ONLINE FIRST

A Randomized Trial Comparing Yoga, Stretching, and a Self-care Book for Chronic Low Back Pain

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Background: Chronic low back pain is a common problem lacking highly effective treatment options. Small trials suggest that yoga may have benefits for this condition. This trial was designed to determine whether yoga is more effective than conventional stretching exercises or a self-care book for primary care patients with chronic low back pain.

Methods: A total of 228 adults with chronic low back pain were randomized to 12 weekly classes of yoga (92 patients) or conventional stretching exercises (91 patients) or a self-care book (45 patients). Back-related functional status (modified Roland Disability Questionnaire, a 23-point scale) and bothersomeness of pain (an 11-point numerical scale) at 12 weeks were the primary outcomes. Outcomes were assessed at baseline, 6, 12, and 26 weeks by interviewers unaware of treatment group.

Results: After adjustment for baseline values, 12-week outcomes for the yoga group were superior to those for the self-care group (mean difference for function, −2.5 [95% CI, −3.7 to −1.3]; $P<.001$; mean difference for symptoms, −1.1 [95% CI, −1.7 to −0.4]; $P<.001$). At 26 weeks, function for the yoga group remained superior (mean difference, −1.8 [95% CI, −3.1 to −0.5]; $P<.001$). Yoga was not superior to conventional stretching exercises at any time point.

Conclusion: Yoga classes were more effective than a self-care book, but not more effective than stretching classes, in improving function and reducing symptoms due to chronic low back pain, with benefits lasting at least several months.

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DESPITE THE AVAILABILITY of numerous treatments for chronic back pain, none have proven highly effective, and few have been evaluated for cost-effectiveness.[1] Self-management strategies, like exercise, are particularly appealing because they are relatively safe, inexpensive, and accessible and may have beneficial effects on health beyond those for back pain.

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One form of exercise with at least "fair" evidence for effectiveness for back pain is yoga,[2] which might be an especially promising form of exercise because it includes a mental component that could enhance the benefits of its physical components. Although all studies of yoga for back pain we could identify found yoga effective,[3-9] most had considerable limitations, including small sample sizes. Our own preliminary trial found yoga to be slightly more effective than a comprehensive program including aerobic, strengthening, and stretching exercises and more effective than a self-care book.[5] The current trial

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compares the effectiveness of yoga classes with that of stretching classes of comparable physical exertion and with that of self-care for chronic nonspecific low back pain. We hypothesized that yoga would be superior to both comparison groups.

METHODS

DESIGN OVERVIEW

We conducted a 3-arm parallel group stratified controlled trial, allocating participants in a 2:2:1 ratio to yoga, stretching exercises, and self-care, respectively. Trial protocol and procedures were approved by the Group Health Research Institute (GHRI) (Seattle, Washing-

ton) institutional review board. Participants gave oral informed consent before telephone eligibility screening. Those remaining eligible provided written informed consent prior to an in-person physical examination and study enrollment. The detailed trial protocol has been published previously[10] and is briefly summarized herein.

SETTING AND PARTICIPANTS

Participants were recruited from Group Health, an integrated health care organization, and from the general population in the Puget Sound, Washington, area. Seven cohorts of classes were conducted in 6 cities in Western Washington from June 2007 through May 2009. Recruitment methods included mailed invitations to Group Health members with back pain–related visits to primary care providers, advertisements in the health plan's magazine, and direct-mail postcards. For 4 cohorts, we augmented these with outreach to the general population. The study was described as a comparison of 3 different approaches designed to decrease the negative effects of back pain on participants' lives.

We excluded persons whose back pain was attributed to a specific cause (eg, spondylolisthesis or fractured vertebra), potentially due to an underlying medical condition (eg, metastatic cancer, pregnancy), complex (eg, sciatica, spinal stenosis, medicolegal issues, or a previous back surgery), minimally painful at time of screening (<3 on a 11-point "bothersomeness" scale of 0 to 10), or not chronic (ie, had lasted < 3 months). We also excluded persons with medical conditions for which yoga or exercise were contraindicated (eg, severe disk disease) and those with major depression, an inability to give informed consent or participate in our interviews owing to mental or medical issues (eg, dementia), or an inability to speak English. Finally, we excluded persons who were unable to attend classes or unwilling to do home practice.

RANDOMIZATION

After completing the baseline interview at Group Health facilities, participants within each recruitment cohort were randomized by a research assistant to the 3 treatment arms in a ratio of 2:2:1 (yoga: stretching: self-care). Treatment assignments were generated by a statistician (A.J.C.) using R software, version 2.10,[11] with random block sizes of 5 or 10, which were then embedded in the computer-assisted telephone interviewing program by a programmer (K.D.) to be inaccessible by study staff prior to randomization.

INTERVENTIONS

A series of 12 standardized, weekly 75-minute yoga and stretching classes, were held in Group Health facilities, designed for people with chronic low back pain unaccustomed to yoga or stretching. Participants were asked to practice 20 minutes on nonclass days and were given handouts and CDs (yoga) or DVDs (stretching) to assist in this. All participants continued to have access to medical care covered by their insurance plan. One researcher (K.J.S.) attended 1 class for each intervention for each cohort to evaluate adherence to the protocols.

YOGA

The yoga classes used the same protocol used in our earlier trial,[5] developed using the principles of viniyoga, and included 17 relatively simple postures, with variations and adaptations. Each class included breathing exercises, 5 to 11 postures (lasting approximately 45-50 minutes), and guided deep relaxation. Six distinct and progressive classes were taught in pairs. Classes were taught by instructors with at least 500 hours of viniyoga training, 5 years of teaching experience, and familiarity with the selected postures and who were briefed by our yoga consultant.

STRETCHING

The stretching classes were adapted from our previous trial,[5] which included aerobic exercises, 10 strengthening exercises, and 12 stretches, held for 30 seconds each (a total of 10.5 minutes of stretching). Classes consisted of 15 exercises designed to stretch the major muscle groups but emphasizing the trunk and legs (a total of 52 minutes of stretching), and 4 strengthening exercises. Classes were led by licensed physical therapists who had previous experience leading classes and had completed a 2-hour teacher training program.

SELF-CARE BOOK

Self-care participants received *The Back Pain Helpbook*,[12] which provides information on the causes of back pain and advice on exercising, making appropriate lifestyle modifications and managing flare-ups.

OUTCOMES AND FOLLOW-UP

Telephone interviews were conducted by masked interviewers at baseline and at 6, 12, and 26 weeks after randomization. Before randomization, information on sociodemographic characteristics, back pain history, and treatment-related beliefs was collected. Primary outcomes were the validated 23-item Roland-Morris Disability Questionnaire (RDQ)[13] and self-rated symptom bothersomeness on a 0 to 10 scale.[14] The 12-week follow-up was considered the primary end point. Secondary outcomes included activity restriction,[15] patient global rating of improvement, and patient satisfaction.[16] Data on adverse events were collected at all follow-up interviews by asking participants if they had experienced any serious health events and anything harmful from the interventions.

STATISTICAL ANALYSIS

Following the a priori primary analysis plan,[10] primary outcomes, RDQ, and symptom bothersomeness were analyzed using regression with generalized estimating equations (GEE),[17] assuming an independent working correlation structure and using robust standard error estimation. Follow-up times and treatment levels were included as categorical variables and all 2-way interactions between the 2 were present in each model. All adjusted models included baseline measures of RDQ and bothersomeness scores, sex, age, body mass index (BMI), days of lower back pain in the past 6 months, pain traveling down the leg, and employment-related exertion. Sensitivity analyses further adjusting for class cohort did not change results (data not shown). Another sensitivity analysis found that results were not affected by the method of analysis (GEE vs linear mixed-effects model).

Similar methods were used to analyze secondary outcomes with modification of the estimating equations for use with binary outcomes. To facilitate understanding and interpretation, we present relative risks between treatment arms for all secondary outcomes using a modified Poisson regression approach assuming Poisson model–based estimating equations with robust standard errors.[18]

To control for multiple comparisons, we evaluated pairwise treatment comparisons for each time point only if the overall omnibus test was statistically significant at the $P = .05$ level. Mean differences, 95% CIs, omnibus P values for the effect of treatment group, and pairwise significance are presented. Ad-

justed means and 95% CIs are presented graphically at each follow-up time.

All analyses were conducted assuming intent-to-treat principles using SAS statistical software (version 9.2; SAS Institute Inc, Cary, North Carolina).[19] All *P* values and 95% CIs are 2-sided with statistical significance at the *P* = .05 level.

LOSS TO FOLLOW-UP

Per the study protocol, we conducted a secondary analysis using a single imputation method of Wang and Fitzmaurice[20] for situations in which nonresponse may be nonignorable to evaluate the sensitivity of the complete case results to differential loss to follow-up between the treatment arms. Results of this analysis for the primary study outcomes (eTables 1-4, which confirm the main findings) are presented in eAppendix (http://www.archinternmed.com).

RESULTS

PARTICIPANTS

Of 757 individuals assessed for eligibility from March 2007 through March 2009, 229 were randomized, including 203 Group Health members (**Figure 1**). One inappropriately randomized individual, whose Patient Health Questionnaire (PHQ-9) score exceeded the eligibility threshold, was removed from the trial when the error was discovered after randomization but before classes began. Thus, 228 persons were included in the analyses (92 randomized to yoga, 91 to stretching, and 45 to self-care). Overall follow-up rates were 90% or 91% at all time points.

Baseline characteristics were well balanced across groups, except the yoga group had greater back dysfunction (**Table 1**). Fifty-nine percent of participants were using medications at baseline, mostly nonsteroidal anti-inflammatory medications. Fewer than 12% of participants reported use of acetaminophen, muscle relaxants, opioids, or antidepressants.

STUDY TREATMENTS

Participants randomized to yoga were more likely than those assigned to stretching to attend at least 1 class (95% vs 82%, respectively) (Figure 1). Attendance was more similar using 2 other measures of class adherence: proportion attending at least 8 classes (65% for yoga and 59% for stretching) and proportion attending at least 3 of the first 6 and 3 of the last 6 classes (67% for yoga and 66% for stretching). The median number of classes attended among those attending at least 1 class was similar (10 vs 9).

Nine or more weekly home practice logs were completed by over 70% of class attendees. Sixty-three percent of yoga class attendees vs 82% of stretching class attendees reported home practice 3 or more days per week. At both 6 and 12 weeks, most participants reported practicing at home at least 3 days in the prior week. The median duration of weekly practice was 100 minutes at week 6 and 60 minutes at week 12 for the yoga group and 120 minutes at week 6 and 75 minutes at week 12 in the stretching group. By 26 weeks, 59% of the yoga group and 40% of the stretching group reported practicing at

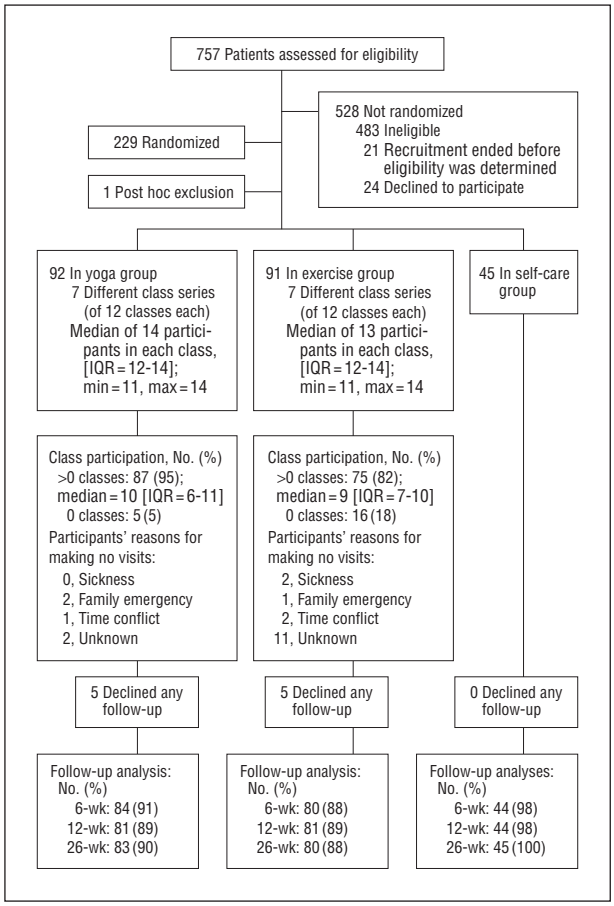

Figure 1. Participant flow diagram. IQR indicates interquartile range; max, maximum; min, minimum.

home at least 3 days in the prior week (median weekly practices of 35 and 30 minutes, respectively).

Participants in both classes rated median "connection" with their class instructor as 7, using a 0 (no connection) to 10 (extremely close connection) rating scale, and rated median support from classmates at 5 on a similar scale. The percentage reporting they would definitely recommend the class to others was substantially higher in the yoga class (85% vs 54%; relative risk = 1.6 [95% CI, 1.1-2.3]; *P* = .03). Most self-care participants (86%) reported reading some of the book, with nearly half reading more than two-thirds of it.

NONSTUDY TREATMENTS

Compared with baseline, roughly a quarter to a third fewer participants in the yoga and stretching groups reported using any medications for back pain in the week prior to each interview. Medication use in the self-care group did not decrease until 26 weeks. Compared with self-care, twice as many participants in the yoga and stretching groups (roughly 40% vs 20%) at the 12- and 26-week follow-up interviews reported decreasing their medication use since the previous interview.

Back pain–related visits to health care providers (mostly massage therapists and chiropractors) were reported by 30% of participants during the classes and 40% during the postclass follow-up period, with no group differ-

Table 1. Baseline Description of Study Participants by Treatment Group

Characteristic	Treatment Group, No. (%)			
	Yoga (n = 92)	Stretching (n = 91)	Self-care (n = 45)	Total (n = 228)
Demographics				
Age, mean (SD), y	46.6 (9.8)	49 (9.9)	50.8 (9.1)	48.4 (9.8)
Women	62 (67)	57 (63)	27 (60)	146 (64)
College graduate	54 (59)	59 (65)	28 (62)	141 (62)
White	80 (87)	76 (84)	43 (96)	199 (87)
Hispanic	2 (2)	3 (3)	2 (4)	7 (3)
Married	71 (77)	60 (66)	34 (76)	165 (72)
Family income >$45 000/y	79 (87)	72 (83)	34 (80)	185 (84)
Employment				
None	13 (14)	11 (12)	5 (11)	29 (13)
Lifts <20 lb at job	58 (64)	54 (60)	25 (56)	137 (61)
Lifts ≥20 lb at job	20 (22)	25 (28)	15 (33)	60 (27)
Smoker	2 (2)	4 (4)	3 (7)	9 (4)
Obese, BMI ≥30	26 (28)	28 (31)	15 (34)	69 (31)
MHI-5 score, mean (SD)				
Mental health component	45.6 (4.0)	45.5 (4.3)	45.3 (3.7)	45.5 (4.0)
Back pain history				
Began >1 y ago	85 (92)	80 (89)	41 (91)	206 (91)
Lasted >1 y	74 (81)	55 (63)	34 (76)	163 (73)
Years of LBP, mean (SD)	10.6 (10.6)	11.1 (9.24)	10.3 (10.6)	10.8 (10)
Pain below knee	13 (14)	13 (14)	11 (24)	37 (16)
Days of back pain in past 6 mo, mean (SD)	147 (47.2)	128 (53.5)	143 (50.9)	139 (51)
>7 d restricted activity due to LBP in the past mo	24 (26)	19 (21)	14 (31)	57 (25)
>1 d in bed due to LBP in past month, %	12 (13)	12 (13)	4 (9)	28 (12)
>1 d of work lost due to LBP in past month	8 (9)	8 (9)	3 (7)	19 (9)
Baseline outcomes, mean (SD)				
RDQ score	9.8 (5.2)	8.6 (4.0)	9.0 (5.0)	9.1 (4.7)
Eligibility bothersomeness score, mean (SD)	5.7 (1.7)	5.4 (1.7)	5.4 (1.8)	5.5 (1.7)
Baseline bothersomeness score	4.9 (1.9)	4.5 (1.9)	4.7 (2.5)	4.7 (2.1)
Pain management				
Hours of back exercise in past week, mean (SD)	0.4 (0.6)	0.3 (0.4)	0.5 (0.5)	0.3 (0.5)
≥3 d of back exercise in past week	25 (27)	21 (23)	18 (41)	64 (28)
Hours of active exercise in past week, mean (SD)	2.4 (3.3)	2.4 (2.5)	2.5 (2.5)	2.4 (2.8)
≥3 d of active exercise in past week	47 (51)	50 (55)	26 (58)	123 (54)
Medication				
Used any medication for LBP in past week	52 (57)	59 (65)	24 (53)	135 (59)
Used NSAIDs for back pain in past week	37 (40)	47 (52)	16 (36)	100 (44)
Used narcotic analgesics for back pain in past week	9 (10)	6 (7)	2 (4)	17 (7)
Injected medication	10 (11)	6 (7)	3 (7)	19 (8)
Very satisfied with overall care for LBP	15 (18)	17 (22)	8 (21)	40 (20)
Expectation of helpfulness, 11-point scale				
Yoga class, median	8.0	8.0	8.0	8.0
Exercise class, median	8.0	8.0	8.0	8.0
Self-care book, median	4.0	4.0	4.0	4.0
Preferred treatment				
Yoga	24 (26)	29 (32)	12 (27)	65 (29)
Exercise	19 (21)	15 (17)	10 (22)	44 (19)
Other	49 (53)	47 (52)	23 (51)	119 (52)
Prior yoga experience				
Ever attended a yoga class	45 (49)	38 (42)	17 (38)	100 (44)

Abbreviations: BMI, body mass index (calculated as weight in kilograms divided by height in meters squared); LBP, lower back pain; MHI, Mental Health Inventory; NSAIDs, nonsteroidal anti-inflammatory drugs; RDQ, Roland Disability Questionnaire.

SI conversion factor: To convert pounds to kilograms, multiply by 0.4536.

ences. Self-reported duration of active exercise in the week prior to interview was similar among the 3 groups at any follow-up period ($P > .50$ for all comparisons).

BACK-RELATED DYSFUNCTION AND SYMPTOMS

Back-related dysfunction (RDQ score) declined over time in all groups (Figure 1 and **Table 2**), with significant differences in the adjusted analyses among the 3 groups at all follow-up interviews (6 weeks: $P = .04$; 12 weeks: $P < .001$; 26 weeks: $P = .03$). Compared with self-care, the yoga group reported superior function at 12 (mean difference, –2.5 [95% CI, –3.7 to –1.3]) and 26 weeks (–1.8 [95% CI, –3.1 to –0.5]), and the stretching group reported superior function at 6 (–1.7 [95% CI, –3.0 to –0.4]), 12 (–2.2 [95% CI, –3.4 to –1.0]), and 26 weeks (–1.5 [95%

Table 2. Mean Estimates and 95% CIs by Treatment Group and Mean Between-Group Differences

Primary Outcomes, Estimate	Mean Estimate (95% CI)			Omnibus *P* Value[a]	Between-Group Difference (95% CI)		
	Yoga	Stretching	Self-care		Yoga vs Self-care	Stretching vs Self-care	Yoga vs Stretching
Unadjusted analysis							
RDQ, week							
6	6.47 (5.37 to 7.58)	5.15 (4.33 to 5.97)	7.04 (5.49 to 8.58)	.05	−0.56 (−2.46 to 1.34)	−1.88 (−3.63 to −0.14)	1.32 (−0.06 to 2.70)
12	4.59 (3.66 to 5.53)	4.43 (3.60 to 5.26)	6.56 (5.17 to 7.94)	.04	−1.96 (−3.63 to −0.29)	−2.12 (−3.74 to −0.51)	0.16 (−1.09 to 1.41)
26	4.49 (3.51 to 5.48)	4.26 (3.30 to 5.22)	5.73 (4.33 to 7.12)	.23			
Bothersomeness, week							
6	4.10 (3.63 to 4.56)	3.78 (3.38 to 4.17)	4.04 (3.43 to 4.66)	.55			
12	3.26 (2.85 to 3.67)	3.59 (3.14 to 4.04)	4.20 (3.61 to 4.80)	.05	−0.95 (−1.66 to −0.23)	−0.61 (−1.36 to 0.13)	−0.33 (−0.94 to 0.27)
26	3.59 (3.12 to 4.06)	3.34 (2.86 to 3.81)	3.80 (3.14 to 4.46)	.52			
Adjusted analysis[b]							
RDQ, week							
6	6.02 (5.15 to 6.89)	5.51 (4.90 to 6.13)	7.26 (6.09 to 8.43)	.04	−1.24 (−2.70 to 0.23)	−1.74 (−3.04 to −0.44)	0.50 (−0.57 to 1.58)
12	4.31 (3.55 to 5.08)	4.61 (3.92 to 5.30)	6.79 (5.83 to 7.76)	<.001	−2.48 (−3.70 to −1.26)	−2.18 (−3.37 to −1.00)	−0.30 (−1.33 to 0.74)
26	4.12 (3.28 to 4.97)	4.47 (3.64 to 5.30)	5.93 (4.92 to 6.95)	.03	−1.81 (−3.12 to −0.50)	−1.47 (−2.78 to −0.17)	−0.35 (−1.52 to 0.83)
Bothersomeness, week							
6	3.95 (3.52 to 4.38)	3.87 (3.51 to 4.24)	4.09 (3.48 to 4.71)	.83			
12	3.18 (2.81 to 3.56)	3.67 (3.23 to 4.12)	4.26 (3.71 to 4.81)	.01	−1.07 (−1.75 to −0.41)	−0.59 (−1.30 to 0.11)	−0.49 (−1.06 to 0.08)
26	3.48 (3.04 to 3.92)	3.42 (2.96 to 3.87)	3.85 (3.24 to 4.46)	.51			

Abbreviation: RDQ, Roland Disability Questionnaire.

[a] Between-group comparisons were calculated only if the omnibus *P* value was <.05 following the least significant difference approach to control for multiple comparisons.

[b] Estimates adjusted for baseline RDQ and bothersomeness score, sex, age, body mass index, days of lower back pain in the past 6 months, pain traveling down the leg, and employment-related exertion.

CI, −2.8 to −0.2]) (Table 2). There were no statistically or clinically significant differences between the yoga and stretching groups (6 weeks [95% CI, −0.6 to 1.6]; 12 weeks [95% CI, −1.3 to 0.7]; 26 weeks [95% CI, −1.5 to 0.8]).

Except at 12 weeks, there were no meaningful differences among the treatment groups for symptom bothersomeness (**Figure 2**). At 12 weeks, the yoga group was significantly less bothered by symptoms than the self-care group (Table 2).

We explored 2 additional measures of clinical improvement: 30% improvement from baseline (representing minimal improvement)[21] and 50% improvement from baseline (representing substantial improvement) (**Table 3**). Compared with self-care at 12 weeks, significantly more participants in both class groups improved by both criteria for both primary outcomes. For example, 52% to 56% of participants in the yoga and stretching groups improved by a least 50% on the RDQ compared with only 23% in the self-care group ($P < .001$). At 26 weeks, both yoga and stretching showed substantial benefits beyond self-care on the RDQ, whereas stretching showed substantial benefits on bothersomeness.

OTHER OUTCOMES

At each follow-up interview, 2% to 6% of participants in the 3 groups reported 7 or more days of activity restrictions over the previous 4 weeks, 5% to 6% of participants reported any days in bed, and 4% to 8% reported any work loss. Compared with self-care, yoga and stretching class participants were significantly more likely to rate their back pain as better, much better, or completely gone at all follow-up times (Table 3). More participants in the yoga and stretching groups were very satisfied with their overall care for back pain.

ADVERSE EVENTS

Of the 87 yoga and 75 stretching class attendees, 13 in each group reported a mild or moderate adverse experience possibly related to treatment (mostly increased back pain), and 1 yoga attendee experienced a herniated disk. One of 45 persons randomized to self-care reported increased pain after doing recommended exercises.

COMMENT

We found that physical activity involving stretching, regardless of whether it is achieved using yoga or more conventional exercises, has moderate benefits in individuals with moderately impairing low back pain. Finding similar effects for both approaches suggests that yoga's benefits were largely attributable to the physical benefits of stretching and strengthening the muscles and not to its mental components. Although the specific exercises differed, most of the yoga and stretching class was spent performing exercises designed to stretch and strengthen back and leg muscles (roughly 45-50 minutes for yoga vs 60-65 minutes for stretching). Elements unique to the yoga class were (1) breathing exercises and a guided deep relaxation, (2) explicitly asking participants if they had difficulties in performing the postures at home or had any questions, and (3) explicit guid-

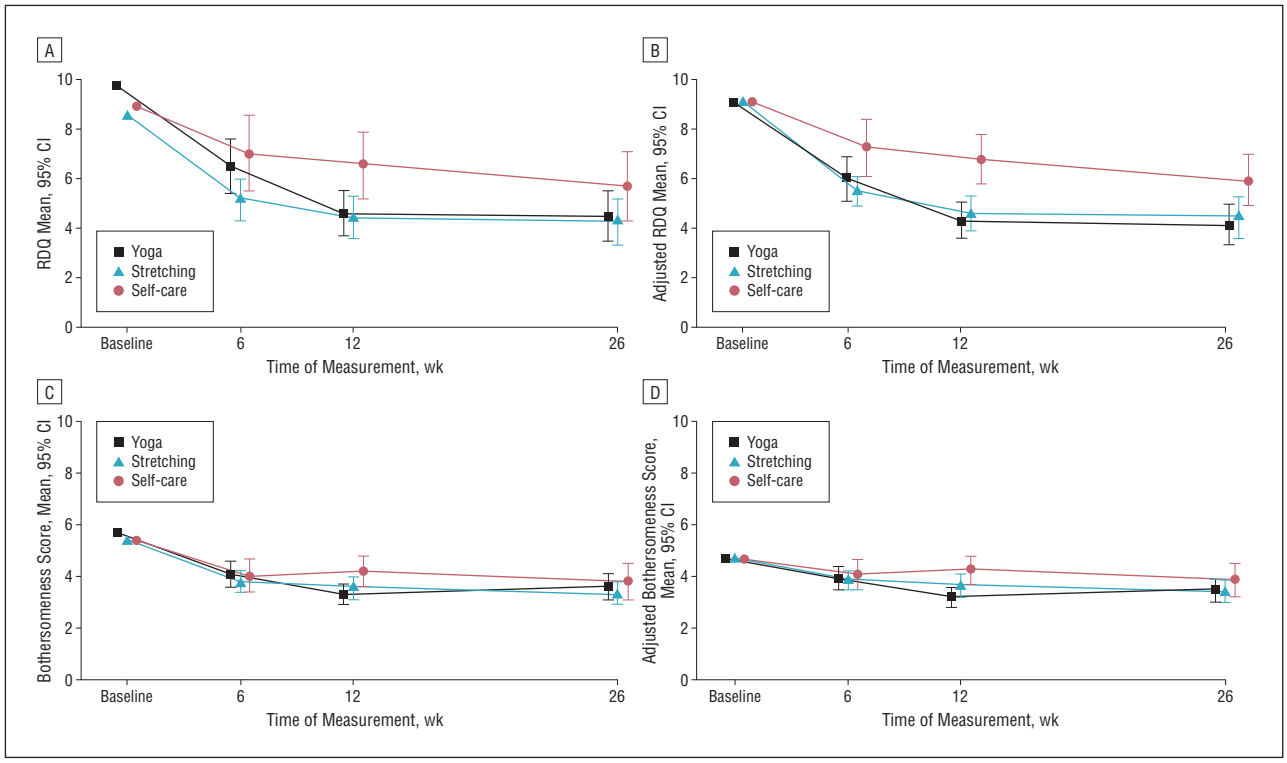

Figure 2. Primary outcomes for yoga, stretching, and self-care at baseline, 6, 12, and 26 weeks. Mean unadjusted (A and C) and adjusted (B and D) Roland Disability Questionnaire (RDQ) (A and B) and bothersomeness scores (C and D) at baseline, 6, 12, and 26 weeks by treatment group.

ance and reminders to practice with awareness of their body. Unique to the stretching class were 5 minutes of warm-up exercises and attempts to create group cohesion through discussion of non–back pain–related topics.

We found that yoga was relatively safe. Similar to other kinds of physical movement, harmful outcomes from yoga were mostly temporarily increased back pain.

We were able to identify 8 published clinical trials of yoga for chronic back pain[3-6,8,9,22,23] but no systematic reviews. All included fewer than 50 participants per arm, with 5 including fewer than 30. The interventions used in these studies differed in many ways, including style of yoga (hatha yoga, Iyengar, or viniyoga), hours of class time (12-72 hours; typically 15 hours), class frequency (from a weeklong retreat of comprehensive yoga to weekly classes 60-90 minutes in length), and duration of delivery (1-24 weeks; median, 12 weeks). While all studies included postures, breathing exercises, and deep relaxation, 2 added meditation practice. Various control groups included waiting lists (3 studies), usual care (3 studies), educational information (1 study), and exercise (2 studies). Only 5 studies collected postintervention follow-up data. Six trials contained serious flaws (eg, small sample sizes coupled with large baseline imbalances on key outcomes,[3,4,22] very poor class attendance,[23] and high loss to follow-up[8,9]). Despite their diversity, all trials concluded that yoga improved back-related function, symptoms, and/or reduced medication usage.

Recent meta-analyses of exercise for persons with chronic back pain have reported modest but clinically questionable effects of exercise compared with usual care.[2,24,25] Further analyses found that stretching and strengthening exercises, supervised exercise, and individual tailoring of the exercises were associated with the best outcomes.[24] Apart from tailoring, these features were part of our stretching classes.

Our self-care book was included in 2 trials evaluating slightly different group-based, self-care educational interventions.[26,27] Both were found superior to usual care. However, we are unaware of studies that have evaluated it as a stand-alone intervention.

The principal strengths of our study are its relatively large size, well-characterized yoga intervention, inclusion of 2 comparison groups (including 1 with exercise of comparable physical exertion), high follow-up rates, use of masked interviewers, and satisfactory adherence to the intervention. Moreover, our sensitivity analysis applying a nonignorable imputation approach to handle missing data confirmed our conclusions.

This study had several limitations: disappointed self-care participants might have been more likely to report worse outcomes, participants were selected from a single site and were relatively well-educated and functional, there was no follow-up beyond 26 weeks, and the amount of stretching performed in the stretching class was substantially greater than that typically found in publicly available classes.

Yoga and stretching are reasonable treatment options for persons who are willing to engage in physical activities to relieve moderately impairing back pain. Because yoga classes can vary enormously, clinicians are advised to recommend classes for beginners or classes that are therapeutically oriented with instructors who are comfortable modifying postures for persons with physical limitations. Clinicians recommending stretching classes should ensure that these contain sufficient back-

Table 3. Secondary Outcomes: Mean Estimates and Relative Risk (RR) for Pairwise Comparisons

Secondary Outcome, Binary Variable	Adjusted Mean Estimates, Mean % (95% CI)[b]			Omnibus *P* Value[a]	Adjusted RR (95% CI)[a]		
	Yoga	Stretching	Self-care		Yoga vs Self-care	Stretching vs Self-care	Yoga vs Stretching
RDQ, 30% improvement, week							
6	55 (46-67)	58 (48-70)	49 (37-67)	.64			
12	75 (66-86)	71 (63-83)	45 (32-63)	.007	1.67 (1.17-2.40)	1.58 (1.10-2.27)	1.06 (0.87-1.28)
26	66 (56-78)	72 (63-83)	55 (43-72)	.18			
RDQ, 50% improvement, week							
6	35 (26-47)	38 (29-49)	21 (12-37)	.10			
12	56 (46-68)	52 (41-63)	23 (14-38)	<.001	2.43 (1.40-4.20)	2.25 (1.29-3.93)	1.08 (0.81-1.43)
26	60 (50-72)	51 (41-63)	31 (21-48)	.007	1.90 (1.21-2.99)	1.63 (1.03-2.59)	1.17 (0.88-1.54)
Bothersomeness score, 30% improvement, week							
6	36 (27-48)	34 (26-45)	32 (23-46)	.89			
12	52 (42-64)	48 (38-59)	23 (15-36)	<.001	2.24 (1.36-3.70)	2.07 (1.26-3.39)	1.08 (0.80-1.46)
26	52 (41-64)	44 (35-56)	29 (19-43)	.03	1.80 (1.12-2.84)	1.52 (0.96-2.43)	1.72 (0.85-1.62)
Bothersomeness score, 50% improvement, week							
6	16 (10-26)	12 (7-21)	11 (6-19)	.58			
12	25 (17-37)	18 (12-27)	11 (6-20)	.04	2.37 (1.14-4.94)	1.66 (0.78-3.51)	1.42 (0.81-2.51)
26	22 (15-34)	29 (21-39)	11 (5-21)	.01	2.13 (0.96-4.73)	2.73 (1.29-5.78)	0.78 (0.47-1.31)
LBP better, much better, or completely gone, week							
6	35 (26-47)	34 (26-46)	11 (5-27)	.003	3.08 (1.26-7.53)	3.01 (1.24-7.32)	1.02 (0.67-1.55)
12	60 (50-72)	46 (36-58)	16 (8-31)	<.001	3.78 (1.86-7.66)	2.90 (1.42-5.93)	1.3 (0.97-1.75)
26	51 (42-63)	51 (41-63)	20 (11-36)	<.001	2.57 (1.39-4.78)	2.58 (1.39-4.77)	1.00 (0.75-1.34)
Very satisfied with overall care for LBP, week							
6	48 (39-60)	35 (26-47)	13 (6-29)	<.001	3.73 (1.62-8.59)	2.72 (1.16-6.36)	1.37 (0.96-1.97)
12	60 (50-73)	42 (33-55)	15 (7-31)	<.001	3.95 (1.90-8.21)	2.77 (1.31-5.89)	1.42 (1.05-1.93)

Abbreviations: LBP, lower back pain; RDQ, Roland Disability Questionnaire.

[a] Between-group comparisons (relative risks) were calculated only if the omnibus *P* value was <.05 following the least significant difference approach to control for multiple comparisons.

[b] Estimates adjusted for baseline RDQ and bothersomeness score, gender, age, body mass index; days of LBP in the past 6 months, pain traveling down the leg, and employment-related exertion.

and leg-focused stretching. Patient preferences, availability of suitable classes, and patient costs should also be considered. Future studies are needed to determine the usefulness of these interventions for more severely impaired patients and those of lower socioeconomic status.

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INVITED COMMENTARY

ONLINE FIRST

Comparative Effectiveness Studies in Chronic Low Back Pain

Progress and Goals

Chronic back pain is common, disabling, and expensive. Essentially all people will have some back pain during their lives, but in a minority of individuals acute back pain will become chronic, with symptoms lasting longer than 3 months and severe enough that some daily activities are impaired. In several recent studies, the proportion of the adult population affected by chronic back pain seems to be rising, with medical and social costs rising as well.[1,2] Given these circumstances, our society has an urgent need for effective, relatively inexpensive treatments to improve patient functional status and reduce pain. The field of chronic low back pain treatment is characterized by a large number of available treatments, but we have relatively poor information regarding how these treatments compare with each other.[3] In such situations of uncertainty, treatment choice may vary, and use of ineffective treatments may proliferate. The United States is currently markedly in-