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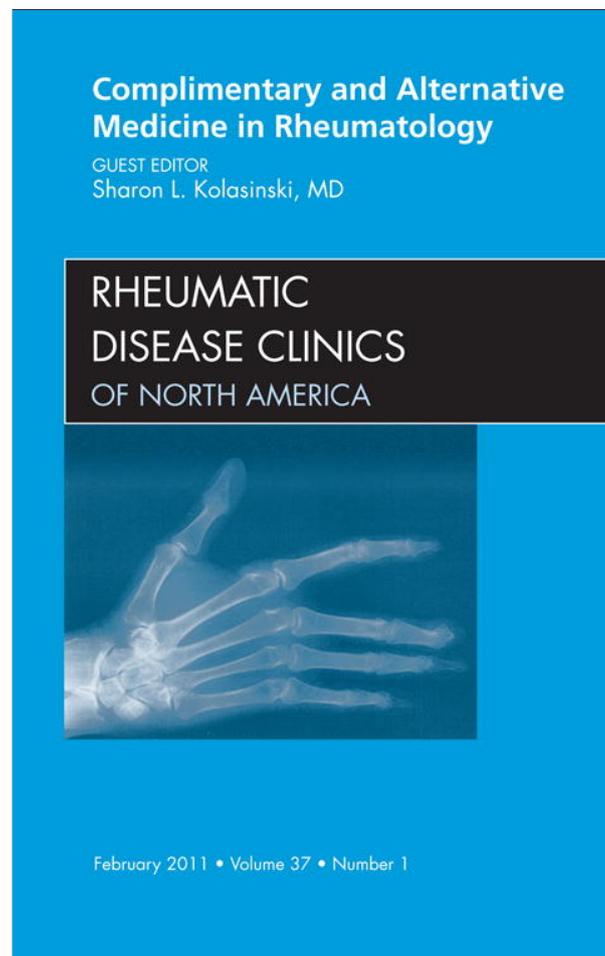


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Yoga for Arthritis: A Scoping Review

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KEYWORDS

- Yoga • Rheumatoid arthritis • Osteoarthritis • Physical activity
- Exercise • Mindfulness

Yoga includes a variety of theories and practices that originated in ancient India and have evolved and spread throughout the world. In Sanskrit, yoga means “to yoke” or connect.¹ This term typically refers to mind-body integration, but over the thousands of years that yoga has evolved, this focus has also been applied to spatial surroundings, nature, other individuals, and spiritual interconnectedness.² The physical practice of yoga, referred to as “hatha,” was originally intended to prepare for meditation, an important spiritual practice in many cultures. In recent decades, hatha yoga has become popular for physical activity and stress management. Other aspects of yoga, including study of ancient texts, dietary practices, acts of service, and moral living, may be mentioned but are not generally a focus of western classes.

After attention to posture, deep breathing, and/or chanting, yoga practice often begins with a slow movement sequence to increase blood flow and warm muscles. This sequence is followed by poses that include flexion, extension, adduction, abduction, and rotation.^{1,3} Holding poses builds strength by engaging muscles in isometric contraction.^{4,5} Moving joints through their full range of motion increases flexibility,^{6,7} whereas standing poses promote balance by strengthening and stabilizing muscles and improving proprioception to reduce falls.^{8,9} Thus, yoga incorporates several elements of exercise that may be beneficial for arthritis.

To cope with pain, patients with arthritis often reduce activity.^{10,11} However, inactivity can result in muscle or tendon shortening, articular capsule contraction, and weakened ligaments.¹² Conversely, regular activity may decrease pain and preserve stability.^{12,13}

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Although there was once a concern that exercise might increase inflammation and exacerbate pain, regular physical activity is now recommended as part of the comprehensive treatment of arthritis.^{14–17} The American College of Rheumatology (ACR),¹⁸ Osteoarthritis Research Society International (OARSI),¹⁹ and the Ottawa Panel²⁰ note that stretching, strengthening, and conditioning exercises can preserve physical function, increase strength, and improve endurance for people with arthritis. All persons with arthritis should consult with their doctor to determine a safe and appropriate approach to increasing physical activity.

Unfortunately, long-term exercise maintenance is uncommon even for healthy individuals, generally approaching 50% after 6 months.²¹ Vigorous exercise is ideal for physical health²² and may be acceptable for some persons with arthritis^{23,24} but it could be intolerable and may not be recommended for those with significant joint instability or damage.^{25,26} Adherence to moderate-intensity exercise is more broadly tolerable but still not attained by most people with arthritis.²⁷ For patients with arthritis, emphasis on stretching, strength, posture, balance, and the ability to adjust pace and intensity are important components of a safe activity, all of which yoga encompasses. Yoga is multifaceted, including focused breathing, mental engagement, stress management, social connection, and/or meditative concentration, along with physical activity. Yoga may offer an alternative to traditional exercise and potential psychological benefits or increased enjoyment for enhanced exercise adherence. Yoga could, therefore, provide another way for patients with arthritis to be active and engaged in an health-promoting behavior. Mind-body interventions, such as yoga, that teach stress management with physical activity may affect diseases from multiple fronts and may be well suited for investigation in both osteoarthritis (OA) and inflammatory immune-mediated diseases such as rheumatoid arthritis (RA).

The goal of this review is to evaluate existing evidence regarding the effects of yoga practice on clinical, functional, and psychosocial outcomes for people with arthritis.

METHODS

Databases including MEDLINE, PsychLIT, PsychINFO, and IndMed (an Indian database) were searched for research trials published from 1980 through May 2010, using yoga (including poses, breathing practices, relaxation, and/or meditation) as an exercise intervention for patients with arthritis. Additional relevant publications found in references from the original search list are also reviewed. Research in progress was searched via abstracts from annual scientific meetings of the American Public Health Association, ACR, OARSI, European League Against Rheumatism, and International Association of Yoga Therapists. The following search terms were used: yoga or yogic and arthritis, arthritic, rheumatoid, rheumatic, or osteoarthritis. This review is limited to studies including quantitative statistical analysis and peer review.

RESULTS

A total of 11 articles that described evaluating the effects of a yoga intervention in persons with arthritis were examined. One case series was excluded for lack of quantitative methods.²⁸ Final analysis consisted of 10 studies (**Table 1**). Among the 10 studies, 6 focused on RA, 2 were for OA only, and 2 included both RA and OA or arthritis in general. The studies were all published from 1980 to 2010.

Study Quality

Study quality was assessed based on study design, sample size, intervention protocol, and statistical analysis. Studies were classified as low, moderate, or high.

Table 1
Studies included in systematic review

Authors	Design	Date Published	Participants	Sample Size	Location	Intervention
Kolasinski et al ³⁹	Cohort	2005	Knee OA in at least 1 knee, 6/7 obese, aged >50 y, all female	7	Philadelphia, PA, USA	90 min, 1/wk for 8 wk (Iyengar)
Garfinkel et al ³⁰	RCT, waiting-list control	1994	Hand OA, age 52–79 y, male and female	17	Philadelphia, PA, USA	60 min, 1/wk for 8 wk (Iyengar)
Dash and Telles ³⁴	Matched controls for age and sex	2001	RA, age 21–43 y, male and female	40	—	15 continuous days
Bosch et al ³⁷	Convenience control	2009	RA, postmenopausal women	16	—	90 min, 3/wk for 10 wk
Badsha et al ³⁶	Convenience control	2009	Middle-aged adults with RA, mostly of Indian and Caucasian descent	47	Dubai, UAE	60 min, 2/wk for 6 wk (Raj)
Letter to the editor						
Haslock et al ³³	RCT, usual care control	1994	RA, age 15–72 y	20	Britain	120 min, 5/wk for 3wk; 1/wk for 3 mo; 10–30 min daily home practice
Evans et al ³⁸	Cohort	2010	RA, young adults	5	Los Angeles, CA, USA	90 min, 2/wk for 6 wk
Abstracts						
Haaz et al ³¹	RCT, waiting-list control	2007	RA or knee OA, age 18–65 y, mostly female, mixed racial background	37	Baltimore, MD, USA	60 min, 3/wk for 8 wk; 1/wk home practice
Haaz ³²	RCT, waiting-list control	2008	RA, age 18–65 y, mostly female, mixed racial background	30	Baltimore, MD, USA	60 min, 3/wk for 8 wk; 1/wk home practice
Sharma ³⁵	Matched controls for age and sex	2005	Any arthritis diagnosis, age 45–66 y, mostly women, all Caucasian	24	Midwestern state, USA	75 min, 1/wk for 6 wk (Kundalini)

Abbreviation: RCT, randomized controlled trial.

These criteria are based on categories set forth by the US Department of Health and Human Services 2002 report.²⁹ Funding source was not included as a category because most studies did not report a funding source, although the available information about funding was described. Because this review includes both randomized and observational trials, categories were adapted for both (**Table 2**).

Study Design

Of the 10 studies included in this review, 4 were randomized controlled trials (RCTs)^{30–33}; 2 compared people with arthritis to healthy controls, matching for age and sex^{34,35}; 2 were non-RCTs (NRCTs)^{36,37}; and 2 were cohort studies.^{38,39} Among the 4 RCTs, 3 had a waiting-list control and the other 2 were usual care. The NRCTs assigned participants to control if they were unable to attend the first class session. None of the studies had an active control group. Of the reviewed studies, 6 were reported as journal articles,^{30,34,36–39} 1 was a letter to the editor,³³ and 3 were presented as abstracts at annual research meetings.^{31,32} One study was presented as an abstract at an annual meeting, followed by publication in a journal that did not include a process of peer review³⁵; therefore, only the abstract was included in this review.

Sample Size

Sample sizes ranged from 3²⁸ to 26³⁶ intervention completers, with similar numbers of comparator groups. Only 1 study had as many as 20 persons per group.³⁶ The necessary sample size to detect differences between groups was not generally described. Generally, a subject to variable item ratio of 10 to 1 is recommended in multivariable regression analysis to avoid type I errors,^{40,41} although this ratio depends on variable distribution.^{42,43}

Table 2			
Study quality scoring based on Health and Human Services recommendations			
	Study Quality Score		
	0	1	2
Study Design	Uncontrolled	Matched or convenience control, such as comparing preexisting groups	Randomized controlled trial
Sample Size (Final Data Set)	0–10/group	11–20/group	>20/group
Intervention	Lacking detailed description about the intervention's components and protocol	Comprehensive yoga program with mention of several components (ie, poses, breathing, meditation)	Well-described comprehensive program, including specific poses and/or modifications, images, class structure
Data Analysis	Justification for outcome measures not described or not validated, unnecessary potential for bias, statistical methods not appropriate for the data	Some limitations in collection and analysis of data that are generally recognized and explained by study authors	Hypothesis-driven outcomes; reliable and validated measures, with efforts to reduce measurement bias; and explanation for use of appropriate statistical methods

There were 6 studies reported on attrition, with rates of 0%,³⁶ 9%,³³ 22%,³⁰ 36%,³⁹ and 37% each,^{35,38} with the 3 most rigorous studies having the lowest rates of attrition. The 2 cohort trials and 1 trial with healthy matched controls had the highest rates of attrition. The greatest retention was from the NRCTs and 2 RCTs. Most studies analyzed data for completers only. Only 1 study reported the consideration of attrition in final analysis, excluding 1 dropout before baseline.³³ Remaining studies did not report attrition.^{31,32,34,44}

Intervention Protocol

Intervention protocols varied widely. The “dose” of yoga varied substantially between studies and was often inconsistent within studies. For example, the study with the greatest dose included 120 minutes of practice 5 times per week followed by once per week for 3 months with 10 to 30 minutes of daily home practice. In contrast, the lowest dose included 60 minutes once per week for 8 weeks. Yet another study was only 15 days long but included daily practice in a retreat setting. Some studies required daily home practice, some weekly, and some had no element of home practice. Although many protocols were developed and/or taught by licensed or certified yoga professionals (teachers, therapists, or scholars), some did not describe the intervention development or delivery. This is further complicated because requirements and regulation of yoga instruction differ by jurisdiction and culture, and credentials of the yoga professionals are not always standardized. Some studies used a style of yoga with a long history and published texts describing teaching methods and practice, whereas others developed a new protocol for the population under investigation. Some studies failed to describe the protocol in any detail.

Three studies, an RCT for hand OA,³⁰ a cohort study for knee OA,³⁹ and an NRCT of young adults with RA,³⁸ used an Iyengar-based yoga program. This style is known for using props (blocks, straps, bolsters) adjusting to individual anatomy.¹ The program for both the OA studies was developed by one of the authors who is a senior certified yoga instructor, and the RA protocol was devised by an experienced Iyengar yoga (IY) teacher.³⁸ The hand OA trial included 10 weeks of “stretching and strengthening exercises emphasizing extension and alignment, group discussion, supportive encouragement and general questions and answers.”³⁰ Poses emphasized respiration and upper body alignment. The protocol is described generally with reference to a previous publication. The knee OA study described a 15-pose series and prop modifications, which could be easily replicated. The RA study by Evans and colleagues³⁸ listed examples of poses. The IY-based programs were conducted for 6,³⁹ 8,³⁰ and 10³⁰ weeks, meeting once or twice weekly for 60 to 90 minutes.

An NRCT for RA used a program developed in consultation with rheumatologists and a certified yoga therapist. This program, conducted by Badsha and colleagues,³⁶ included stretches, strengthening, meditation, and deep breathing of biweekly classes for 6 weeks. A study with healthy matched control by Dash and Telles³⁴ included poses, breathing practices, meditation, lectures, and joint loosening exercises in a 14-day yoga training camp. The RCT by Haslock and colleagues³³ used gentle tailored poses, breath control, meditation, lectures, and discussions, with the intention to soften emotions. For the first 3 weeks, 120-minute sessions were held 5 days per week, followed by weekly 120-minute sessions for 3 months.

Abstracts from an RCT of RA and OA discussed the use of a gentle yoga program developed by rheumatologists, psychologists, and a registered yoga therapist,^{31,32} incorporating poses, breathing practices, relaxation, meditation, chanting, and supplemental reading. A study with age- and sex-matched controls taught a social cognitive theory-based Kundalini yoga intervention to those diagnosed with arthritis.³⁵ Kundalini

yoga concentrates on the spine, with a focus on raising energy and awareness.⁴⁵ The study included poses, breathing techniques, meditation, and relaxation. In 2 studies,^{33,39} the reader is referred elsewhere for description of the practice.

Data Collection and Analysis

Well-validated instruments were administered by blinded assessors in 6 studies.^{28,30,33,34,39,44} These included anatomic changes, biomarkers, performance outcomes, and clinical assessment. The inclusion of unmasked assessors in one study was found to be its greatest limitation.³⁶

All but 2 studies^{33,35} measured baseline variables and outcomes recommended by ACR or OARSI.^{46,47} None used sham yoga to blind participants. Consequently, all self-report data sustain possible expectation bias. However, the chosen self-report instruments are commonly used for persons with arthritis and known for strong psychometric properties.

One study with healthy controls created a new assessment tool to measure intervention efficacy and participant perceptions.³⁵ The investigators had previously used some of the questions in this population and demonstrated strong validity and reliability. Additions to the tool were checked for face and content validity by 3 academics.

Only 2 trials (an NRCT and a cohort study) reported efforts to ensure that data characteristics supported the methods (such as assuming a normal distribution) and adjusted the statistical plan as necessary.^{36,39} Eight articles and abstracts described hypotheses up front and linked outcomes to those hypotheses. The other 2 listed feasibility as their primary outcome.^{33,35} However, some outcomes were not well explained in the study's context. For example, a study comparing patients with RA to healthy controls hypothesized that yoga would result in increased strength.³⁴ However, this study measured pre- and postintervention nonsteroidal antiinflammatory drug (NSAID) dose, without assessing analgesic or other medication use and included no pain measures.

Overall Study Quality

Of 8 possible points, studies ranged from 3 to 6 in overall study quality (**Table 3**). Future expansion from pilot studies and abstracts may include greater rigor. Although available information is limited, the strongest studies can point toward associations that may be confirmed with additional trials.

Authors	Study Design	Sample Size	Intervention	Data Collection/ Analysis	Overall
Kolasinski et al, ³⁹ 2005	0	0	2	2	4
Garfinkel et al, ³⁰ 1994	2	1	2	1	6
Haslock et al, ³³ 1994	2	1	2	1	6
Dash and Telles, ³⁴ 2001	1	1	1	1	4
Sharma, ³⁵ 2005	0	1	1	1	3
Badsha et al, ³⁶ 2009	1	2	2	1	6
Haaz et al, ³¹ 2007 and Haaz et al, ³² 2008	2	1	1	1	5
Bosch et al, ⁴⁴ 2003	2	0	1	1	4
Evans et al, ³⁸ 2010	0	0	1	1	2

STUDY FINDINGS

Professional organizations have provided evidence-based recommendations for the use of particular outcomes for RA and OA. ACR suggests that trials of RA use the following measurement tools: tender joint count, swollen joint count, patient pain assessment, patient and physician global assessment of disease activity, patient assessment of physical function, and laboratory evaluation of one acute phase reactant.⁴⁶ For OA, OARSI recommends pain as the primary outcome, along with physical function and a patient global assessment.⁴⁷ These outcomes can be measured with any tool that has adequate validity, reliability, and responsiveness. Later addition of other outcomes were not ruled out, such as physician global assessment, health-related quality of life (HRQL), inflammation, stiffness, and time to surgery. Although no study included all of the recommended outcomes, most included one or more. See **Table 4** for study findings.

Clinical Outcomes

The Disease Activity Score (DAS) is an index developed to measure RA disease activity that has been extensively validated for use in clinical trials.^{48,49} This index includes the number of tender and swollen joints along with the erythrocyte sedimentation rate or C-reactive protein levels and a patient assessment of disease activity. Two RA studies measured DAS-28 (includes a 28 joint count), and both found statistically significant improvements for patients participating in the yoga intervention as compared with controls.^{32,36}

Two studies measured ring size as a marker of hand inflammation. Haslock and Ellis³³ reported a trend toward statistical difference in ring size for persons with RA, whereas Garfinkel and colleagues³⁰ observed no change in ring size in persons with hand OA. A difference in antiinflammatory medications for persons with RA could not be attributed to the intervention because the 2 groups differed at baseline.³⁴

Only 1 knee OA study reported on stiffness but found no improvement,³⁹ although a trend toward improvement for global patient assessment was reported. The hand OA trial saw improved finger tenderness and finger range of motion.⁵⁰ A study of general arthritis (diagnostic inclusion criteria unclear) used its own symptom self-report instrument, with no improvements demonstrated.³⁵

Functional Ability

Several studies assessed strength, balance, flexibility, and/or mobility. Three studies used hand grip, which has been considered a clinical measure of general strength,⁵¹ hand function, pain, disease activity,⁵² and future disability.⁵³ Improvements were found for 2 RA studies^{33,34} but not in the study on hand OA.³⁰ An NRCT of postmenopausal women with RA showed improved balance,³⁷ whereas the knee OA pilot study found no change in 50 ft time.³⁹

Of the 5 studies in RA, 4 used the Health Assessment Questionnaire (HAQ), a self-report of disability status, as an outcome measure. Two studies found significant improvement compared with controls or baseline,^{36,37} and another study showed a trend toward improvement.³³ The HAQ also includes a visual analog scale (VAS) of pain, which was used in 3 of the RA studies. Two studies demonstrated significant improvement,^{37,38} whereas 1 study found no change.³⁶ Although the HAQ is often considered to be a disease-specific tool intended for use in RA, it has also been used more broadly and was included in a study on hand OA.³⁰ In this study, there was no change in the functional dimension of the HAQ, but pain measured by VAS

Table 4 Study findings				
Authors	Study Quality	Clinical Outcomes	Functional Outcomes	Psychosocial Outcomes
Kolasinski et al ³⁹	4	Improved: WOMAC pain, function Trend: GA No change: stiffness	No change: 15 m walk time	Improved: affect
Garfinkel et al ³⁰	6	Improved: finger tenderness, hand pain, ROM No change: hand function, ring size	No change: grip strength	—
Haslock et al ³³	6	Trend: HAQ-DI, ring size	Improved: grip strength	No change: GHQ
Dash and Telles ³⁴	4	—	Improved: grip strength	—
Sharma ³⁵	3	—	—	Improved: self-efficacy for yoga
Badsha et al ³⁶	6	Improved: HAQ-DI, DAS-28 No change: HAQ pain	—	No change: physical/mental quality of life
Haaz et al ³²	5	Improved: tender/swollen joints	—	Improved: physical & emotional roles, energy (RA), pain (RA) Trend: mental health, energy (OA), pain (OA)
Bosch et al ⁴⁴	4	Improved: HAQ-DI and pain	Improved: balance	Improved: depressive symptoms, daytime cortisol levels Trend: diurnal and awakening cortisol levels
Evans et al ³⁸	2	Improved: pain (PDI, HAQ) Trend: physical functioning No change: HAQ-DI	—	Improved: vitality, mental health, global severity, self-efficacy Trend: chronic pain acceptance, mindfulness

Abbreviations: DAS-28, Disease Activity Score (includes a 28 joint count); GA, Global Assessment; GHQ, General Health Questionnaire; HAQ-DI, Health Assessment Questionnaire-Disability Index; PDI, Pain Disability Index; ROM, range of motion; WOMAC, Western Ontario and McMaster Osteoarthritis Index.

did improve significantly; however, the HAQ is not as sensitive to changes in persons with OA.⁵⁰

Psychosocial Outcomes

The Arthritis Impact Measurement Scale 2 (AIMS2) and the Medical Outcomes Study 36-Item Short Form Health Survey (SF-36) assess HRQL. The SF-36 is a general measure,⁵⁴ whereas the AIMS2 is specifically designed for arthritic patients.⁵⁵ Both the measures contain mental and physical domains. The AIMS2 addresses unique issues of this population, but the SF-36 allows for comparison with nonarthritic participants.

Significant improvement in AIMS2 score was seen for knee OA, with a trend toward improved symptoms and patient global assessment. Using the SF-36, one study found no improvements,³⁶ whereas an abstract reported improved emotional roles and energy, with a trend toward improved mental health.³¹

Improvements in psychosocial health were tracked using other instruments, including the Beck Depression Index.³⁷ Two RA studies noted no changes in psychological health, measured by the General Health Questionnaire³³ and SF-36.³⁶ Change in cortisol levels, a common biomarker of psychological stress, was also measured, with significant improvement in daytime measurements and a trend for improved diurnal and awakening levels.³⁷ Measures of pain included the Western Ontario and McMaster Osteoarthritis Index (WOMAC), a validated index for OA of the knee and hip, for a study of OA³⁹ and the Pain Disability Index for a study of RA.³⁷ Improvements in pain were statistically significant in both the studies.³⁸ Persons with arthritis who practiced Kundalini yoga reported increased self-efficacy and frequency of yoga behaviors.³⁵

Medication Use

Two studies required that no changes were made to treatment during the trial,^{33,39} and one RA study required stable dose of disease-modifying antirheumatic drugs and a limit to glucocorticoid use.³⁷ Badsha and colleagues³⁶ reported reductions in medication use for 3 persons with RA in the yoga group (3 corticosteroids, 1 etanercept, 2 methotrexate) because of clinical improvement and none in the control group. Dash and Telles³⁴ noted a statistically significant reduction in NSAID use for the intervention group with RA, although groups differed at baseline. Other studies did not report changes in medication or procedures to maintain stable medication use.

Funding Sources

Most articles and abstracts did not disclose whether the study was funded. The study by Badsha and colleagues³⁶ was funded by the Emirates Arthritis Foundation and by an unrestricted grant from Abbott Pharmaceuticals, with no reported conflicts of interest. Research by Kolasinski and colleagues³⁹ was partially supported by ACR Clinical Summer Preceptorship Program. The letter to the editor by Haslock and Ellis³³ notes in acknowledgments that "Marks and Spencer contributed to the cost of data processing." No other mention is made of funding support.

DISCUSSION

The assessment of yoga for arthritis is in its infancy. In general, the studies that are reported in the literature are very small in both size and scope. The use of recommended outcomes and validated measures was typical, but only a few outcomes were

included in each study. Therefore, there is too little overlap in disease state and measured variables to pool data or draw preliminary conclusions.

HRQL is an important self-reported outcome that can inform about the broad effects of interventions on several life domains. Few studies included HRQL, and none used it as a primary outcome. Although tools like the HAQ and WOMAC measure arthritis disability and its impact on daily activities, they do not assess the 8 domains of health ranging from physical limitations to energy and mental health. In addition, because these tools are primarily used in arthritic populations, comparison with healthy adults or other chronic conditions is not possible.

Study designs varied and each had drawbacks, including lack of masking, lack of control groups, group crossover, and biased group assignment. In these cases, limitations were often noted, but efforts made to reduce bias were not always explained. No study included comparison treatment arms. This exclusion would strengthen findings but requires a larger sample size and greater resources, which is a challenge in time-intensive behavioral research trials.³⁰

Yoga describes a range of practices. Although most studies described a comprehensive intervention (poses, breathing, relaxation, and/or meditation), the styles, doses, and format varied. Researchers must be clear about the delivered intervention and that it is population appropriate. Determining which aspects of the practice are safe and beneficial can only follow when it is known what has been tested. Especially, with patients who have considerable musculoskeletal limitations and symptoms, what is taught and how it is modified should be detailed in future research and practice. Beyond this, researchers should provide protocol transparency so that larger more rigorous trials can replicate the interventions using the same methods to confirm or dispute findings. Furthermore, when design methods and statistical analyses are not well described, research cannot be properly evaluated and readers are unable to determine whether methodological flaws may be responsible for errors in findings.

For classroom-based interventions, it may be challenging to recruit participants willing to travel and dedicate several hours per week for months, especially with unpredictable painful diseases. Understudied interventions are often limited to the safest and healthiest people (by age and/or disease status) to ensure no harm before expanding the study to vulnerable populations. Although this practice reduces qualifying participants, particularly for a rarer disease (such as RA), it can bias the sample and limit generalizability to all persons with the disease.

Arthritis encompasses many diagnoses. The 2 most common OA and RA have significant pathophysiologic differences, and effects of an intervention such as yoga may not be the same for each. Moreover, the effects of yoga on isolated hand OA versus knee OA may also have significantly different outcomes. Combining persons with different diseases in the same intervention and analyzing the data collectively could mask an effect that is strong for just a portion of participants or could suggest a universal effect that only applies to a subgroup with one particular form of arthritis. The use of biomarkers as treatment outcomes improves the current understanding of how additional biochemical and pathophysiologic parameters of diseases respond to interventions.

The research in this review was conducted in diverse populations across the globe, which suggests broad interest as well as cross-cultural acceptance. However, perceptions of yoga, teaching methods, and differences in arthritis treatment are likely to influence intervention effects and, possibly, result in different findings.

Overall, the most consistent findings were for tender or swollen joints in persons with RA, which improved for all 3 studies that used this outcome. Another common outcome was pain, which improved in 6 out of 8 studies, measured by various tools.

Disability improved in 3 out of 4 studies. Self-efficacy improved in both studies in which it was measured. Mental health and energy improved in 2 out of 3 studies. For grip strength, improvements were seen in both studies of RA but not in the study of OA that included it. Results for global health and physical functioning were inconsistent. Measures of disease symptoms and physical functioning were more commonly used than markers of physical fitness or psychosocial functioning. Because different instruments were often used to assess the same outcome, interpretation of results across studies is compromised.

A goal of future studies should be to create standardized protocols that are optimized to enhance safety, enjoyment, and long-term adherence (including specific poses and modifications). Studies have varied considerably with regard to the frequency and duration of yoga practice, as well as the style and specific class content. The practice studied should be thoroughly described, including specifying the yoga lineage (Iyengar, Kundalini, and other types) in the Methods section or separately publishing intervention details.

Interdisciplinary collaboration in the design of yoga interventions is appropriate for this population. Yoga experts, rheumatology clinicians, or clinical researchers are not equipped to create an authentic and appropriate yoga program alone without consultation with each other. Such a program requires careful attention to the stress on joints and connective tissue, as well as the consideration of joint range of motion and adaptation during potential disease flares. An arthritis-appropriate program that has been created in careful collaboration and well tested through rigorous research methods is required as a next step in the evolution of this research.

Of significant interest is to study the mechanisms by which yoga affects arthritis symptoms. The use of standardized outcome measures and appropriate statistical methods is essential for confirming findings. Large comprehensive trials are required to validate improvements indicated by this collection of small pilot studies.

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