in appropriate postural alignment during their daily activities. Yoga increases muscle strength and flexibility, cardiovascular endurance, and pulmonary function [42], and may decrease fear avoidance and facilitate functional movement [43]. This may explain why a majority of the participants experienced a decrease in pain and improved function overall, as increased physical fitness is con-elated with less physical dysfunction [44]. Yoga can result in decreased depression and stress, and can increase a sense of hopefulness [45], which may have contributed to improved quality of life seen in the reviewed studies. However, more than half of the articles included in this review used an inactive control group. Therefore decrease in pain and improved function and quality of life can result from just overall general benefits of physical exercises. Additionally, the benefits in yoga group can also come from extra attention and positive expectations from the researchers, resulting in risk for bias. By limiting the review to only RCTs and with 11 out of the 13 (85%) categorized as good quality, our results provide a reliable, yet conservative, analysis of the current

evidence. As there are a limited number of well-designed, evidence-based studies that evaluate the efficacy of yoga for CLBP, it was hard to select articles with homogenous yoga protocols (style, intensity, and duration). Therefore, it is not possible to conclude which type of yoga or yoga intensity i s best for CLBP treatment. Also, because this review was restricted to only RCTs of English language, there may be additional evidence that would have contributed to this review. However, a thorough search of the evidence was conducted based on the inclusion and exclusion criteria, including a review of all reference lists of identified articles.

Limitations of Studies

One limitation of this systematic review is to generalize the results from the studies included. Generalizability is lacking due to poor follow up rates with less than 85% of subjects initially allocated to groups included in the analysis [6,36,40] significant group differences in sociodemographics [6,40], and the absence of an intention to treat analysis [35,36,38]. Further limitations include the high number of dropout rates and small sample sizes, leaving these studies without enough power to detect statistically significant between group differences for pain, function, and quality of life measures. The feasibility of the yoga interventions were replicable among the majority of studies, however limitations were presented in the studies that evaluated the efficacy of a one week intensive yoga program. Although significant results were reported, the intervention would be hard to simulate in an uncontrolled real life situation, making it difficult to translate these results to the general population. Other limitations consist of the high use of self-report measures which may have led to biased results. One of the biggest drawbacks includes using inactive control groups. Seven [31-34,36,39,40] out of the 12 articles that showed significant results in favor of the yoga group for at least one outcome measure were designed with inactive control groups. These control groups were instructed to go about their usual care without any addition of therapeutic intervention. Because of this, it may be difficult to determine if the significant results were due to the yoga intervention itself, or if other factors regarding the design influenced the results. These factors could include extra attention directed towards the yoga group, support from other group members, or just completing a form of exercise, which could stimulate progress and healing regardless of the type of intervention. The use of non-study treatments was high in a few studies, making it difficult to determine if the significant improvements in pain, function, and quality of life were specifically attributable to yoga.

Conclusion

CLBP is a highly prevalent, leading cause of functional disability, and can lead to economic burden, depression, anxiety, and sleep disturbances. Although the current evidence is diverse and varying in quality, our systematic review suggests that yoga therapy can have a positive effect on pain, functional disability, and quality of life in individuals with CLBP as compared to inactive individuals. Benefits were also seen when yoga was compared to physical exercise, but it is difficult to generalize the results based on limited number of studies. Therefore, there is a need to compare yoga to standard physical therapy measures including a large sample size to determine if yoga has specific effects. As research on this topic continues to expand, attention will also be needed to be focused on the style and intensity of yoga that best treats CLBP along with the mechanisms of action that leads to these improved outcomes.

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