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Impact of Iyengar yoga on quality of life in young women with rheumatoid arthritis

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Abstract

Objective—Rheumatoid arthritis (RA) is a chronic, disabling disease that can greatly compromise health related quality of life (HRQOL). The aim of this study was to assess the impact of a 6-week twice/week Iyengar yoga (IY) program on HRQOL of young adults with RA compared to a usual-care waitlist control group.

Method—The program was designed to improve the primary outcome of HRQOL including pain, as well as disability and psychological functioning in patients. Assessments were collected pre, post, and at 2-months following treatment. Weekly ratings of anxiety, depression, pain and sleep were also recorded. A total of 26 participants completed the intervention (yoga = 11; usual care waitlist = 15). All participants were female (mean age =28 years).

Results—Overall attrition was low at 15%. On average, women in the yoga group attended 96% of the yoga classes. No adverse events were reported. Relative to the usual-care waitlist, women assigned to the yoga program showed significantly greater improvement on standardized measures of HRQOL, pain disability, general health, mood, fatigue, acceptance of chronic pain and self-efficacy regarding pain at post treatment. Almost half of the yoga group reported clinically meaningful symptom improvement. Analysis of the uncontrolled effects and maintenance of treatment effects showed improvements in HRQOL general health, pain disability and weekly ratings of pain, anxiety and depression that maintained at follow-up.

Conclusion—The findings suggest a brief IY intervention is a feasible and safe adjunctive treatment for young people with RA, leading to health related quality of life (HRQOL), pain disability, fatigue, and mood benefits. Moreover, improvements in quality of life, pain disability and mood persisted at the 2-month follow-up.

Keywords

Yoga; arthritis; young adults

Rheumatoid arthritis (RA) is a chronic autoimmune disorder that can impact joint function and health-related quality-of-life (HRQOL), especially when arthritis develops early in a person's life [1, 2]. Health care use, depression and pain are high amongst adolescents and

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young adults with arthritis, even compared to young people with other chronic conditions [1]. The maintenance of emotional and physical functioning is important in this group. Pain and debilitated functioning may leave many young people with RA in a socially and emotionally compromised state [3] with difficulties persisting into later adulthood. Because young patients may encounter exceptional difficulties dealing with their illness, interventions targeting young adults are warranted.

Despite the need for physical and psychological treatments aimed at young people with RA, traditional approaches remain limited [4]. A multi-pronged treatment strategy is recommended, including rehabilitation efforts that promote a range of physical outcomes such as ambulation and balance [5]. Patients who exercise regularly report decreased pain and improved functioning [6]. Iyengar yoga (IY) may be suited to meeting the rehabilitation needs of people with RA. The tradition has evolved specific methods of teaching therapeutic yoga practices to people with health problems [7-9]. These methods include a focus on correct anatomical alignment, thought to protect joints, and the use of supportive props designed to relieve tension and inflammation in the body. Poses can also be individualized for each patient, a method that is an important concern for RA patients given that affected bodily areas and progression of the disease can vary markedly between individuals. Focus on the body, including alignment of the posture and fluctuating bodily sensations, as well as the breath, provide meditative benefits. The rigorous, systematized teacher training support IY's use within the medical and research fields [10].

Yoga has led to a number of positive changes in individuals with musculoskeletal problems, with few safety concerns [11-13]. Previous literature has demonstrated the promise of yoga for older people with RA, however the utility of yoga for younger populations is unknown. With the exception of our recent single-arm, early pilot work examining IY for pain and functioning in young adults with RA [14], there have been no studies focused specifically on young patients. Despite being limited by a small sample size, our feasibility study showed a high level of acceptance of Iyengar yoga amongst young people with RA, as well as significant reductions in pain, pain disability, depression, mental health, vitality, and self-efficacy following the 6 week course of yoga. Attendance was high (mean = 95%) and no adverse events were reported. The strength of patient's quantitative and qualitative reports of improvement led us to conduct the current study, using an exploratory randomized usual-care waitlist-control design.

The first aim of the current study was to compare the impact of our 6-week IY intervention on the primary outcomes of HRQOL including pain, and disability, and the secondary outcomes of pain intensity, disease activity and psychological functioning to that of a usual care wait-list control group. To test the clinical significance of the program, patients' global improvement compared to baseline was also examined. The second aim was to examine treatment effects and maintenance of treatment gains on all participants who received the IY intervention (i.e., combining the immediate and waitlisted yoga groups) on the primary outcomes as well as data from a weekly monitoring report of pain, anxiety, depression and sleep before, during and after treatment.

METHOD

Study Design

Upon entry, participants were randomized to receive either immediate yoga (the yoga group) or the usual-care waitlist group (control group). The control group received yoga after the completion of the waitlist period. Thus, participants in the yoga group were assessed at three time points: 1) baseline; 2) post-treatment and 3) 2 month follow-up. The control group was

assessed at 4 time points; 1) baseline; 2) post-waitlist (the yoga group's post-treatment); 3) post-treatment and 4) 2 month follow-up.

Inclusion Criteria—The inclusion criteria for the current study included diagnosis of RA for at least six months according to the revised 1987 ACR criteria or juvenile idiopathic arthritis (JIA) for at least six months, aged between 16-35 years; concomitant use of disease modifying antirheumatic medications, non-steroidal anti-inflammatory drugs (NSAIDs), or low dose corticosteroids permitted provided doses were stable for 4 weeks; ability to provide written informed consent and ability to speak and understand English. Participants were excluded if they were currently pregnant, recently experienced injury, had a history of drug or alcohol abuse or had been on any experimental medications in the preceding 6 months. Full approval for this study was received from the University of California, Los Angeles Institutional Review Board (IRB).

Treatment Conditions

Iyengar Yoga Program—The intervention was based on the protocol we developed in our previous pilot study [14] and consisted of 6 weeks of classes held twice per week. The classes were 1.5 hours in duration (total dose = 18 hours). A make-up class was available at the end of the program. Classes had a maximum of 7 students, lead by an experienced IY teacher (B.S) and assisted by at least one junior teacher. To standardize delivery, a working list of poses (see Table 1) was developed with a senior Iyengar yoga teacher, who served as an advisor to the study. Classes were held in the UCLA Pediatric Pain Program Yoga Studio which is equipped with standard IY equipment, including ropes fastened securely to the walls, blankets, bolsters, and blocks.

A full range of yoga postures were taught to the students, including supine poses, passive backbends, standing poses, supported inversions, twists, seated postures and forward bends. The postures were taught with props. The classes were sequenced over time and as students developed skills, more challenging postures were introduced. Individual limitations were addressed as needed for pain, range of motion in particular joints, and fatigue. For example, three students had severe limitations in the mobility of the joints in their hips, knees, shoulders and wrists that prevented them from getting up and down off the floor. Rather than using the floor as a base, as is typically the case during supine and seated postures, we raised the floor by using several chairs for support. In another example of the range of modifications that were used, students who could not bend their knees hung from the wall ropes in a modified straight legged version of rope headstand. In cases where students had shoulder, elbow and wrist problems, supine poses were performed with supportive blankets under their arms.

Classes were held during a week-day evening and on a weekend afternoon to ensure that employed participants and full-time students had access to classes. Homework was suggested, but not required, and interested participants were invited to take props home for the duration of the intervention.

Usual care while waitlisted control group—This condition controlled for the effects of routine care of patients treated for RA. It is not uncommon in psychological or behavioral research contexts to include a waitlist condition in early stages of the clinical trial process. Given that a gold standard in control groups has yet to be set in yoga research, we opted for a usual-care waitlist condition at this early stage of testing the intervention. Control participants were contacted weekly by a research assistant, who administered a weekly monitoring form. Upon completion of the waitlist period, the control group was offered yoga.

Participants

Seventy-three participants were originally screened for study eligibility. Thirty patients accepted to participate and were randomized to either the yoga or waitlist control group (see Figure 1). Of the 73 participants who were assessed for eligibility, 21 were excluded based upon eligibility criteria. An additional 22 participants declined to participate, with the most common reason cited being conflicts with or being too busy to commit to yoga classes. Thus, 30 participants were randomized into the groups. Attrition was less than 15%. Out of the 30 participants who were randomized and completed baseline assessments, four dropped out (3 in the yoga group, 1 in the waitlist group). These participants were lost early in the study; for example, one participant in the yoga group completed the baseline assessments but did not attend any yoga classes. There were no significant age or disease characteristic differences between those who dropped out of the study and those who completed. The randomized controlled trial results are based on the 26 participants who completed baseline and post assessments (yoga = 11; control = 15). After being offered yoga, two waitlist participants dropped out. Results based on the maintenance of treatment benefits are based on the 24 yoga completers. All participants were female.

Participants received a diagnosis of RA by a rheumatologist. At the baseline medical assessment, as well as at the end of the intervention, a DAS28 joint examination was performed by a physician blind to group assignment. After the joint count evaluation, the DAS28 score was calculated by including the sedimentation rate and the general health assessment rated by the evaluating physician using a visual analogue scale. At the baseline exam, the mean DAS28 score was 4.5 (SD = 1.9) and at post-intervention, the mean DAS28 score was 3.3 (SD = 1.4). The scores did not differ by group.

Seven participants reported comorbid chronic conditions, with the most common ($n=5$) being lupus. Other comorbid conditions reported were connective tissue disorder, osteoarthritis, and epilepsy. Of the 26 study completers, 21 reported taking at least one disease-modifying antirheumatic drug (DMARD) at baseline assessments. Seven reported taking nonsteroidal anti-inflammatory drugs (NSAIDs), and five reported regularly taking prednisone. Both groups had similar medication profiles and there were no significant differences between the groups in DMARD use. Additional demographic and clinical information for participants are presented in Table 2.

Recruitment and Assessment

Recruitment for the study occurred between August 2009 – January 2011, with recruitment continuing during yoga class cohorts. The primary recruitment strategy included advertisements in rheumatology offices and local community bulletin boards, arthritis support group newsletters and events and through physician referrals of patients, and online sources (e.g., Craigslist, the Clinical Trials.gov website). Participants who lived greater than 25 miles from the yoga studio where classes were administered were offered \$10 each session attended to cover gas expenses.

Eligibility was determined during a phone screening session with a qualified research assistant and interested patients were informed that they would be randomized into either a yoga or a waitlist group. Before the baseline assessment, patients were randomized in blocks. Principal investigators were blinded to participant randomization during the study process.

Participants were scheduled for a baseline assessment approximately 2 weeks prior to the start of yoga classes. All eligible participants were e-mailed a link to complete a battery of questionnaires (detailed below) at the baseline, upon completion of the yoga intervention and at 2-month follow-up. In addition, weekly functioning data was collected from

participants. The weekly monitoring forms were administered once a week for 2 weeks preceding the start of the intervention to determine baseline functioning, once a week throughout the duration of the intervention and again at 2-month follow-up. A link to an on-line version of the monitoring form was emailed weekly to participants, and followed up with reminder emails to ensure timely completion.

Measures

HRQoL and Functioning—Short Form-36: (SF-36) [15]: was used to measure HRQOL. Four of the scales measuring well-being were used, including the vitality, bodily pain, general health and mental health sub-scales. A higher score denotes increased quality of life, such that higher scores on the bodily pain scale denote less pain.

Pain Disability Index (PDI): measures pain-related functioning [16] and asks about ability to participate in basic life activities, including home responsibilities, recreation social activity, sexual behavior, self-care and life-support activity. Patients rate their level of disability on a rating scale of 0-10. A higher score indicates more disability. Good internal reliability ($\alpha = 0.82$) and validity have been reported [16, 17].

Health Assessment Questionnaire Disability Index (HAQ- DI): assesses arthritis-specific functioning [18], including dressing, grooming, rising, eating, walking and hygiene, activities. The HAQ-DI also has a Global Scale which asks about the patient's general health from 0 (very well) to 100 (very poor).

Disease Activity Scale (DAS) 28 is a combined index that measures disease activity in patients with RA. This index includes a physician performed 28 tender joint count, 28 swollen joint count, erythrocyte sedimentation rate (ESR) and general health assessment using a visual analogue scale.

Global Improvement Scale (GIS): This scale asks participants to rate their relative RA symptoms on a 7 point scale. The specific wording is as follows: “Compared to the way you felt before you entered the study, have your RA symptoms over the past 7 days been from (1)=substantially worse, to (7)=substantially improved [19]”. Global improvement is noted for patients endorsing moderately or substantially improved status.

Psychological Functioning—Brief Symptom Inventory (BSI-18): [20] was used to measure mood and asks patients about their anxiety, somatization, and depressive symptoms in the past 7 days on a 5-point Likert scale ranging from ‘Not at all’ to ‘Extremely.’ The BSI-18 has shown good internal consistency and validity [20]. Higher scores denote more symptoms.

Functional Assessment of Chronic Illness Therapy Fatigue Subscale (FACIT-Fatigue) [21]: includes 13 items that assess physical and functional consequences of fatigue. Scores range from 0-52 on a reverse 4-point Likert scale, with higher scores indicating less fatigue.

Chronic Pain Acceptance Questionnaire (CPAQ) [22]: measures the degree to which patients are willing to accept pain and move towards one's values even while experiencing pain [23]. This is a 20-item measure with acceptable reliability ($\alpha = 0.78-0.82$) and validity [22]. Higher scores denote greater acceptance.

Five Factor Mindfulness Questionnaire (FFMQ) [24, 25]: is a self-report five-facet measure of mindfulness, which refers to the direction of attention to present moment experience. The five facets of mindfulness measured include Observe, Describe, Act with Awareness, Nonjudging and Nonreactivity. Items are rated on a Likert scale ranging from 1 (‘never or

very rarely true') to 5 ('very often or always true'). The FFMQ has been shown to have good internal consistency. Higher scores reflect greater mindfulness.

Arthritis Self-efficacy Scale (ASES): [26] is designed to assess arthritis patients' beliefs that they can perform tasks or cope with the consequences of chronic arthritis. The scale has 20 items to measures three subscales: pain, function and other symptoms. The pain scale can be combined with the other symptoms scale.

Weekly Monitoring Form (WMF) assessed participants' weekly worst pain, average pain, anxiety, depression, and trouble with sleep using a 0-10 numeric rating scale (NRS). For example, patients were asked to rate their worst pain over the past week from 0 (no pain) to 10 (worst pain imaginable); anxiety from 0 (no anxiety) to 10 (worst possible anxiety); depression from 0 (no depression) to 10 (worst possible depression); difficulty staying asleep for the entire night from 0 (no difficulty) to 10 (very difficult). Participants were also asked to report any adverse events during the classes, any changes in medication, home practice of yoga and level of physical activity.

Statistical Analyses

To ensure that randomization produced equivalent groups, t tests and chi square tests compared the yoga and control groups on all demographic and baseline clinical variables. The data were analyzed for skewness and to ensure that data met assumptions for parametric tests. A minimum alpha level of .05 was used for analyses.

Inferential analysis took place in two stages. We first conducted analysis of treatment effects in the controlled trial data (pre to post-treatment in the yoga versus waitlist groups on the primary and secondary outcomes). Post-treatment group effects were analyzed using analysis of covariance (ANCOVA) controlling for baseline scores. The groups' baseline scores on the individual outcome measures were included to ensure that baseline measure differences between the groups were accounted for. Any significant differences on disease characteristics between the groups were also included as covariates. Clinical significance was calculated for the four domains relevant to chronic pain trials as recommended by the Initiative on Methods, Measurement and Pain Assessment in Clinical Trials (IMMPACT): pain intensity, physical functioning, emotional functioning and global improvement [27]. Using the IMMPACT recommendations regarding the clinical importance of treatment outcomes [28], we calculated the clinical importance of the changes in the yoga group on these outcomes.

Second, we analyzed uncontrolled effects and treatment gains on a sample of all participants who began treatment (i.e yoga and waitlist groups combined, n=24). We used post-waiting list assessments as pretreatment assessments for waiting list participants. Linear mixed models were performed to assess significant linear trends over time for the primary outcomes, and for the weekly reports of pain, anxiety, depression and sleep before, during and after treatment. Tests evaluated differences from baseline to post-treatment and from baseline to 2-month follow up to evaluate maintenance of treatment gains. Mixed models can handle missing data and do not require that such data points be excluded or estimated. Random intercepts were included in the models, with time as the independent factor. Separate analyses were conducted for each of the measures. Inferential statistics and modeling was accomplished with SPSS version 19.0.

RESULTS

Preliminary Analyses

Initial tests revealed one significant baseline difference between the yoga and control groups. As shown in Table 2, the yoga group had experienced RA for significantly longer than the control group. The duration of RA for the yoga and control groups was 15.8 and 6.8 years respectively. Duration of RA symptoms was therefore included as a covariate in all between-groups analyses. None of the other demographic and clinical variables were significantly different between groups.

Examination of the outcome measures for normality and skewness revealed that one of the yoga participants was a consistent outlier, scoring greater than 2 standard deviations below the mean on six of the post-intervention outcome measures. This person was excluded from further analyses and the final analyses for the controlled trial are based on 10 yoga participants and 15 controls. The data met normality assumptions and ANCOVAs examining group differences at post-intervention controlling for baseline scores and duration of RA were performed. The GIS was only assessed at post-treatment and thus duration of RA was the only covariate included for the analysis of this scale.

Controlled Trial—Table 3 shows HRQOL, arthritis functioning, and psychological functioning variables at pre and post assessment by group. Results from analyses evaluating post-treatment group differences on the primary outcome measures of PDI, and two of the SF-36 subscales, namely general health and vitality, were significant favoring the yoga group. However, there were no group differences on the pain or mental health SF-36 subscales, the DAS28 or the HAQ-Disability score. The HAQ general health question did reveal a difference, with the yoga group reporting significant improvements in general well-being compared to the waitlist condition. Significant findings favoring the yoga group were seen for a number of the psychological secondary outcomes, including the FACIT fatigue scale, the BSI global severity scale, the CPAQ, the nonjudging facet of mindfulness and self efficacy regarding pain. The yoga group also reported significantly greater global improvement of RA symptoms as assessed by the GIS compared to the waitlist controls.

Clinical significance: The IMMPACT recommendations for clinically important differences in pain intensity use reduction in pain of 10-20% as minimally important, with >30% change reflecting moderate improvement and >50% reduction reflecting substantial improvement. For the SF-36 pain scale, 40% of the yoga group experienced substantial improvement, 10% moderate improvement and 10% minimal improvement (40% remained unchanged). Surprisingly, the control group experienced similar levels of improvement.

We used the IMMPACT gauge of one-half of the standard deviation of a mood scale [28] to determine the clinical significance of the functioning and psychological outcomes. The following functioning scales showed clinically significant improvement in the yoga group: SF-36 general health, vitality and PDI. The following psychological outcomes were clinically improved: BSI somatization, BSI global severity, FACIT fatigue, FFMQ nonjudge, and ASES pain. As recommended by the IMMPACT guidelines, the percentage of patients reporting global improvement was also calculated. The percentage of patients reporting substantially worse to substantially improved symptoms compared to baseline functioning on the GIS are shown in Figure 2. For the yoga group, no one reported a worsening of symptoms. A large majority of the yoga group reported improvement, from slight improvement (50%), moderate improvement (20%), to substantial improvement (20%). In accordance with guidelines, ratings above 'slight improvement' were combined. In the yoga group, 40% reported clinically important levels of improvement. For the waitlist group, only one participant reported clinically important levels of improvement.

Uncontrolled Effects and Maintenance of Treatment Response—Means and standard deviations for the primary outcomes at pre-treatment, post-treatment and 2-month follow up are shown in Table 4 for all participants who began treatment (i.e the yoga and waiting list groups combined). Figure 3 depicts the weekly monitoring form data across baseline, treatment and follow-up for both groups combined. Thus, the baseline refers to the two weeks preceding yoga, which occurred at the beginning of the study for the yoga group and after the waitlist period for the waitlist group, weeks 1-6 of the yoga intervention, and then 2-months following completion of yoga for both groups.

Mixed model tests of fixed effects revealed that over time, yoga led to significant improvements in the PDI ($F(46) = 3.93$, $p = .03$) with baseline scores significantly higher than post-intervention ($t(46) = -2.51$, $p = .02$) and 2-month follow-up ($t(46) = -2.34$, $p = .02$), indicating reductions in pain disability following yoga that were maintained at follow-up. There were no significant differences on the HAQ-DI ($F(46) = 1.82$, $p = .17$). Yoga led to significant improvement in 3 out of the 4 quality of life subs-scales: SF-36 vitality ($F(46) = 6.07$; $p = .01$) such that post-intervention scores were significantly improved from baseline ($t(46) = 3.48$, $p = .00$) but not at follow-up; SF-36 general health ($F(46) = 10.96$, $p = .00$), such that post-intervention scores were significantly improved from baseline ($t(46) = 4.06$, $p = .00$) and maintained at 2-month follow-up ($t(46) = 4.06$, $p = .00$); SF-36 mental health ($F(46) = 4.43$, $p = .02$) with post-intervention scores significantly improved from baseline ($t(46) = 2.95$, $p = .01$) but not at follow-up ($t(46) = 1.78$, $p = .08$). Reductions in the SF-36 bodily pain sub-scale were not statistically significant ($F(46) = 2.97$, $p = .06$).

Mixed models tests revealed statistically significant time effects for a number of the weekly monitoring variables, including a decrease over time in worst pain ($F(181) = 2.63$; $p = .01$) that was significant from baseline to week 3 of the yoga intervention and maintained across the remainder of the intervention and at the 2-month follow up. Significant improvement was revealed for anxiety ratings over time ($F(181) = 4.39$, $p = .00$) and for depression over time ($F(181) = 3.29$, $p = .00$), both of which saw significant improvements during week 2 of the yoga intervention that maintained across the intervention and at the 2-month follow-up. Decreases in average pain ($F(181) = 1.83$, $p = .07$) and sleep difficulties ($F(181) = 1.59$, $p = .10$) were not statistically significant.

Yoga practice: Ten women reported practicing at home during the intervention; duration of home sessions ranged from 5-45 minutes and the number of times practiced at home ranged from once during the intervention to 27 sessions during the intervention (median = twice during the intervention). At the 2-month follow-up, six women still reported practicing yoga during the previous week, either in a formal class or at home (range 1-3 sessions/week for 13-45 minutes duration).

Discussion

Compared to the usual-care waitlist condition, the yoga group displayed significantly greater improvement on the primary outcomes of pain disability and two of the HRQOL subscales (general health and vitality). There were no group differences on pain, arthritis disability or disease activity. Many of the psychological outcomes including fatigue, mood, chronic pain acceptance, mindfulness and self-efficacy were significantly improved in the yoga group. Of importance, the yoga group showed significantly greater global improvement compared to controls, with almost half of the yoga group reporting clinically meaningful improvement of symptoms. The clinical significance of outcomes following interventions is critical in evaluating efficacy [28]. Overall, our results indicate that while the IY intervention did not reduce measures of disease activity or pain, participants randomized to receiving yoga did report feeling better.

Findings regarding the maintenance of treatment effects are also of note. Combining the yoga and waitlist yoga groups in the analysis allowed for increased power to examine the impact of IY over time. The combined group (yoga and waitlisted yoga) showed improvement in functioning after treatment that maintained at follow-up for the primary outcomes of pain disability and HRQOL general health as well as for weekly ratings of worst pain, anxiety and depression. Two of the HRQOL subscales, vitality and mental health showed significant improvement post-intervention—gains that were not maintained at follow-up. It is interesting that both the post-intervention vitality and mental health HRQOL sub-scales reached normative values for healthy females [15].

The findings are consistent with our previous pilot work showing IY to be safe, feasible and a promising adjunct therapy in improving the well-being of young patients with RA. This study expands these findings by including a randomized controlled design, a larger sample size, and a range of physical and psychological outcomes. The present findings indicate that yoga may be associated with improvements in a number of domains. It is unclear from our evidence how long treatment effects maintained; improvements in general health, pain disability and weekly ratings of anxiety, depression and worst pain were maintained at 2 months, while post-intervention improvements in the SF-36 vitality and mental health sub-scales were not. The effects of continued and varied intensities of yoga practice on the maintenance of benefits are also unclear. While one quarter of the participants reported engaging in some yoga at the 2-month follow-up, only 3 participants had taken a formal yoga class (range: 1-3 classes) during the follow-up period, which may not have been sufficient to continue improvements demonstrated during the intervention. Further studies are needed to elucidate these dose related effects.

The weekly monitoring data provide a window into the functioning of participants across the intervention. Following the second week of classes, participants reported significant improvements in their mood, while their ratings of worst pain significantly improved after the third week of classes. These improvements were maintained compared to baseline across the intervention and at the 2-month follow up. The benefits reported post-intervention (including pain disability and HRQOL) may have been partly due to these gradual improvements beginning early in treatment.

RA patients in their young adult years may be in particular need of complementary interventions that can be used alongside conventional medicine. Recent biologic agents have been successful in halting disease progression, however, protracted medication use has also been associated with harmful side effects, including gastrointestinal problems, kidney or liver damage and cancer [29]. For a group that is expected to actively participate in social, work and family life for many years to come, long-term behavioral interventions that can be incorporated into the individual's life-style are critical. Not only does yoga share many of the benefits of traditional exercise, but yoga is also likely to confer specific benefits such as mindfulness and acceptance of one's pain, as demonstrated by the findings here. Acceptance of pain has been linked to improved physical and emotional functioning in patients with chronic pain [30], and acceptance-based treatment approaches have gained wide use and approval in pain management [31]. The results of the present study indicate that IY is a potentially valuable treatment tool for promoting young patient's pain acceptance and quality of life. Further research should explore the possibility that yoga's impact upon wellbeing occurs through pain acceptance.

The lack of group difference on measures of pain and objective disease activity is interesting. It is possible that yoga's main impact is upon a subjective sense of well-being rather than upon biological functioning. Another possibility is that 6 weeks was not a sufficient time-frame to see the kind of fundamental changes that would be required to halt

the progression of RA. For example, inflamed joints, included in the DAS-28, may require months of strengthening and opening before improvements are evident. Further, the psychological well-being that the yoga group reported may take longer than 6 weeks to feedback into the physiological and structural bodily system to result in reduced inflammation and pain. A longer intervention would be required to ascertain whether biological systems are affected as a result of yoga.

A number of limitations temper the strength of our conclusions. Despite using a standard randomization procedure, it was clear that the groups were different in terms of duration of RA. The yoga group had experienced RA for longer and was more disabled than the control group. In fact, two of the participants in the yoga group used wheel-chairs, whereas no one in the control group did. While we controlled for the duration of RA in analyses, it is unlikely that this simple statistical step would have completely accounted for this difference. Although the randomization problems are clearly a study limitation, the fact that we still found group differences favoring the yoga participants speaks to the robustness of IY in improving well-being. We would expect that the control group would remain fairly stable in functioning across the intervention, but they improved over time. It is difficult to know whether spontaneous recovery of functioning was behind this improvement, or whether the prospect of undertaking yoga may have sparked improvement. A further limitation is the lack of an active control group; it is not possible to determine whether the benefits seen in the yoga group were a result of the yoga intervention or to nonspecific effects such as group membership. However, there is a lack of consensus in the literature about what constitutes an appropriate active control group in yoga trials and our intention in this early step of the research was to ascertain whether a yoga intervention would be superior to usual care. Another limitation is the sample size. Although the present study is larger than our initial feasibility study, the sample was still relatively small and the findings should be replicated with a larger group of both men and women with RA. The fact that only women entered the study likely speaks to the higher incidence of RA in women [32] and the greater popularity of yoga amongst women than men [33]. Nevertheless, future studies should actively recruit male patients. Expectations regarding treatment efficacy may also have influenced outcomes (for example, participants were told during class that certain poses were designed to help their symptoms). However, the gradual improvements seen in the weekly reports suggest that benefits were treatment-dependent and contingent upon cumulative practice over time.

We must be mindful in differentiating the tradition of yoga employed here, Iyengar yoga, from other forms of yoga practiced within mainstream classes. Yoga is one of the fastest growing activities with 6.1% of the adult US population taking regular classes [34]. However, not all forms of yoga are comparable and there is much variability in teacher training standards, use of supportive props and knowledge of medical conditions. Iyengar yoga is one of a few traditions that incorporates the kind of training, knowledge and support that is imperative when studying medical populations. Without a sufficiently trained teacher knowledgeable about RA, patient safety may be compromised. Therefore we caution against generalizing the study findings to other forms of yoga.

Overall, the findings of this exploratory randomized controlled trial provide promising support for the beneficial effects of IY on young adults with RA. Although the 6-week, twice weekly intervention did not produce significant changes in disease activity or pain, many markers of well-being - including quality of life, mood and fatigue-improved in the yoga group compared to the control group. Our weekly monitoring data show statistically significant improvement beginning the second to third week of yoga, and it is possible that improvement would have maintained for as long as participants received yoga. The possibility that participants' functioning would have neared or even reached normative age-related values with long-term practice cannot be ruled out, especially given that their vitality

and mental health returned to normative values after only 6-weeks of treatment. Our findings suggest that certain benefits, including improved feelings of general health, may persist long-term.

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Figure 1.
Study participant flow chart.

Figure 2.
Percentage of the yoga and control groups responding to the GIS categories

Figure 3.
Weekly Monitoring of Pain, Sleep, Anxiety and Depression pre-, during and post- yoga for the combined yoga and waitlist groups

Table 1**Key yoga postures for RA**

Sanskrit name	Description
<i>Standing Postures</i>	
Tadasana Urdhva Hastasana	Mountain posture with arms stretched up
Tadasana Urdhva Baddha Hastasana	Mountain posture with bound hands
Tadasana Paschima Baddha Namaskarasana	Mountain posture with bound arms
Utthita Trikonasana, with a block	Extended triangle posture
Utthita Parsvakonasana, with a block	Extended side angle stretch
Utthita Ardha Chandrasana, with a block and a wall for balance	Half moon posture
<i>Backbends</i>	
Viparita dandasana on backbender	Inverted staff pose
Viparita dandasana on two chairs with thoracic support	
<i>L shaped poses</i>	
Upavista Konasana	Seated wide angle posture
Baddha Konasana	Bound angle posture
Sukhasana and dandasana	Legs crossed and legs straight while upright
<i>Forward Bends</i>	
Adhomukha Swastikasana, with chair and blankets	Downward-facing cross-legged posture
<i>Twists</i>	
Bharadvajasana, with chair	Torso twist
<i>Inversions</i>	
Adhomukha Svanasana, with hands on chair	Downward facing dog posture
Salamba Sirsasana, with ropes	Headstand with support
Setubandha Sarvangasana, with cross bolsters, strap and blankets	Full bridge posture
Setubandha Sarvangasana, on a bench with viparita karani box and bolster	Full bridge posture
Salamba Sarvangasana, with a chair, a bolster, a sticky mat, and a blanket	Shoulder stand
Halasana, with chair and bolster	Plough posture
Supta konasana with two chairs	Reclining angle
Viparita Karani, with two blocks, a wall, a bolster and blankets	Inverted lake posture
<i>Supine Postures</i>	
Supta Padangusthasana, with strap, bolster and blankets	Reclining big toe posture
Supta Baddha Konasana, with bolster, strap and blankets	Reclining bound angle posture
Supported Savasana, bolster and blankets	Corpse posture

Note: A more detailed list of poses and sequences is available from the corresponding author, upon request.

Table 2

Yoga and control group characteristics

Characteristic	Total Sample (n=26)	Yoga group (n=11)	Control group (n=15)
	n (%) / M (SD)	n (%) / M (SD)	n (%) / M (SD)
Age, years	28.3 (3.9)	29.9 (2.9)	27.1 (4.2)
Years since diagnosis	10.6 (9.0)	15.8 (9.8)	6.8 (6.3) **
<i>Ethnicity</i>			
Hispanic	11 (42.3%)	5 (45.5%)	6 (40.0%)
Non-Hispanic	15 (57.7%)	6 (54.5%)	9 (60.0%)
<i>Race</i>			
Caucasian	17 (65.4%)	7 (63.6%)	10 (66.7%)
Multi-racial	4 (15.4%)	1 (9.1%)	3 (20.0%)
Asian	1 (3.8%)	0 (0%)	1 (6.7%)
Did not specify	4 (15.4%)	3 (27.3%)	1 (6.7%)
<i>Education</i>			
Some college	6 (23.0%)	2 (18.2%)	4 (26.7%)
Bachelor's degree	10 (38.5%)	4 (36.4%)	6 (40.0%)
Master's or higher	10 (38.5%)	5 (45.5%)	5 (33.3%)
<i>Baseline medical assessment</i>			
Joints tender	8.2 (9.2)	7.8 (9.0)	8.5 (9.7)
Joints swollen	8.8 (9.9)	9.4 (9.5)	8.4 (10.5)

**
p<.01

Table 3

Yoga and control group differences on primary and secondary outcomes

	Pre-treatment	Post-treatment	2-month follow-up
	Mean (SD)	Mean (SD)	Mean (SD)
Primary Outcomes			
SF-36 bOdy pain (higher =less pain)	53.8 (26.5)	63.3 (25.3)	59.8 (27.4)
SF-36 vitality	41.7 (20.0)	56.0 (23.5) *	48.5 (25.3)
SF-36 mental health	68.9 (17.6)	78.8 (12.7) *	74.8 (17.2)
SF-36 general health	45.7 (21.0)	54.3 (19.9)	54.3 (20.8) *
PDI	20.4 (18.8)	15.3 (16.7)	15.0 (19.0) *
HAQ-DI	0.86 (0.74)	0.73 (0.68)	0.73 (0.83)

*
p <.05

Table 4

Changes in primary outcomes following yoga for both groups combined

Variable	Yoga		Control		Effect (F)
	Baseline Mean (SD)	Post Mean (SD)	Baseline Mean (SD)	Post Mean (SD)	
Pain & Disease Functioning					
SF-36: Bodily Pain	47.6 (25.8)	59.1 (19.2)	41.9 (25.4)	59.3 (26.4)	0.61
SF-36: General Health	47.1 (25.0)	60.1 (21.4)	51.0 (22.3)	47.0 (16.7)	8.16**
SF-36: Vitality	47.5 (19.8)	64.5 (12.3)	36.7 (22.7)	37.7 (21.7)	9.79**
SF-36: Mental Health	74.4 (12.0)	81.6 (6.9)	66.7 (17.3)	67.8 (19.5)	0.56
PDI	26.5 (19.3)	13.5 (14.5)	18.7 (18.7)	15.4 (17.3)	5.42*
HAQ: Disability	1.2 (0.8)	0.9 (0.7)	0.9 (0.8)	0.7 (0.7)	0.10
HAQ: Health	41.7 (25.3)	31.5 (28.5)	36.0 (29.9)	55.9 (31.5)	4.45*
DAS28	4.6 (1.7)	3.3 (1.2)	4.4 (2.1)	3.3 (1.6)	0.18
Psychological functioning					
BSI: Somatization	4.2 (3.2)	2.1 (1.6)	3.2 (2.6)	3.4 (2.9)	7.99*
BSI: Depression	1.8 (1.8)	1.0 (1.1)	2.1 (2.8)	3.1 (3.1)	2.89
BSI: Anxiety	3.0 (1.9)	2.2 (1.6)	2.2 (2.3)	2.9 (2.8)	0.72
BSI: Global Severity	9.0 (5.2)	5.3 (2.9)	7.5 (6.7)	9.5 (7.8)	4.38*
CPAQ: Total	69.3 (21.1)	77.7 (18.6)	72.8 (13.3)	72.7 (12.7)	8.77**
FACIT: Fatigue	32.3 (11.1)	40.2 (6.4)	29.1 (15.0)	29.7 (11.9)	5.87*
FFMQ: Observe	28.3 (4.3)	29.1 (5.7)	24.3 (7.1)	26.9 (6.9)	0.61
FFMQ: Describe	26.5 (5.0)	27.9 (6.0)	30.1 (6.3)	29.5 (5.8)	2.29
FFMQ: Awareness	28.1 (5.7)	28.5 (6.5)	28.5 (5.1)	28.6 (6.3)	0.00
FFMQ: Nonjudge	29.2 (5.8)	32.3 (3.8)	27.3 (7.3)	27.5 (7.3)	4.37*
FFMQ: Nonreact	23.1 (4.2)	22.4 (3.7)	21.4 (4.9)	21.4 (4.4)	0.00
ASES Function	6.20 (3.0)	7.97 (2.22)	7.90 (2.25)	8.16 (2.36)	3.68
ASES Pain	12.96 (4.84)	15.68 (2.90)	13.31 (4.07)	13.84 (4.11)	4.86*

Variable	Yoga		Control		Effect (F)
	Baseline Mean (SD)	Post Mean (SD)	Baseline Mean (SD)	Post Mean (SD)	
GIS		4.5 (1.0)		3.3 (0.9)	3.29**

**
p<.01

*
p<.05