2019

Can Yoga Therapy Help to Decrease Osteoarthritis-related Pain in Adults with Knee Osteoarthritis?

Justin Mahr
Philadelphia College of Osteopathic Medicine

Can yoga therapy help to decrease osteoarthritis-related pain in adults with knee osteoarthritis?

Justin Mahr, PA-S

A SELECTIVE EVIDENCE BASED MEDICINE REVIEW

In Partial Fulfillment of the Requirements For

The Degree of Master of Science

In

Health Sciences – Physician Assistant

Department of Physician Assistant Studies
Philadelphia College of Osteopathic Medicine
Philadelphia, Pennsylvania

December 14, 2018

Abstract

Objective: The objective of this selective EBM review is to determine whether or not yoga therapy can help to decrease osteoarthritis-related pain in adults with knee osteoarthritis.

Study Design: A review of two randomized controlled trials and one randomized control trial pilot study that were published in English in peer-reviewed journals after 2007.

Data Sources: All articles were selected from peer-reviewed journals and found via PubMed.

Outcome(s) Measured: Patient perception of pain using either a Walking Numerical Rating Scale (WNRS) and/or a Western Ontario and McMaster Universities OA Index scale (WOMAC).

Results: All three studies found a significant decrease in pain levels among patients participating in a hatha yoga intervention as compared with those participating in alternate therapeutic programs and/or controls. In Ebnezar et al. the mean walking pain score after 90 days of yoga therapy reduced 64.88% from baseline ($P<0.001$), while the control group reduced 41.98% ($P<0.001$). The Cheung et al. 2017 study reported a decrease in WOMAC pain scores by 2.8 points as compared with a reduction of 1.2 amongst an Aerobics and Strengthening Exercise program group and an *increase* of 0.2 amongst an education control group ($P<0.05$). They also reported a significant difference in both WOMAC and visual analog pain score means adjusted for baseline at 8 weeks between the yoga and ASE interventions and between the yoga and control groups. The Cheung et al. 2014 RCT also found found a significantly lower (p-value=0.01) mean self-reported WOMAC pain score in the yoga group as compared to a wait-list control group at 8 weeks.

Conclusions: The results of all three RCTs reviewed provides evidence that regular hatha yoga practice can reduce patient's perception of knee osteoarthritis-related pain while actively engaged in a yoga program.

Key Words: yoga, osteoarthritis

INTRODUCTION

Osteoarthritis (OA) is a chronic and progressive condition defined by pathologic destruction of all components of a joint, including most prominently non-uniform deterioration of cartilage and bone hypertrophy along areas of articulation. It is mostly non-inflammatory or minimally inflammatory as compared to other forms of arthritis, like rheumatoid arthritis which involves prominent inflammation.[1] The condition's onset may be precipitated or hastened by an initial mechanical injury, increased stress from some forms of repetitive use of the involved joint(s) or from increased weight load secondary to obesity. Some metabolic conditions are also known to contribute to osteoarthritis-precipitating joint damage such as hyperparathyroidism, hemochromatosis, and ochronosis.[3] However, it is often merely a result of the normal "wear and tear" of aging joints. Thus, the condition is extremely common.

It is estimated that osteoarthritis affects over 30 million U.S. adults and is the most common cause of adult disability in America—the fifth most common cause worldwide.[2] Nearly half of those individuals—an estimated 14 million people—specifically experience symptomatic *knee* osteoarthritis.[2] The prevalence of osteoarthritis among Western countries is expected to rise 66-100% by 2020 due to aging populations and the increasing prevalence of obesity.[1] With such a high prevalence, osteoarthritis places a major burden on healthcare systems. While more recent estimates are lacking, it is estimated that in 2010 arthritis of all forms resulted in over 100 million outpatient healthcare visits with osteoarthritis accounting for about 25% of these.[2] In terms of cost, it is estimated that over $27 billion in health care expenditures are due to *knee* osteoarthritis alone.[2]

Osteoarthritis begins with the erosion of joint cartilage that eventually leads to changes in subchondral bone via activation of osteoclasts and osteoblasts.[1] Bone along the joint margins

hypertrophies and osteophytes form, which are visible on radiographs.[1] Other known changes that result include stretching of the joint capsule, weakening of surrounding muscles, and minimal synovitis which can less commonly lead to mild fluid collection in the joint. Patients typically begin to experience symptoms insidiously as the joint's condition worsens. Common complaints from patients include stiffness of affected joint(s) as well as pain that is worse with activity and generally relieved by rest.[3] Additionally, patients may experience a loss in the joint's range of motion and may notice crepitus, which can be felt over the affected joints. This combination of symptoms can thus lead to a limitation in normal activities and therefore a decrease in patients' quality of life.

Current treatment of osteoarthritis is predominantly symptomatic. It is generally recommended that patients with knee osteoarthritis begin supervised exercise programs to maintain range of motion and strengthen the joint's surrounding muscles, with hydrotherapy being a commonly recommended method.[3] Exercise, in addition to dietary intervention, can also be used for weight reduction in overweight patients who are experiencing increased symptoms due to increased joint load. Medical treatment generally begins with oral acetaminophen or oral NSAIDs, which tend to be more effective.[3] While oral NSAIDs may be effective for many patients in treating OA-related pain, their continued use is well known for its toxicity on the gastrointestinal system and can be nephrotoxic. This leads to potentially not only gastric ulcers but GI bleeding, perforations, and can worsen already compromised renal function. For this reason, topical treatments are often attempted such as diclofenac gel 1%, a topical NSAID shown to be effective for knee osteoarthritis, as well as capsaicin cream though this hasn't shown significant benefit for specifically knee osteoarthritis.[3] Finally, medical treatment also includes intra-articular injections of corticosteroids, hyaluronate, or platelet-rich plasma.[3] These, while

often initially effective, have diminished effect over time yet should be limited to a maximum of three to four administrations per year. In sum, all of these treatments generally provide temporary relief at best. Surgical intervention is an effective option for some joints, including knee osteoarthritis. This includes both joint resurfacing and total joint replacements, which both improve function and reduce symptoms.[3]

The above medical treatments have all shown varying degrees of efficacy in treating OA-related knee pain but none are definitive and some, such as oral NSAIDs, carry significant side effects and risks. Surgical intervention of course also carries with it a host of risks including infection, septic arthritis, and the usual surgical/anesthesia-related complications. For this reason, and because exercise programs have been shown to be beneficial for patients with osteoarthritis, it is worth examining the effectiveness of hatha yoga specifically, which has been used as an adjunctive practice to help reduce knee OA-related pain and other symptoms.[4,5,6] This paper evaluates three randomized control trials comparing the efficacy of hatha yoga integration into treatment of osteoarthritis-related pain of the knee in addition to other or no adjunctive modalities.

OBJECTIVE

The objective of this selective EBM review is to determine whether or not yoga therapy can help to decrease osteoarthritis-related pain in adults with knee osteoarthritis.

METHODS

Key words used to search for literature for this review included yoga and osteoarthritis. All three articles were published in English, and each was published in a peer-reviewed journal. The literature was discovered via searches performed though PubMed and AMED. Articles were selected based on their relevance to the clinical question and if they focused on patient-oriented

Table 1: Demographics & Characteristics of included studies

Study	Type	#Pts	Age	Inclusion criteria	Exclusion criteria	W/D	Interventions
Ebnezar, Nagarathna, Yogitha, Nagendra[4] (2012)	RCT with two arms	250	35-80 years	Persistent pain for 3 months; moderate to severe pain on walking; KL radiologic grading of II–IV in x-ray films taken within 6 months prior; fully ambulant; literate	Acute knee pain; secondary OA due to another condition; KL grade I changes on x-ray; major medical or psychiatric disorders	15	40 minutes of supervised integrated yoga therapy per day following 20 mins of physiotherapy w/ transcutaneous electrical stimulation and ultrasound for 2 weeks. Then, at-home yoga therapy practice for 40 mins/day for the following 10 weeks.
Cheung, Wyman, Bronas, McCarthy, Rudser, Mathiason[5] (2017)	RCT with three arms	83	>60 years old; mean age 71.6 years +/- 8 years	Community-dwelling adults >60 years; have self-reported medical diagnosis of symptomatic knee OA ≥6 months; have not practiced any yoga for 2 months; not currently in a supervised exercise program >2x per week	Symptoms of joint locking to a degree that affects the individual's balance and makes participating in a group exercise program unsafe; chronic use of assistive devices; corticosteroid injections within 3 months of study entry; hyaluronic acid injection within 6 months of study start date; history of knee surgery within the last 2 years; knee joint replacement; self-reported comorbidities including uncontrolled hypertension, unstable heart conditions, or comorbidities with overlapping symptoms (i.e., rheumatoid arthritis).	10	One 45-min yoga class per week for eight weeks plus an additional 30 min/day, four times/week of yoga practice at home
Cheung, Wyman, Resnick, Savik[6] (2014)	Pilot RCT with two arms	36	65-90 years old; mean age 71.9 years	Community-dwelling women between the ages of 65 and 90 years; had a symptomatic OA of knee diagnosis for at least 6 months; had no previous training in any form of yoga; were not currently participating in a supervised exercise program	Symptoms of joint locking; instability indicated by chronic use of a knee brace, cane, walker, or wheelchair; a corticosteroid injection in the symptomatic joint within 3 months of study entry; a hyaluronic acid injection in the symptomatic joint within 6 months of study entry; a history of knee surgery within the last 2 years or a joint replacement at any point; self-reported significant medical comorbidities that might preclude exercise participation: a) uncontrolled high blood pressure or heart condition; b) other comorbid condition with overlapping symptoms (i.e. fibromyalgia, rheumatoid arthritis)	0	One 60-minute hatha yoga class per week for eight weeks in addition to 30-minute yoga sessions four times per week at home.

evidence that matters (POEMs). Inclusion criteria included randomized control trials published after 2007. Articles were excluded if they were published before 2007 or used patients under the age of 18. Statistics reported and used include mean changes from baseline and p-values.

Two randomized control trials and one pilot randomized control trial were used in this review. The population of interest includes adults over 35 years of age with symptomatic knee osteoarthritis. All three studies used the intervention of a hatha yoga program, with intervention specifics for each study listed in Table 1. The outcomes measured in all three studies included change from baseline of self-reported OA-related knee pain.

OUTCOMES MEASURED

All three studies measured OA-related knee symptoms including pain, as reported by patients. The Ebnezar et al. study used a Walking Numerical Rating Scale (WNRS) to determine walking pain at baseline, on the 15th day of the program and on the 90th day of the program. This involved asking patients to mark the severity of their pain over the past few days on a 10-cm line that was drawn with one end labeled "0" representing "no pain", and the opposite end labeled "10" representing "worse possible pain."[4] Both the Cheung et al. 2017 and Cheung et al. 2014 studies used a Western Ontario and McMaster Universities OA Index scale (LK scale 3.1; WOMAC) to measure three symptom domains, one of which is pain. This is a 24-question survey administered to patients that includes 5 questions regarding pain. These questions are answered "using a 5-point Likert scale where 0 represents having no symptom and 4 represents having a severe symptom."[5] Points are added to create a pain score on a 0-20 scale. The Cheung et al. 2017 study also gave patients a 0-10 visual analog pain scale to answer. The Cheung et al. 2017 study collected this data at baseline, 4 weeks, and 8 weeks.[5] The Cheung et al. 2014 study

collected data at baseline, 4 weeks, 8 weeks, and 20 weeks for the experimental group and at baseline and 8 weeks for the wait-list control group.[6]

RESULTS

The Ebnezar et al. study was a prospective, randomized, parallel active controlled study with two arms comparing an adjuvant hatha yoga therapy program with adjuvant therapeutic exercise program—each following patients' standard transcutaneous electrical stimulation and ultrasound treatments. Demographics of participants are included in Table 1. The experimental yoga group participated in 40 minutes of guided yoga class following their traditional 20 minutes of physiotherapy for 2 weeks and were then instructed to continue daily 40-minute yoga sessions at home for 12 weeks, which were monitored by daily logs, phone calls every 3 days, and weekly reviews.[4] The control group participated in 40-minute non-yogic therapeutic exercises following 20-minute standard physiotherapy sessions for 2 weeks, and then were advised to continue daily 40-minute sessions of therapeutic exercises at home for 12 weeks, which was monitored using the same methods as above. Patient's symptoms were assessed using a 0-10 Walking Numerical Rating Scale answered by patients at baseline and again on the 15^{th} and 90^{th} days of the program.[4] The study listed 7 of the 125 participants of the yoga group as dropouts which were not included in final analysis, while 8 members of the control group were lost. Details of compliance with the programs was otherwise not discussed in the literature. The researchers assessed walking pain by analyzing mean change from baseline in both the yoga group and the control group, which is listed in Table 2. They used a Wilcoxin signed-rank test with a p-value of <0.001 to determine there was a significant difference within groups and a Mann-Whitney U test with a p-value of <0.001 to determine that there was also a significant difference between groups after interventions.[4] Their analysis determined there was a significantly larger improvement in

walking pain scores in the yoga group, with a 64.88% reduction in mean walking pain scores after 90 days, as compared with the control group (41.98% reduction). The researchers reported a difference in mean change from baseline between the two groups of 2.25, a 22.5% difference, determined with a p-value of <0.001.

Table 2: Yoga vs. Control: Change in walking pain in Ebnezar et al.

	Baseline walking pain: mean and SD	90th day walking pain: mean and SD	% change in mean from baseline
Yoga group	9.54 ± 0.60	3.35 ± 0.99	64.88%, p<0.001
Control group	9.29 ± 0.73	5.35 ± 1.49	41.98%, p<0.001

The Cheung et al. 2017 study was a parallel randomized control trial with 3 arms, including a hatha yoga group, a low-impact aerobics and strengthening exercise (ASE) group, and a control group receiving education on osteoarthritis.[5] The sample included 83 adults over the age of 60 with knee OA who had not practiced yoga within at least 2 months. The yoga group participated in one 45-minute guided yoga class per week in addition to four 30-minute yoga sessions at home for 8 weeks. The research did not mention details of supervision or issues of compliance to the at-home program amongst participants. The ASE group participated in one 45-minute ASE class in addition to four 15-30 minute ASE sessions at home for 8 weeks. The control group received education materials on managing OA, in addition to weekly phone calls inquiring about their health. Symptoms were evaluated in all participants at baseline, at 4 weeks, and at 8 weeks using the WOMAC and visual analog scale. To evaluate outcome differences between the yoga group versus the ASE group and the education control group at 8 weeks, researchers "adjusted means by baseline values and calculated contrasts with 95% confidence intervals."[5] A p-value cutoff of <0.05 was used to determine the significance of results. The researchers compared the 8-week means adjusted for baseline between groups and determined there were significantly (as defined by p<0.05) lower knee pain scores, on both WOMAC pain

scores and visual analog pain scales, in the yoga group as compared with both the ASE group and the education control group.[5] This data is presented in Tables 3 and 4.

Table 3: Mean WOMAC pain scores at baseline, 8 weeks, and change from baseline in Cheung et al. 2017

	Mean at baseline (Standard Deviation)	Mean adjusted for baseline at 8 weeks (95% CI)	Change in mean from baseline (no p-value listed in research)
Yoga group	7.9 (2.8)	5.1 (4.1, 6.0)	2.8 (14%)
ASE group	7.7 (4.4)	6.5 (5.5, 7.4)	1.2 (6%)
Control group	6.3 (3.1)	6.5 (5.4, 7.6)	-0.2 (1%)

Table 4: Effects of Yoga vs. comparison groups on pain score means adjusted for baseline at 8 weeks in Cheung et al. 2017

	Yoga vs. ASE Mean difference (95% CI)	**Yoga vs. Control** Mean difference (95% CI)
WOMAC pain (0-20)	-1.4 (-2.7, -0.1), p-value= 0.038	-1.5 (-2.9, -0.0), p-value= 0.045
Visual analog pain scale (0-10)	-1.1 (-2.2, -0.1), p-value= 0.030	-1.2 (-2.2, -0.1), p-value= 0.031

The Cheung et al. 2014 study was a pilot study using a randomized control trial with two arms that assessed whether a hatha yoga program showed preliminary evidence of reducing knee OA-related symptoms including pain. Their study compared a hatha yoga intervention group participating in an 8-week yoga program with a wait-list control group (who later received the same yoga intervention after an initial 8 week waiting period). Each group included 18 women, 65-90 years old, who were assigned to groups using simple randomization method, with 0% lost to follow up.[6] Inclusion and exclusion data are supplied in Table 1. Patient perception of pain was measured using the WOMAC score. The researchers compared differences in mean pain scores adjusted for baseline at 8 weeks between the hatha yoga group and the control group by using an analysis of covariance, with data presented in Table 5. Their analysis found a significantly (p-value= .01) lower self-reported WOMAC pain score in the yoga group as compared to the wait-list control group at 8 weeks. They reported the mean pain score adjusted

for baseline at 8 weeks in the yoga intervention group to be 2.6 lower, or 13% lower than the control group, which was determined significant with a p-value of 0.01.

Table 5: Difference in WOMAC pain score means adjusted for baseline at 8 weeks in Cheung et al. 2014

	Control	Yoga	Difference at 8 weeks
Baseline mean (SD)	7.7 (4.2)	9.3 (4.0)	
8 weeks adjusted mean (SD)	8.3 (.67)	5.8 (.67)	**2.6 (.96)** ***p-value= .01***
Change from baseline	0.6 (3%) *no p-value reported*	-3.5 (17.5%) *no p-value reported*	

No adverse events or injuries occurred as a result of hatha yoga intervention in any of the three studies presented.

DISCUSSION

All three trials reviewed by this study showed a statistically significant decrease in self-reported pain with p-values <0.05. Among the three studies, hatha yoga effectiveness was compared to a mix of exercise-free controls as well as other non-yogic exercise interventions and all three studies found yoga's effectiveness in reducing pain to be greater than all other comparison groups. That being said, while differences in outcomes were determined to be statistically significant in all studies, it may be questioned if the actual reduction of pain was significant in terms of being something that matters to the patients. For instance, while in the Cheung et al. 2017 study there was a statistically significant 14% reduction in pain from baseline with yoga practice, 14% may not be significant enough for patients to want to participate regularly in the practice. Still, yoga practice is not being proposed as stand-alone intervention, but rather adjunctive therapy and therefore the studies' results still support its recommendation. Thus, while these studies did not report any adverse outcomes, future studies may be done to focus more on the safety of yoga practice in OA patients, so that further cost-benefit analyses can be made.

All three studies also did have their limitations. Common to all was an issue with generalizability. Ebnezar et al. had the largest sample size with a relatively equal gender distribution as compared to the other two studies, however its sample of participants was limited to patients at one specialty orthopedic center in Bengaluru, India. The Cheung et al. 2017 study sample was more homogenous, with the majority being Caucasian women who were well-educated.[5] Finally the Cheung et al. 2014 study's sample was composed entirely of women from the same community. Therefore, all studies had significant limitations on their generalizability to the entire population dealing with knee OA pain. While there is a higher incidence of OA in older women as compared to men[1], it is common in both genders, therefore more equal distribution of gender in samples would be beneficial. Sample size proved to be another limitation of the studies. For instance, small sample size likely contributed to the statistically significant differences between intervention and control group characteristics (comorbidities and education) at baseline in the Cheung et al 2014 study. These issues can be overcome in future studies by using larger and more heterogeneous samples, as well as using more sophisticated randomization methods.

Another potential issue at play is that of supervision and enforcement of the yoga programs. All studies used a blend of supervised yoga class and an at-home yoga practice that was either not supervised or had limited supervision (e.g. participant-submitted video recordings; written logs). Therefore, all of the studies relied in part on participants' honesty and accuracy of practice logs/reports. Additionally, without supervision of the yoga practice, proper technique could not be observed and enforced by the teachers used in the classes. Further studies may attempt to avoid this limitation by using an entirely supervised class-based yoga intervention rather than relying on additional at-home practice.

While yoga practice appears to offer patients benefit in these studies, it does have some inherent limitations to its use. As yoga class is generally not currently covered by health insurance companies, cost can be an obstacle with the requirement of gym memberships, drop-in class costs, and additional costs for supplies. In general, it also requires patients have a means of transportation to attend classes (at least initially for training), which may be an additional cost. Further, while yoga classes may be easy to find in metropolitan areas, they may not be as accessible in more rural regions.

CONCLUSION

The studies reviewed above support the use of hatha yoga as an adjunctive therapy for reduction of pain in patients with knee osteoarthritis. All three randomized control trials demonstrated a significant reduction in self-reported knee pain by those participating in hatha yoga programs. Based on their findings yoga should continue to be recommended as an adjunctive therapeutic modality for OA-related knee pain sufferers. While one of the above studies demonstrated yoga to be significantly more effective than another exercise program in reducing self-reported pain, more research can be done to determine this more conclusively and compare yoga to other non-pharmacologic interventions. Further research may also provide more information about yoga's potentially variable effectiveness at different points along the progressive course of the condition. For example, future research may elect to study groups of patients based on number of years with symptoms or degree of radiological OA evidence. As discussed above, more research may be done to also assess the safety of yoga practice in patients with knee OA, though early research assessing its safety for arthritis more broadly has shown promising signs of both efficacy and safety for individuals with vulnerable joints.[7]

References

1. Felson DT. Osteoarthritis. In: Kasper D, Fauci A, Hauser S, Longo D, Jameson J, Loscalzo J. eds. *Harrison's Principles of Internal Medicine, 19e* New York, NY: McGraw-Hill; 2014. http://accessmedicine.mhmedical.com.ezproxy.pcom.edu:2048/content.aspx?bookid=1130&sectionid=79751047. Accessed October 03, 2018.

2. Arthritis Foundation. Arthritis by the Numbers: Book of Trusted Facts and Figures. https://www.arthritis.org/Documents/Sections/About-Arthritis/arthritis-facts-stats-figures.pdf. Published 2018. Accessed October 03, 2018.

3. Hellman, DB, Imboden Jr JB. Rheumatologic, Immunologic, & Allergic Disorders. In: McPhee, SJ, Papadakis MA, eds. *Current Medical Diagnosis & Treatment 2018*. 57th edition. United States: McGraw Hill Education; 2018.

4. Ebnezar J, Nagarathna R, Yogitha B, Nagendra HR. Effects of an integrated approach of hatha yoga therapy on functional disability, pain, and flexibility in osteoarthritis of the knee joint: A randomized controlled study. *The Journal of Alternative and Complementary Medicine*. 2012;18(5):463-472. doi: 10.1089/acm.2010.0320.

5. Cheung C, Wyman JF, Bronas U, McCarthy T, Rudser K, Mathiason MA. Managing knee osteoarthritis with yoga or aerobic/strengthening exercise programs in older adults: A pilot randomized controlled trial. *Rheumatology International*. 2017;37(3):389-398. doi:10.1007/s00296-016-3620-2.

6. Cheung C, Wyman JF, Resnick B, Savik K. Yoga for managing knee osteoarthritis in older women: A pilot randomized controlled trial. *BMC Complementary and Alternative Medicine*. 2014;14(1):160. doi: 10.1186/1472-6882-14-160.

7. Moonaz SH, Bingham CO, Wissow L, Bartlett SJ. Yoga in sedentary adults with arthritis: Effects of a randomized controlled pragmatic trial. *J Rheumatol*. 2015;42(7):1194-202.