SIN-CHN SCIENTIFIC PRESS PTE.LTD.

Molecular & Cellular Biomechanics 2025, 22(3), 419.
https://doi.org/10.62617/mcb419

Review

Evaluating the impact of yoga on pain, mobility, and quality of life among individuals diagnosed with knee osteoarthritis: A systematic review

Ansh Tivari[1], Satyalakshmi Komarraju[1], Sathyanath D.[2], Shrikanth Muralidharan[3,*]

[1] National Institute of Naturopathy, Ministry of Ayush, Pune 411001, India
[2] Department of Clinical Naturopathy, National Institute of Naturopathy, Ministry of Ayush, Pune 411001, India
[3] Department of Research, National Institute of Naturopathy, Ministry of Ayush, Pune 411001, India
*** Corresponding author:** Shrikanth Muralidharan, shrikanthmuralidharan23@gmail.com

CITATION

Tivari A, Komarraju S, D S, Muralidharan S. Evaluating the impact of yoga on pain, mobility, and quality of life among individuals diagnosed with knee osteoarthritis: A systematic review. Molecular & Cellular Biomechanics. 2025; 22(3): 419. https://doi.org/10.62617/mcb419

ARTICLE INFO

Received: 25 September 2024
Accepted: 4 December 2024
Available online: 21 February 2025

Abstract: Introduction: Yoga, combining physical postures, meditation, and controlled breathing, may restore balance between mind and body, potentially alleviating KOA symptoms and enhancing quality of life. This systematic review aims to evaluate the efficacy of yoga in treating KOA, focusing on pain relief, mobility, and quality of life. **Materials and Methods:** A comprehensive literature search was conducted in Medline/PubMed, Google Scholar, and the Cochrane Library databases to identify studies up to 2022. Using a combination of MeSH and free-text terms, the search targeted randomised controlled trials (RCTs) investigating yoga interventions for KOA. Data extraction was performed independently by three authors, focusing on study characteristics, intervention details, control group interventions, outcome measures, and results. **Results:** Nine studies involving 372 participants were included. Sample sizes varied from 11 to 125 participants, with ages ranging from 51 to 71 years. Yoga interventions varied in style, duration, and intensity, with sessions ranging from 40 to 90 min, three to six times per week. Yoga significantly reduced pain compared to control groups. Mobility improvements were noted in walking tests and chair-stand exercises. **Conclusion:** The evidence suggests yoga is a beneficial adjunct therapy for managing KOA, enhancing pain relief, mobility, and quality of life. However, heterogeneity in study designs, participant characteristics, and yoga protocols limits definitive conclusions.

Keywords: knee osteoarthritis; mobility; pain; quality of life; yoga

1. Introduction

Knee osteoarthritis (KOA) is a degenerative joint disease characterized by pain, stiffness, and reduced mobility, affecting millions globally. Conventional treatments such as pharmacotherapy and surgical interventions can alleviate symptoms but are often associated with significant risks, including adverse side effects and high financial costs. These treatments typically address symptoms rather than the root causes of KOA, prompting the exploration of alternative therapies.

In recent years, public interest in complementary approaches, including yoga, has grown. Yoga is a holistic practice that integrates physical postures, controlled breathing, and meditation to restore balance between the mind and body. Its potential for managing chronic conditions such as KOA lies in its ability to improve joint flexibility, reduce inflammation, and enhance mental well-being. However, despite increasing research, the efficacy of yoga in reducing KOA symptoms and improving patients' quality of life remains underexplored [1].

The rationale for investigating yoga as a treatment for KOA stems from its unique benefits compared to conventional therapies. Unlike pharmacological

treatments, yoga poses are gentle and non-invasive, making them suitable for individuals with joint issues. Additionally, yoga addresses both physical and psychological aspects of KOA, which may lead to sustained improvements in pain management and mobility. Given the high cost and side effects associated with traditional treatments, there is an urgent need for cost-effective, non-pharmacological interventions that can be easily implemented [2,3]. KOA contributes significantly to disability and impacting mobility and quality of life [4]. Conventional therapies such as medications, physical therapy, and surgeries, including joint replacement, offer symptom relief but fail to curb the disease's progression. These treatments are associated with risks like cardiovascular complications, gastrointestinal issues, and substantial financial burden, further straining healthcare systems worldwide [5–7]. Despite promising findings, existing research on yoga for KOA is hindered by inconsistent intervention protocols, such as varying durations, intensities, and types of yoga practices used across studies. This systematic review aims to evaluate the efficacy of yoga in managing KOA, focusing on its impact on pain relief, mobility, and overall quality of life. By examining current evidence, this study seeks to determine whether yoga can serve as a viable alternative or complementary therapy for KOA patients [8,9].

2. Materials and methods

2.1. Data sources and search strategy

A comprehensive literature search was conducted in the Medline/PubMed, Google Scholar, and Cochrane Library databases to identify studies published up to 2022. A combination of Medical Subject Headings (MeSH) and relevant free-text terms was employed to maximize search sensitivity. MeSH terms included "osteoarthritis," "yoga," and "knee," while free-text terms encompassed "randomized controlled trial," "pain," "mobility," "balance," "symptoms," and "quality of life." Boolean operators (AND, OR) were utilized to construct the search strategy. The PubMed search string was refined using advanced search functions to specifically target randomized controlled trials (RCTs) investigating yoga interventions for KOA-((“Osteoarthritis”[MeSH Terms] AND “Knee”[MeSH Terms]) AND (“Yoga”[MeSH Terms] OR “Yoga Therapy”[MeSH Terms])).

2.2. Study selection

Inclusion criteria for studies were:

1) Published in English
2) Clinical trials
3) Participants diagnosed with KOA
4) Yoga as the intervention

Studies were excluded if they did not meet these criteria. Initially, titles and abstracts were screened by two independent researchers to identify potentially eligible studies. This was followed by a detailed review of the full-text articles of selected studies to rigorously apply inclusion and exclusion criteria. Discrepancies in study selection were resolved through discussion and consensus among the reviewers.

Nine reports were included for the final review as shown in the PRISMA flow chart (**Figure 1).**

2.3. Data extraction

Three authors independently extracted data using a standardized data extraction form. Extracted data included study characteristics (e.g., author, publication year, sample size, participant demographics), intervention details (e.g., yoga type, duration, frequency), control group interventions, outcome measures, and results. Disagreements during the extraction process were resolved through consensus or consultation with a fourth reviewer. The standardized tool ensured consistency across reviewers and minimized errors.

2.4. Risk of bias and study limitations

No risk of bias assessment was conducted in this review, which is a significant limitation.

2.5. Heterogeneity in study design and intervention

The studies included in this review displayed considerable heterogeneity in design, participant demographics, and intervention characteristics. Differences in yoga type, duration, and frequency, as well as variations in baseline characteristics of participants (e.g., age, severity of KOA), introduce challenges in drawing generalized conclusions. This heterogeneity limits the ability to conduct a meta-analysis and may affect the overall interpretation of yoga's efficacy in managing KOA.

2.6. Inclusion of non-randomized studies

While the primary focus was on randomized controlled trials, some non-randomized studies were included to provide a broader perspective. Although this approach enriches the dataset, it introduces biases inherent in observational studies, such as selection bias and confounding. These studies occupy a lower position in the evidence hierarchy, and their findings should be interpreted with caution. Nonetheless, their inclusion helps capture a wider range of evidence, especially in areas where RCTs are limited.

The Visual Analog Scale (VAS) and the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) were chosen as outcome measures for assessing KOA symptoms due to their widespread use, validity, and reliability in capturing pain and functional impairments associated with KOA. VAS provides a simple, sensitive, and quantitative measure of pain intensity, allowing for easy comparison of baseline and post-intervention pain levels. WOMAC, on the other hand, is a disease-specific instrument that comprehensively evaluates pain, stiffness, and physical function in patients with osteoarthritis. It is particularly well-suited for KOA as it captures the impact of symptoms on daily activities, providing a holistic view of the patient's condition. These tools are preferred over general quality-of-life measures or less specific scales because they are tailored to the clinical features and functional limitations unique to KOA, ensuring more precise and meaningful

assessment of intervention outcomes.

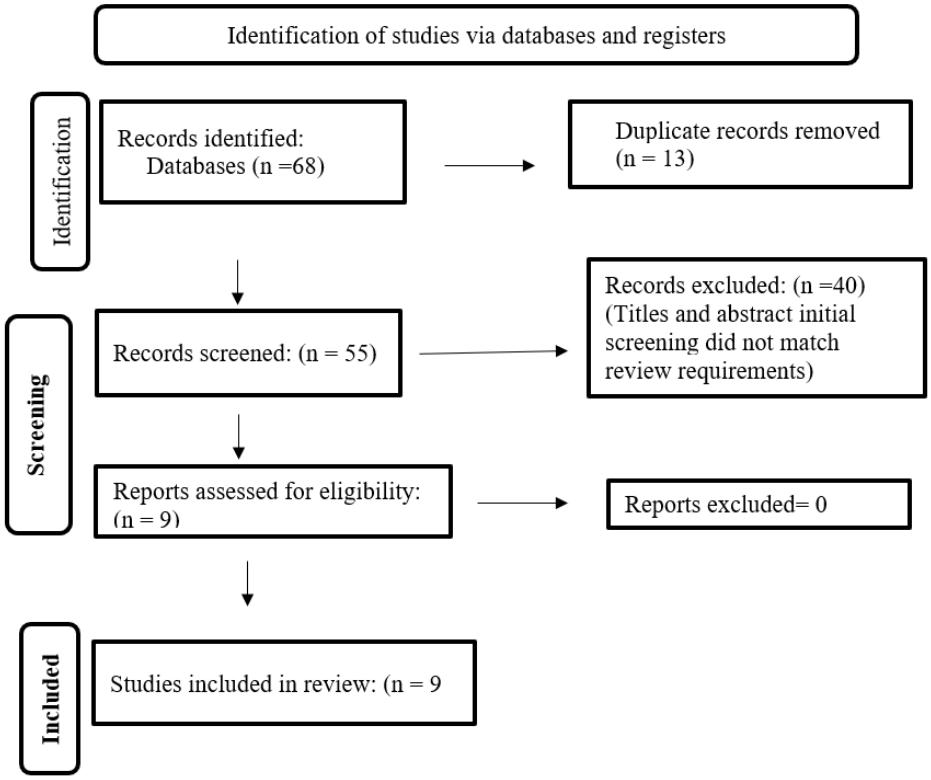

Figure 1. PRISMA flow chart.

3. Results

Nine studies, encompassing 372 participants, were included in this review. Sample sizes varied across studies, ranging from 11 to 125 participants in both intervention and control groups. While the duration of KOA was explicitly reported in only one study, all included studies reported outcomes related to pain and other symptoms, suggesting a minimum KOA duration of at least six months. Participants' ages ranged from 51 to 71 years. While four studies exclusively included female participants, three included male and female participants, as shown in **Table 1**.

Table 1. Study characteristics.

Sr No.	Study	Study design	No. of Participants	Analysed participants	Duration of KOA (years)	Age (mean ± SD)	Gender
1.	Ebnezar et al. [10]	RCT	Y/C = 125/125	Y/C = 118/117	From <1 to >2 years	Y/C = 59.56±9.54/ 59.42±10.66	Both male and female
2.	Ebnezar et al. [11]	RCT	Y/C = 125/125	Y/C = 118/117	From <1 to > 2 years	Y/C = 59.56 ± 9.54/59.42 ± 10.66	Both male and female
3.	Ebnezar and Yogitha [12]	RCT	Y/C = 125/125	Y/C = 118/117	From <1 to > 2 years	Y/C=59.56±9.54/ 59.42±10.66	Both male and female
4.	Cheung et al. [13]	RCT	Y/C = 18/18	Y/C = 18/18	At least six months	Y/C = 71.9 in both groups	All females
5.	Kolasinski et al. [14]	Single group pre-post study	Y = 11	Y = 7	At least six months	Y = 58.5 ± 8.5	All females

Table 1. (*Continued*).

Sr No.	Study	Study design	No. of Participants	Analysed participants	Duration of KOA (years)	Age (mean ± SD)	Gender
6.	Brenneman et al. [15]	Single group pre-post study	Y = 45	Y = 39	Unclear	Y = 60.3 ± 6.5	All females
7.	Ebnezar et al. [16]	RCT	Y/C = 125/125	Y/C = 118/117	From <1 to > 2 years	Y/C = 55.6 ± 8.3/55.4 ± 10.7	Both male and female
8.	Nambi and Shah [17]	RCT	Y/C = 15/15	Y/C = 15/15	At least six months	Y/C = 52 ± 5/54 ± 4	Both male and female
9.	Ghasemi et al. [18]	Quasi-RCT	Y/C = 15/15	Y/C = 11/14	Unclear	Y/C = 51 ± 8.7/51.11 ± 10.8	All females

(Y—Yoga group and C—Control group).

Table 2 provides the details of the interventions and the outcome. In one study, the control group conducted activities similar to those in the yoga group after eight weeks, whereas the other two utilised conventional exercise as their control group throughout the trial. Another study revealed that the yoga group received Iyengar yoga, TENS, knee strengthening exercises, and EMG biofeedback. No control group was used in two additional studies. The yoga group practised for eight weeks in all three trials. The two groups were compared for eight weeks of a 20-week experiment—the other two trials employed 12-week yoga programmes. Most studies reported three to four weekly 60–90-min sessions. Three studies showed that a regular yoga practice includes asana (moving), pranayama (breathing), and meditation (relaxation); two found that asana alone was enough, and the last reported the respondents' posture while doing yoga but didn't identify the type. Two studies used WOMAC to assess yoga's pain reduction effects in KOA patients. Eight weeks of regular yoga reduced pain ratings compared to pre-and post-intervention. Cheung et al. found significant pain score differences across groups at eight weeks. Pain differences were statistically significant in the 4–8 and 4–20 week yoga groups. Four trials evaluated KOA pain using VAS. After a three-month yoga intervention with physiotherapy, there was a notable difference in pain levels across the groups ($p < 0.001$). The yoga group had a more significant effect size than the therapeutic exercise and physiotherapy control group. After eight weeks of intervention, the yoga group in Nambi and Shah had a 56.83% VAS drop compared to the control group (38.15%). The yoga group showed a substantial decrease in pain intensity compared to the control group, as measured by pre-and post-intervention VAS scores ($p < 0.05$).

Three assessments assessed mobility in various ways. After 12 weeks of intervention, the yoga group showed a significant variation in walking time compared to the control and other groups, with a more significant effect size ($p < 0.001$). The time it took to walk fifty feet remained the same after eight weeks of yoga. After a 12-week yoga programme, participants' mobility was assessed using a stair-climbing method, a 30-s chair stand, and a 6-min walk test. The results show significant gains in the 6-m walk test ($p < 0.001$) and the 30-s continuous standing test ($p < 0.006$), but there was no change in the stair-climbing plan. Four trials yielded quality of life. Two tested the Knee Injury and Osteoarthritis Outcome Scale. A 12-week yoga exercise programme significantly improved quality of life (QOL)

levels compared to pre- and post-intervention scores ($p < 0.001$).

A significant difference in QOL was seen between the control and yoga groups based on pre-and post-intervention ratings ($p < 0.005$). Ebnezar et al. evaluated quality of life using the Short Form 36 (SF-36). There were significant differences from one group to another and across all SF-36 categories ($p < 0.001$). On days 15 and 90, the yoga group showed more improvement than the control group. After eight weeks, neither the yoga nor the control group demonstrated a statistically significant improvement in quality of life according to the Cantril Self-Anchoring Ladder and the Short Form Health Survey. The Cantril Self-Anchoring Ladder assessed the quality of life at the "current" and "in 5 years" time points. Between weeks 4 and 8, the yoga group's intervention on the Cantril Self-Anchoring Ladder resulted in substantially higher "QOL current" scores ($p = 0.045$), but there was no change in the "QOL in 5 years" scores. The SF-12 score remained unchanged throughout time.

Table 2. Key characteristics from the included studies

Study	Comparison	Control group	Yoga group	Yoga therapy practice	Main outcomes	Time
Cheung et al. [13]	Compare yoga to usual care (8 weeks) 8–20-week pre- and post-yoga interventions	Another program (8 weeks) Hatha yoga intervention (8–20 weeks)	Restorative yoga (60 min weekly for eight weeks) Do 30 min of yoga four times a week at home.	Asanas Pranas Meditation	WOMAC, SPPB, PSQI SF-12 & Cantril Self-Anchoring Ladder QOL	8 Weeks
Ebnezar et al. [11]	Yoga + PT versus PT	PT (20 min/day/2 weeks) Practices (40 min/day, six days/week) Practice at home (12 weeks) Once/3-day compliance Once/week/12 weeks review	PT (20 min/day/2 weeks) 40-min/day/2-week integrated yoga treatment Integrated yoga (40 min/day/ten weeks)	Asanas that promote yogic purification Methods for Stress Reduction Physical positions are known as asanas Teachings and guidance in pranayama, meditation	QOL (SF-36)	14 weeks
Ebnezar et al. [10]	Yoga + PT versus PT	PT (20 min/day/2 weeks) Daily 40-min practices Practice at home (12 weeks) Once/3-day compliance Once/week/12 weeks review	PT (20 min/day/2 weeks) 40-min/day/2-week integrated yoga treatment Integrated yoga (40 min/day/ten weeks)	Sukhma yoga Methods of relaxation Physical postures Pranayama, meditation, lectures, and counselling.	Walking time (50 m) is painful. WOMAC Sign: active mobility Sign: tenderness Signs include oedema and crepitus.	14 weeks
Ebnezar and Yogitha [12]	Yoga + PT versus PT	PT (20 min/day/2 weeks) Daily 40-min practices Practice at home (12 weeks) Once/3-day compliance Once/week/12 weeks review	PT (20 min/day/2 weeks) 40-min/day/2-week integrated yoga treatment Integrated yoga (40 min/day/ten weeks)	Sukhma yoga Methods of relaxation Physical postures Pranayama, meditation, lectures, and counselling.	Pain during walking WOMAC sign: soreness Symptom: morning stiffness	14 weeks

Table 2. (*Continued*).

Study	Comparison	Control group	Yoga group	Yoga therapy practice	Main outcomes	Time
Ebnezar et al. [16]	Yoga + PT versus PT	PT (20 min/day/2 weeks) Daily 40-min practices Practice at home (12 weeks) Once/3-day compliance Once/week/12 weeks review	PT (20 min/day/2 weeks) 40-min/day/2-week integrated yoga treatment Integrated yoga (40 min/day/ten weeks)	Sukhma yoga Methods of relaxation Physical postures Meditation, Pranayama, Lectures, and Counselling	Anxiety scores Resting pain Sign: early morning stiffness	14 weeks
Kolasinski et al. [14]	Yoga versus control (no specific exercise)		Modified Iyengar yoga (90-min classes/week/8 weeks)	Asanas	GA WOMAC AIMS2 Psychological subsets Global Physician Assessment: 50-foot walk rate	Eight weeks
Brenneman et al. [15]	Yoga versus control		Yoga (60 min/sessions/3 sessions/week/12 weeks)	Unclear	Self-reported pain and physical function (Knee injury and Osteoarthritis Outcome Score) and knee strength (extensor and flexor torques)	12 weeks
Ghasemi et al. [18]	Yoga versus ordinary daily activities	Ordinary daily activities	Hatha yoga (3x/week, 60 min/session, eight weeks)	Movement: Asana Breathing exercises Relaxation/meditation	VAS KOOS	Eight weeks
Nambi and Shah [17]	Comparison of yoga + EMG biofeedback + knee strengthening exercise + TENS.	EMG biofeedback (3x/week/8 weeks) Knee strengthening (3x/week/8 weeks) TENS (20 min/3 times/week)	Three 90-min sessions each week for eight weeks of Iyengar yoga Three times each week for eight weeks, EMG biofeedback Joint strengthening exercises three times each week for eight weeks EMG (20 min, three times weekly)	Asanas	VAS WOMAC	Eight weeks

EMG: Electromyography, PT: Physiotherapy, WOMAC: Western Ontario and McMaster Universities Osteoarthritis Index, AIMS2: Arthritis Impact Measurement Scale 2, SPPB: Short Physical Performance Battery, KOOS: Knee Injury and Osteoarthritis Outcome Scale, QOS: Quality of sleep, QOL: Quality of life, ADL: Activities of Daily Life, PSQI: Pittsburgh Sleep Quality Index, SF-12: Health Related Short Form 12, PCS: physical component summary, MCS: mental component summary; Cantril current and five years, GA: Global Assessment, VAS: Visual Analog Scale, KAM: Knee adduction moment.

4. Discussion

A growing body of evidence suggests that yoga may be a beneficial adjunct therapy for managing KOA. Several studies have shown improvements in pain, function, and quality of life, but the variation in effect sizes across studies highlights important considerations. For instance, Ebnezar et al. [10] and Cheung et al. [11] reported significant improvements in pain and function, with large effect sizes, suggesting strong benefits of yoga over conventional physiotherapy or no exercise. In contrast, Kolasinski et al. [12] observed more modest improvements, potentially due to shorter intervention durations or less intensive yoga protocols.

This variation in effect sizes may be attributed to differences in participant characteristics (e.g., age, gender, severity of KOA), yoga styles (e.g., Hatha vs.

Iyengar) [13,14,17], and adherence levels. Furthermore, the inconsistent control groups and diverse outcome measures, such as VAS [17,18] and WOMAC [13,14,16], complicate direct comparisons. However, the sample size varied considerably across included studies, potentially impacting the reliability of aggregated outcomes. This variability in sample sizes could lead to differential weight in the synthesis, thereby affecting the robustness of conclusions.

Based on observed trends, a standardized yoga protocol for KOA could include a 12-week program with three 60-min sessions per week. Each session should comprise a 10-min warm-up with gentle joint movements, 30 min of yoga poses focused on improving joint flexibility and muscle strength (e.g., modified Warrior Pose, Chair Pose, and Bridge Pose), 10 min of pranayama (breathing exercises such as Nadi Shodhana and Anulom Vilom) to enhance relaxation and reduce stress, and a 10-min cooldown involving guided meditation or relaxation.

Several limitations of this review warrant consideration. Firstly, the inclusion of studies with varying methodologies, participant characteristics, and yoga interventions hinders the ability to draw definitive conclusions about the efficacy of yoga for KOA. Secondly, the reliance on self-reported outcomes may overestimate the benefits of yoga, as these measures are susceptible to bias. Thirdly, the lack of long-term follow-up studies limits our understanding of the sustained effects of yoga on KOA. Finally, the absence of standardised yoga protocols across studies makes comparing outcomes and identifying optimal treatment parameters difficult. The variation in control groups, such as usual care (e.g., medications, physical therapy) and no-exercise interventions, significantly affects the comparability of outcomes across studies evaluating yoga for KOA. Studies using usual care as a control provide a realistic comparison of yoga's additional benefits over standard treatments but may introduce variability due to differences in the type and intensity of usual care. Conversely, no-exercise control groups offer a clearer baseline to evaluate yoga's efficacy in isolation but may not reflect real-world conditions where patients typically receive some form of treatment. This inconsistency complicates the synthesis of findings and weakens the ability to draw definitive conclusions about yoga's comparative effectiveness.

5. Conclusion

The limited availability of high-quality randomised controlled trials and variations in study designs, participant characteristics, yoga interventions, and outcome measures precludes drawing definitive conclusions on yoga's efficacy and best practices for KOA management. Future research should prioritise rigorous methodological approaches, standardised yoga protocols, and the incorporation of objective outcome measures to advance the field.

Ethical approval: Not applicable.

Conflict of interest: The authors declare no conflict of interest.

References

1. Musumeci, G., Mobasheri, A., & Szychlinska, M. A. (2015). Age-related degeneration of articular cartilage in the

pathogenesis of osteoarthritis: molecular markers of senescent chondrocytes. Histology and Histopathology, 30(1), 1–12.
2. Szychlinska, M., Leonardi, R., Al-Qahtani, M., Mobasheri, A., & Musumeci, G. (2016). Altered joint tribology in osteoarthritis: reduced lubricin synthesis due to the inflammatory process. New horizons for therapeutic approaches. Annals of Physical and Rehabilitation Medicine, 59(3), 149–156.
3. McAlindon, T. E., Bannuru, R. R., Sullivan, M. C., et al. (2014). OARSI guidelines for the non-surgical management of knee osteoarthritis. Osteoarthritis and Cartilage, 22(3), 363–388.
4. Musumeci, G., Castrogiovanni, P., Trovato, F. M., et al. (2015). Physical activity ameliorates cartilage degeneration in a rat ageing model: a study on lubricin expression. Scandinavian Journal of Medicine and Science in Sports, 25(2), e222–e230.
5. Desveaux, L., Lee, A., Goldstein, R., & Brooks, D. (2015). Yoga in the management of chronic disease. Medical Care, 53(7), 653–661.
6. Liu, X.-C., Pan, L., Hu, Q., Dong, W.-P., Yan, J.-H., & Dong, L. (2014). Effects of yoga training in chronic obstructive pulmonary disease patients: a systematic review and meta-analysis. Journal of Thoracic Disease, 6(6), 795–802.
7. Cramer, H., Lauche, R., Haller, H., Dobos, G., & Michalsen, A. (2015). A systematic review of yoga for heart disease. European Journal of Preventive Cardiology, 22(3), 284–295.
8. Bosch, P. R., Traustadóttir, T., Howard, P., & Matt, K. S. (2009). Functional and physiological effects of yoga in women with rheumatoid arthritis: a pilot study. Alternative Therapies in Health and Medicine, 15(4), 24–31.
9. Groessl, E. J., Weingart, K. R., Aschbacher, K., Pada, L., & Baxi, S. (2008). Yoga for veterans with chronic low-back pain. Journal of Alternative and Complementary Medicine, 14(9), 1123–1129.
10. 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. J Altern Complement Med. 2012 May;18(5):463-72. doi: 10.1089/acm.2010.0320.
11. Ebnezar J, Nagarathna R, Bali Y, Nagendra HR. Effect of an integrated approach of yoga therapy on quality of life in osteoarthritis of the knee joint: A randomized control study. Int J Yoga. 2011 Jul;4(2):55-63. doi: 10.4103/0973-6131.85486.
12. Ebnezar J, Yogitha B. (2012). Effectiveness of Yoga Therapy with the Therapeutic Exercises on Walking Pain, Tenderness, Early Morning Stiffness and Disability in Osteoarthritis of the Knee Joint - A Comparative Study. J Yoga Phys Ther 2:114. doi:10.4172/2157-7595.1000114
13. Cheung, C., Wyman, J.F., Resnick, B. et al. Yoga for managing knee osteoarthritis in older women: a pilot randomized controlled trial. BMC Complement Altern Med 14, 160 (2014). https://doi.org/10.1186/1472-6882-14-160
14. Kolasinski SL, Garfinkel M, Tsai AG, Matz W, Van Dyke A, Schumacher HR. Iyengar yoga for treating symptoms of osteoarthritis of the knees: a pilot study. J Altern Complement Med. 2005 Aug;11(4):689-93. doi: 10.1089/acm.2005.11.689.
15. Brenneman EC, Kuntz AB, Wiebenga EG, Maly MR. A Yoga Strengthening Program Designed to Minimize the Knee Adduction Moment for Women with Knee Osteoarthritis: A Proof-Of-Principle Cohort Study. PLoS One. 2015 Sep 14;10(9): e0136854. doi: 10.1371/journal.pone.0136854.
16. Ebnezar J, Nagarathna R, Yogitha B, Nagendra HR. Effect of integrated yoga therapy on pain, morning stiffness and anxiety in osteoarthritis of the knee joint: A randomized control study. Int J Yoga. 2012 Jan;5(1):28-36. doi: 10.4103/0973-6131.91708.
17. Nambi GS, Shah AA. Additional effect of iyengar yoga and EMG biofeedback on pain and functional disability in chronic unilateral knee osteoarthritis. Int J Yoga. 2013 Jul;6(2):123-7. doi: 10.4103/0973-6131.113413.
18. Ghasemi GA, Golkar A, Marandi SM. Effects of hata yoga on knee osteoarthritis. Int J Prev Med. 2013 Apr;4(Suppl 1): S133-8.