Annals of Internal Medicine | ORIGINAL RESEARCH

Yoga for Chronic Low Back Pain

A Randomized Trial

Helen E. Tilbrook, BSc, MSc; Helen Cox, BSc, MSc; Catherine E. Hewitt, BSc, MSc, PhD; Arthur Ricky Kang'ombe, BSc, MSc; Ling-Hsiang Chuang, BSc, MSc, PhD; Shalmini Jayakody, BSc, MSc; John D. Aplin, MA, PhD; Anna Semlyen, BA, MSc; Alison Trewhela, DBL, CSL; Ian Watt, BSc (Med Sci), MB, ChB, MPH; and David J. Torgerson, MSc, PhD

Background: Previous studies indicate that yoga may be an effective treatment for chronic or recurrent low back pain.

Objective: To compare the effectiveness of yoga and usual care for chronic or recurrent low back pain.

Design: Parallel-group, randomized, controlled trial using computer-generated randomization conducted from April 2007 to March 2010. Outcomes were assessed by postal questionnaire. (International Standard Randomised Controlled Trial Number Register: ISRCTN 81079604)

Setting: 13 non–National Health Service premises in the United Kingdom.

Patients: 313 adults with chronic or recurrent low back pain.

Intervention: Yoga (n = 156) or usual care (n = 157). All participants received a back pain education booklet. The intervention group was offered a 12-class, gradually progressing yoga program delivered by 12 teachers over 3 months.

Measurements: Scores on the Roland–Morris Disability Questionnaire (RMDQ) at 3 (primary outcome), 6, and 12 (secondary outcomes) months; pain, pain self-efficacy, and general health measures at 3, 6, and 12 months (secondary outcomes).

Results: 93 (60%) patients offered yoga attended at least 3 of the first 6 sessions and at least 3 other sessions. The yoga group had better back function at 3, 6, and 12 months than the usual care group. The adjusted mean RMDQ score was 2.17 points (95% CI, 1.03 to 3.31 points) lower in the yoga group at 3 months, 1.48 points (CI, 0.33 to 2.62 points) lower at 6 months, and 1.57 points (CI, 0.42 to 2.71 points) lower at 12 months. The yoga and usual care groups had similar back pain and general health scores at 3, 6, and 12 months, and the yoga group had higher pain self-efficacy scores at 3 and 6 months but not at 12 months. Two of the 157 usual care participants and 12 of the 156 yoga participants reported adverse events, mostly increased pain.

Limitation: There were missing data for the primary outcome (yoga group, n = 21; usual care group, n = 18) and differential missing data (more in the yoga group) for secondary outcomes.

Conclusion: Offering a 12-week yoga program to adults with chronic or recurrent low back pain led to greater improvements in back function than did usual care.

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For author affiliations, see end of text.

Back pain is a common and costly condition (1, 2). Exercise treatment, although widely used and recommended, has only a small effect on back pain (3–5). Yoga may offer an alternative approach to the treatment of low back pain. The benefits of yoga may be greater than those of exercise alone because yoga offers a combination of physical exercise with mental focus, and patients are taught good posture, self-awareness, and self-care along with relaxation. We recently conducted a literature review and found evidence that yoga may be an effective treatment of chronic low back pain (6–12). However, the previous studies had limitations, including small sample sizes, a single yoga teacher delivering the program, and short-term follow-up. We therefore conducted a trial to determine whether offering a 12-week yoga program to adults with chronic or recurrent low back pain led to greater improvements in back function than usual care (13) (https://hscisrv07.york.ac.uk/yoga/html/index.html).

METHODS

Design Overview

In this parallel-group, randomized, controlled trial, participants were allocated in an overall ratio of 1:1 to usual care or yoga. Participants were recruited between July 2007 and July 2008, with final follow-up in November 2009. The Leeds (East) Research Ethics Committee approved the study (reference 07/Q1206/35).

Setting and Participants

Thirty-nine general practices were recruited to the study. Participating general medical practices searched patient databases and mailed out an invitation packet to all individuals aged 18 to 65 years who had a visit for low back pain in the past 18 months; database searches were undertaken in 2 waves. In addition, during the second wave of recruitment, advertisements were also placed in local media. Individuals who were interested in participating were asked to return a consent form and an eligibility

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Context

Is yoga an effective therapy for low back pain?

Contribution

In this trial, adults with chronic or recurrent low back pain were randomly assigned to a 12-session, 3-month yoga program ($n = 156$) or usual care ($n = 157$). The yoga group had better back function but similar back pain and general health scores at 3, 6, and 12 months compared with the usual care group. Eight participants reported adverse events, such as increased pain, that were perhaps related to yoga.

Caution

Compliance with yoga was incomplete, and some outcome data were missing.

Implication

Yoga can improve some outcomes in adults with chronic low back pain.

—The Editors

questionnaire containing the Roland–Morris Disability Questionnaire (RMDQ) (14)—a 24-item questionnaire with scores ranging from 0 (best) to 24 (worst)—to the York Trials Unit.

Trial coordinators determined eligibility; criteria were as follows: a score of 4 or more on the RMDQ, musculoskeletal pain bounded by the lowest ribs and gluteal folds, and ability to attend 1 of the yoga venues. Patients were excluded if they 1) did not return a baseline questionnaire (second recruitment wave only), 2) had performed yoga in the previous 6 months, 3) could not get off the floor unaided, 4) could not use stairs, 5) were pregnant, 6) had life-threatening comorbid conditions, 7) had previously undergone spinal surgery, 8) had severe documented psychiatric problems or alcohol dependency, and 9) had indications of serious spinal neurologic abnormality (1 or more of the following: difficulty passing urine; numbness around their back passage, genitals, or inner thighs; numbness, pins and needles, or weakness in both legs; or unsteadiness on feet). Eligibility was confirmed through the participant's general practitioner.

Randomization and Interventions

The randomization sequence was computer generated by an independent data manager and was stratified by participants' prespecified availability to attend yoga classes from a list of classes available, with 1 block per class. Eligible participants' details were entered into a randomization database by the trial coordinators and secretary, who were blinded to the allocation sequence. A variable allocation ratio was used for each class to ensure that no more than 15 participants were allocated to any 1 class. Classes for which fewer than 15 participants expressed availability had an allocation ratio favoring the intervention group to ensure that there were equal numbers of participants in each group. Seven participants were added later and were randomly assigned individually in a 1:1 ratio.

All participants received a back pain education booklet (*The Back Book* [15]) and usual care. The intervention group was also offered a yoga program. The usual care group was offered a 1-time session of yoga after final follow-up.

Yoga for Healthy Lower Backs

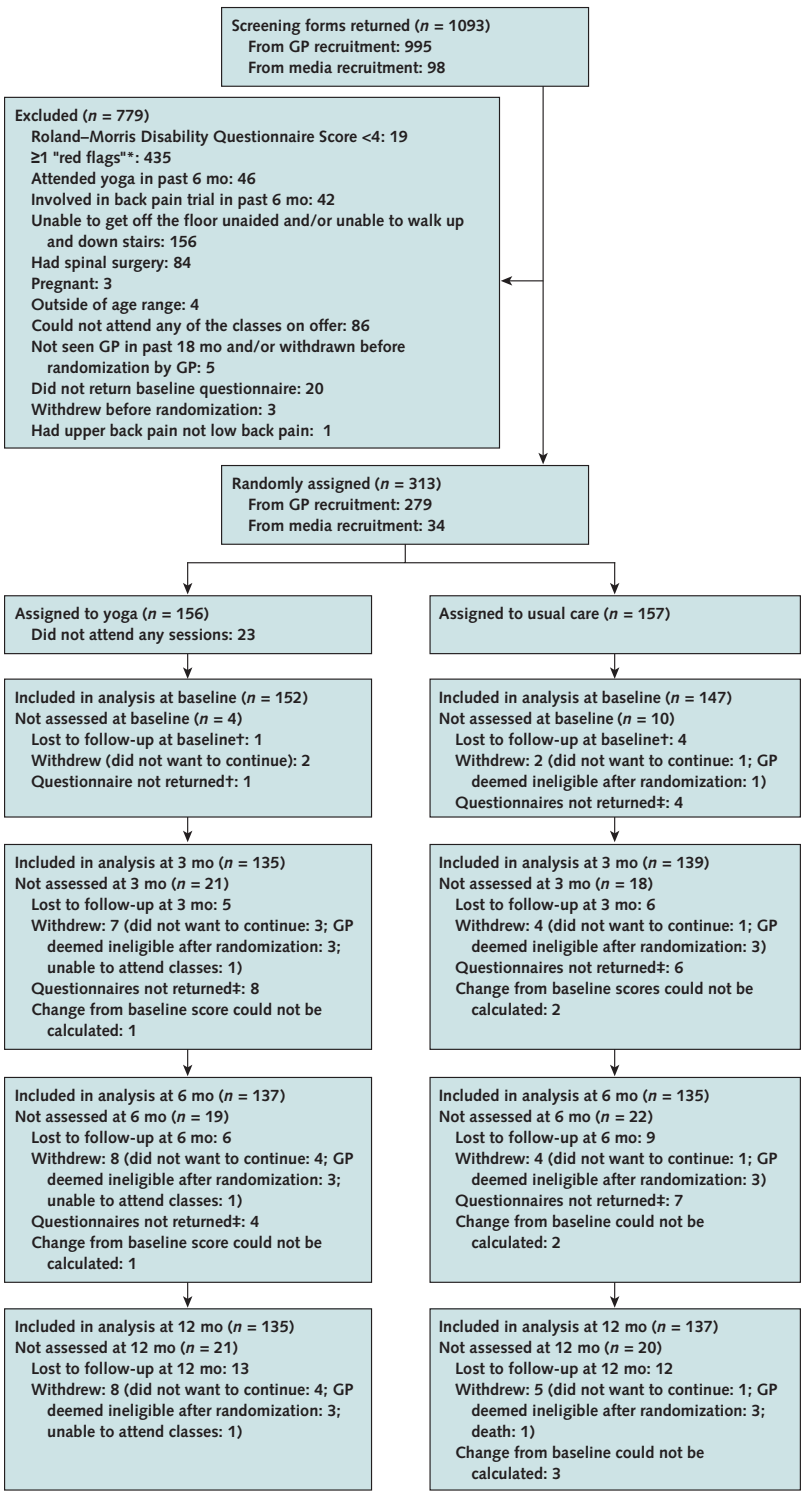
Twenty experienced yoga teachers from 2 yoga associations—the British Wheel of Yoga and Iyengar Yoga (10 from each)—were recruited for the study. Teachers attended program training sessions over 2 weekends. All teachers taught the same form of yoga according to the teachers' manual class plans and the pose descriptions and sequences contained in the students' manual. For each course, 2 teachers were selected: 1 to teach and 1 to serve as back-up. Treatment fidelity was assessed on 2 separate occasions by the back-up yoga teachers. At each assessment, a report was completed and sent to the trial coordinators for review. The fidelity of content was verified by this process, and no changes resulted from the monitoring sessions.

Yoga was delivered in nonmedical centers in England (Cornwall, North and West London, Manchester, and York) and was delivered in twelve 75-minute classes (1 class per week). The classes ran from November 2007 to February 2008 and from September 2008 to December 2008. At the first class, participants were given the student manual, a mat, and a relaxation compact disc (which featured 4 narrated guided relaxations focusing on body parts, color meditation, breath awareness, and mental positivity). Home practice sheets were distributed in the class at 4 intervals over the 12 weeks.

The yoga program introduced participants to the foundational elements of yoga adapted appropriately for low back pain, including *asana, pranayama,* relaxation techniques, mental focus, and philosophy. Classes consisted of an introduction to the weekly theme; pain-relieving or settling-in relaxing poses; a program of seated, standing, prone, and supine poses; educative postural advice; and 5 to 15 minutes of relaxation. Poses targeted stiff, weak, and uneducated areas of the whole body, with the intention of improving mobility, strength, and posture and reducing pain. Later classes featured postures that built on previous weeks, with the aim of increasing confidence in performing more daily activities. Classes sought to train participants in using yoga in everyday life and at home. Participants were encouraged to undertake yoga for 30 minutes daily or to practice at least 2 times per week, and to use the compact disc.

See the **Video Supplement** (available at www.annals.org) for further information.

Figure 1. **Study flow diagram.**



GP = general practitioner.

* An indicator of a more serious medical condition.

† Baseline questionnaires were sent out after randomization to the first-wave participants (n = 165) and before randomization to the second-wave participants (n = 148). Participants who did not return a baseline questionnaire in the second wave were not randomly assigned.

‡ Participants who did not return a questionnaire at that time point but completed questionnaires at subsequent follow-ups. Therefore, the numbers given for "questionnaire not returned" are not cumulative. Number included in analysis refers to numbers included in the main mean Roland–Morris Disability Questionnaire analyses.

Table 1. **Baseline Characteristics of Participants With Low Back Pain Allocated to Yoga or Usual Care***

Characteristic	Usual Care Group		Yoga Group	
	Participants, *n*	Data	Participants, *n*	Data
Age	157		156	
Mean (SD)		46.3 (11.5) y		46.4 (11.3) y
Median (interquartile range)		46.4 (38.5–55.5) y		47.2 (37.6–56.0) y
Male participants	157	43 (27)	156	50 (32)
Age when participant left full-time education	146		152	
≤16 y		50 (34)		51 (34)
17–19 y		34 (23)		42 (28)
≥20 y		59 (40)		55 (36)
Still in full-time education		3 (2)		4 (3)
Completed further education since leaving school, college, or university	140	79 (56)	141	85 (60)
Employment status	142		143	
Employed part-time		33 (23)		30 (21)
Employed full-time		61 (43)		63 (44)
Unemployed		9 (6)		7 (5)
Unable to work because of poor health		10 (7)		9 (6)
At home, not looking for paid employment		11 (8)		18 (13)
Self-employed		18 (13)		16 (11)
Type of employment	140		135	
Foreman/supervisor		3 (2)		14 (10)
Manager		27 (19)		27 (20)
Self-employed with employees		6 (4)		6 (4)
Self-employed without employees		18 (13)		14 (10)
Other employee		85 (61)		74 (55)
Never been in paid employment		1 (1)		0 (0)
Current back pain	143	110 (77)	152	118 (78)
Medication use	147	81 (55)	152	87 (57)
Disability				
Median time that the participant has been unable to undertake usual activities (range)	144	0 (0–28) d	150	0 (0–28) d
Median time that back pain kept the participant in bed (range)	145	0 (0–7) d	151	0 (0–14) d
Duration of back pain problems	155		153	
Median (range)		72 (3–480) mo		96 (3–540) mo
Mean (SD)		113.5 (115.3) mo		130.28 (117.0) mo
Intervention preference	156		155	
Yoga		95 (61)		112 (72)
Usual care		7 (4)		4 (3)
Indifferent		54 (35)		39 (25)
Belief that yoga works	157		156	
Yes		81 (52)		93 (60)
No		0 (0)		1 (1)
Don't know		76 (48)		62 (40)
Expectation that yoga works	157		156	
Yes		87 (55)		89 (57)
No		0 (0)		2 (1)
Don't know		70 (45)		65 (42)

* Unless otherwise noted, values are the numbers (percentages) of participants.

Outcomes and Follow-up

Questionnaires were posted with a prepaid envelope. Nonresponders were initially followed up with postal reminders and then with a telephone call by the trial coordinators or secretary to collect the primary outcome measure. A subset of participants was randomly assigned to receive an electronic reminder on the day

they were due to receive the 6-month questionnaire (16). First-wave participants received £5 with the 12-month questionnaire, and second-wave participants received £5 with the 3-, 6-, and 12-month questionnaires.

Outcomes were measured before randomization; at baseline; and at 3, 6, and 12 months. The prespecified primary outcome was back function at 3 months, immediately after the yoga intervention. Back function was measured by using the RMDQ (14).

Secondary outcomes were 1) 6- and 12-month measures of the primary outcome; 2) physical and mental health Short Form-12 (SF-12) Health Survey component summary scores (17, 18); 3) back pain scores on the Aberdeen Back Pain Scale (ABPS) (19); 4) self-efficacy scores on the Pain Self-Efficacy Questionnaire (PSEQ) (20); 5) EuroQol-5D health index (21) (results reported separately); 6) number of days spent in bed and number of days with restricted activity (follow-up data reported separately); 7) economic data, including medication use over the previous 4 weeks and other health care use (reported separately); 8) beliefs, expectations, and preferences for treatment at baseline (22, 23); 9) class attendance (self-reported and class registers); and 10) use of yoga at home. We did not collect data on participants' use of nonsteroidal anti-inflammatory drugs or other physical activities.

Finally, participants were asked to call if they experienced an adverse event or became pregnant. All events were reported in accordance with National Research Ethics guidelines. Adverse events were assigned potential causality by 1 author (a practicing general practitioner and professor of primary and community care) within the time frame stated in the guidelines. There was no predefined list of possible adverse events. An independent steering committee reviewed all adverse events.

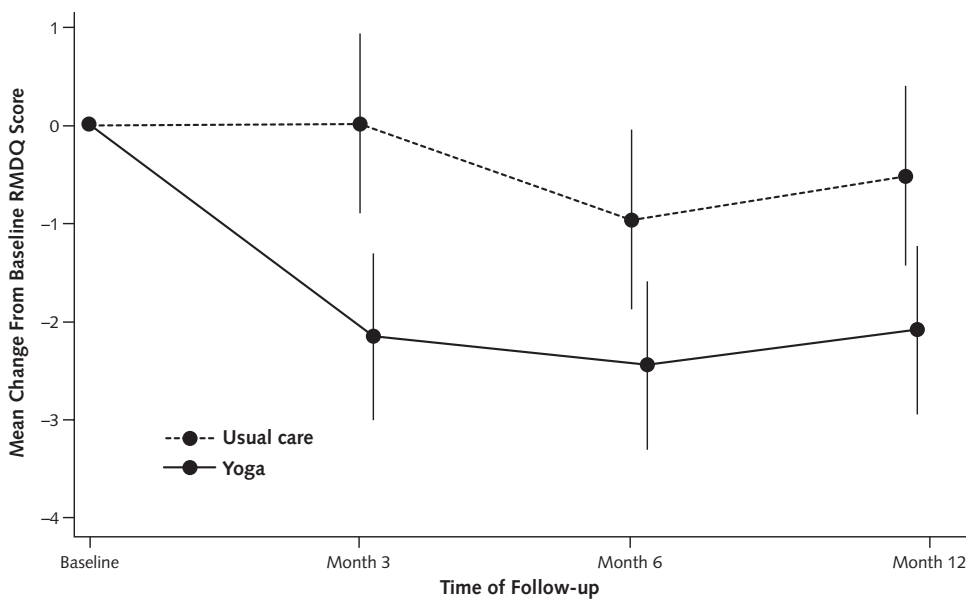
Statistical Analysis

The United Kingdom BEAM (Back Pain Exercise and Manipulation) trial (3) found that a change in the RMDQ score of 1.57 points was a cost-effective difference. Assuming an SD of 4 points (as in the United Kingdom BEAM sample size), this results in an effect size of 0.39. To detect this effect size, assuming 80% power and 20% attrition, we required a total of 262 participants (131 per group).

The analysis plan was agreed on in advance by an independent trial steering committee. Analyses were conducted according to the original randomized treatment assignment regardless of adherence to protocol. Analyses were performed by using SAS software, version 9.2 (SAS Institute, Cary, North Carolina). The statistician was blinded to randomized group.

Analyses were conducted by using a linear mixed model (proc mixed in SAS) to compare changes from baseline in RMDQ scores between the groups over time. The linear mixed model assumed that data were missing at random. Time was treated as a categorical variable and was included as a fixed effect in addition to group, age, sex, eligibility RMDQ score, class preference (stratification factor), group and time interaction, and duration of back pain. The likelihood ratio test was used to select the best covariance pattern. Model diagnostics showed that residu-

Figure 2. **Mean RMDQ scores over time, by randomly assigned group.**



Mean changes from baseline are all predicted means and 95% CIs, estimated from the mixed-effects models, and were adjusted by month, age, sex, eligibility score, class availability, and duration of back pain as fixed effects and random intercepts as random effects. RMDQ = Roland–Morris Disability Questionnaire.

Table 2. **Results of the Linear Mixed Model for the RMDQ Outcome Measure: Main Analysis and Sensitivity Analysis**

Variable	Mean Baseline RMDQ Score (SD)	Mean Change in RMDQ Score From Baseline (95% CI)*					
		Month 3	*P* Value	Month 6	*P* Value	Month 12	*P* Value
Main analysis							
Yoga group	7.84 (3.96)	−2.14 (−3.00 to −1.29)		−2.42 (−3.27 to −1.57)		−2.04 (−2.90 to −1.19)	
Usual care group	7.75 (4.72)	0.03 (−0.89 to 0.94)		−0.94 (−1.86 to −0.02)		−0.48 (−1.39 to 0.43)	
Between-group difference in means		−2.17 (−3.31 to −1.03)	<0.001	−1.48 (−2.62 to −0.33)	0.011	−1.57 (−2.71 to −0.42)	0.007
Sensitivity analysis							
Best-case analysis†							
Yoga group		−2.90 (−3.89 to −1.91)		−3.10 (−4.09 to −2.11)		−2.85 (−3.84 to −1.86)	
Usual care group		0.52 (−0.55 to 1.58)		−0.10 (−1.16 to 0.97)		−0.08 (−1.15 to 0.98)	
Between-group difference in means		−3.42 (−4.75 to −2.08)	<0.001	−3.01 (−4.34 to −1.67)	<0.001	−2.77 (−4.11 to −1.43)	<0.001
Worst-case analysis‡							
Yoga group		−0.29 (−1.30 to 0.72)		−0.78 (−1.79 to 0.23)		−0.10 (−1.11 to 0.91)	
Usual care group		−0.18 (−1.26 to 0.91)		−1.41 (−2.49 to −0.33)		−0.93 (−2.01 to 0.15)	
Between-group difference in means		−0.11 (−1.47 to 1.24)	0.87	0.63 (−0.73 to 1.98)	0.36	0.83 (−0.53 to 2.19)	0.23

RMDQ = Roland–Morris Disability Questionnaire.
* Mean changes from baseline and between-group differences (yoga minus usual care) are predicted means and 95% CIs, estimated from the mixed-effects models and adjusted by month, age, sex, eligibility score, class preference, and duration of back pain as fixed effects and random intercepts as random effects in all models. A lower score indicates better health.
† All yoga participants with missing data were assigned the lowest RMDQ score from yoga participants with observed data, and all usual care participants with missing data were assigned the highest RMDQ score from usual care participants with observed data.
‡ All yoga participants with missing data were assigned the highest RMDQ score from yoga participants with observed data, and all usual care participants with missing data were assigned the lowest RMDQ score from usual care participants with observed data.

als were normally distributed with constant variance, and random intercept effects did not depart significantly from the normal distribution (24, 25). Difference in scores between the groups at 3 (primary outcome) months and at 6 and 12 months (secondary outcomes), and 95% CIs were estimated from the model. To explore the effect of participant intervention preference, the above model was extended to include intervention preference and an interaction term between intervention preference and group. The Fisher exact test was also used to explore the association between adherence and intervention preference.

To assess departures from the missing-at-random assumption in the primary outcome model, a best-case and worst-case sensitivity analysis was undertaken. Under the best-case analysis, all yoga participants with missing data were assigned the lowest RMDQ score from yoga participants with observed data, and all usual care participants with missing data were assigned the highest RMDQ score from usual care participants with observed data. Under the worst-case analysis, all yoga participants with missing data were assigned the highest RMDQ score from yoga participants with observed data, and all usual care participants with missing data were assigned the lowest RMDQ score from usual care participants with observed data.

The ABPS, SF-12 mental and physical component scores, and PSEQ were analyzed by using the same analysis method as used for the primary outcome. The number of adverse events by participant and the total number of events by group were summarized.

Role of the Funding Source

This trial was funded by Arthritis Research UK and sponsored by the University of York. The funding source had no role in designing the study; collecting, analyzing, and interpreting the data; writing the report; or deciding to submit the manuscript for publication.

RESULTS

A total of 1093 individuals with low back pain were screened, and 313 (28.7%) were randomly assigned from 5 centers: 156 to yoga and 157 to usual care (**Figure 1**). Participants were mostly middle-aged employed women (**Table 1**); the average duration of back pain was 10 years (SD, 9.7), and 77% had current back pain. At baseline, 207 (67%) participants expressed a preference for yoga, 11 (4%) preferred usual care, and 93 (30%) had no preference. Two participants did not express a preference.

Study Treatments

There were 16 yoga courses, and the average number of participants allocated to each was 9.75 (SD, 3.68; median, 10 [range, 3 to 15]). The range in mean change from baseline RMDQ scores at 3 months by class was −6.5 to 0. Ninety-three (60%) participants attended at least 3 of the first 6 classes and at least any other 3 classes (adhered); of the remaining participants, 40 (26%) attended at least 1 class but did not meet the above criteria (mean attendance, 3.1; median attendance, 3.0 [range, 1 to 8]) and 23 (15%) did not attend any classes. Of participants who adhered,

72% ($n = 66$) expressed a preference for yoga at baseline, 1% ($n = 1$) preferred usual care, and 27% ($n = 25$) had no preference; 1 person did not express a preference. Of participants who did not adhere, 73% ($n = 46$) expressed a preference for yoga, 5% ($n = 3$) preferred usual care, and 22% ($n = 14$) had no preference. There was no association between treatment preference at baseline and adherence ($P = 0.39$, Fisher exact test).

RMDQ Scores

The yoga group had better back function at 3 (primary outcome), 6, and 12 (secondary outcomes) months than the usual care group (**Figure 2** and **Table 2**). The adjusted mean RMDQ score was 2.17 points (95% CI, 1.03 to 3.31 points) lower in the yoga group at 3 months, 1.48 points (CI, 0.33 to 2.62 points) lower at 6 months, and 1.57 points (CI, 0.42 to 2.71 points) lower at 12 months.

There was no overall association between RMDQ score and class preference ($P = 0.119$), and the effect of treatment did not vary by baseline intervention preference (P for interaction = 0.39) or whether the participant had current back pain at baseline (P for interaction = 0.27).

Sensitivity Analyses

Under the best-case analysis, participants in the yoga group continued to have better back function at 3, 6, and 12 months than participants in the usual care group, with larger treatment effect estimates (**Table 2**). Conversely, under the worst-case analysis, there was no evidence of a difference in back function between the yoga and usual care groups.

Secondary Outcome Measures

The yoga and usual care groups had similar back pain and general health scores at 3, 6, and 12 months; the yoga group had higher pain self-efficacy scores at 3 and 6 months but not at 12 months (**Table 3**). There was no association at all time points between pain and general health and treatment (ABPS, $P = 0.136$; SF-12 physical component score, $P = 0.21$; SF-12 mental component score, $P = 0.145$), and the results did not vary by month of follow-up (P for interaction for ABPS = 0.39; for SF-12 physical component score = 0.82; for SF-12 mental component score = 0.24). There was an association over all time points between the PSEQ score and treatment ($P = 0.022$), and the effect of treatment did not vary by month of follow-up (P for interaction = 0.36).

For all secondary outcome measures, there were differential rates of missing outcome data between the 2 groups. The rates of missing data ranged from 17% to

Table 3. **Results of the Linear Mixed Model for the Secondary Outcome Measures***

Outcome Measure	Mean Baseline Value (SD)	Mean Change From Baseline (95% CI)					
		Month 3	*P* Value	Month 6	*P* Value	Month 12	*P* Value
ABPS†							
Yoga group	25.36 (10.59)	−3.62 (−5.56 to −1.69)		−3.98 (−5.95 to −2.01)		−3.23 (−5.20 to −1.27)	
Usual care group	26.69 (10.87)	−1.20 (−3.23 to 0.83)		−2.24 (−4.28 to −0.20)		2.51 (−4.54 to −0.48)	
Between-group difference in means		−2.42 (−4.97 to 0.12)	0.062	−1.74 (−4.32 to 0.84)	0.186	−0.73 (−3.30 to 1.84)	0.58
SF-12 PCS‡							
Yoga group	44.41 (9.13)	2.65 (1.07 to 4.23)		2.89 (1.28 to 4.50)		2.99 (1.39 to 4.59)	
Usual care group	44.04 (9.45)	1.29 (−0.35 to 2.94)		1.64 (−0.01 to 3.29)		2.20 (0.55 to 3.84)	
Between-group difference in means		1.36 (−0.70 to 3.41)	0.20	1.24 (−0.83 to 3.33)	0.24	0.80 (−1.28 to 2.87)	0.45
SF-12 MCS‡							
Yoga group	45.04 (10.90)	1.94 (0.14 to 3.73)		1.64 (−0.18 to 3.46)		0.83 (−0.98 to 2.65)	
Usual care group	45.02 (10.66)	−0.08 (−1.94 to 1.78)		−0.37 (1.50 to −2.24)		0.41 (−1.45 to 2.27)	
Between-group difference in means		2.02 (−0.31 to 4.35)	0.090	2.02 (−0.34 to 4.37)	0.093	0.42 (−1.92 to 2.77)	0.72
PSEQ‡							
Yoga group	44.04 (10.71)	3.85 (1.85 to 5.84)		4.29 (2.27 to 6.32)		3.35 (1.33 to 5.37)	
Usual care group	43.78 (11.76)	0.88 (−1.22 to 2.99)		0.97 (−1.15 to 3.08)		1.60 (−0.50 to 3.70)	
Between-group difference in means		2.96 (0.35 to 5.58)	0.027	3.33 (0.68 to 5.97)	0.014	1.75 (−0.87 to 4.38)	0.190

ABPS = Aberdeen Back Pain Scale; PSEQ = Pain Self-Efficacy Questionnaire; SF-12 MCS = Short Form-12, mental component score; SF-12 PCS = Short Form-12, physical component score.

* Number of participants with missing data: ABPS—baseline (yoga, 4; usual care, 10), month 3 (yoga, 26; usual care, 21), month 6 (yoga, 30; usual care, 25), month 12 (yoga, 29; usual care, 22); SF-12 PCS and SF-12 MCS—baseline (yoga, 5; usual care, 10), month 3 (yoga, 28; usual care, 21), month 6 (yoga, 32; usual care, 24), month 12 (yoga, 32; usual care, 21); PSEQ—baseline (yoga, 4; usual care, 10), month 3 (yoga, 26; usual care, 22), month 6 (yoga, 30; usual care, 26), month 12 (yoga, 29; usual care, 21). Mean changes from baseline and between-group differences (yoga minus usual care) are predicted means and 95% CIs, estimated from the mixed-effects models, and adjusted by month, age, sex, eligibility score, class preference, and duration of back pain as fixed effects and random intercepts as random effects.

† A lower score indicates better health.

‡ A higher score indicates better health.

Table 4. **Adverse Events**

Adverse Event	Usual Care Group (*n* = 157)	Yoga Group (*n* = 156)
Serious adverse events, *n*		
Accident/injury*	1	0
Increased back pain possibly or probably related to yoga	0	1
Increased back pain unrelated to yoga	0	0
Other pain probably related to yoga†	0	0
Death	1	0
Nonserious adverse events, *n*		
Accident/injury*	0	1
Increased back pain possibly or probably related to yoga	0	4
Increased back pain unrelated to yoga	0	3
Other pain probably related to yoga†	0	3

* Unrelated to intervention.
† All patients had a history of other pain.

21% in the yoga group and 13% to 17% in the usual care group.

Adverse Events

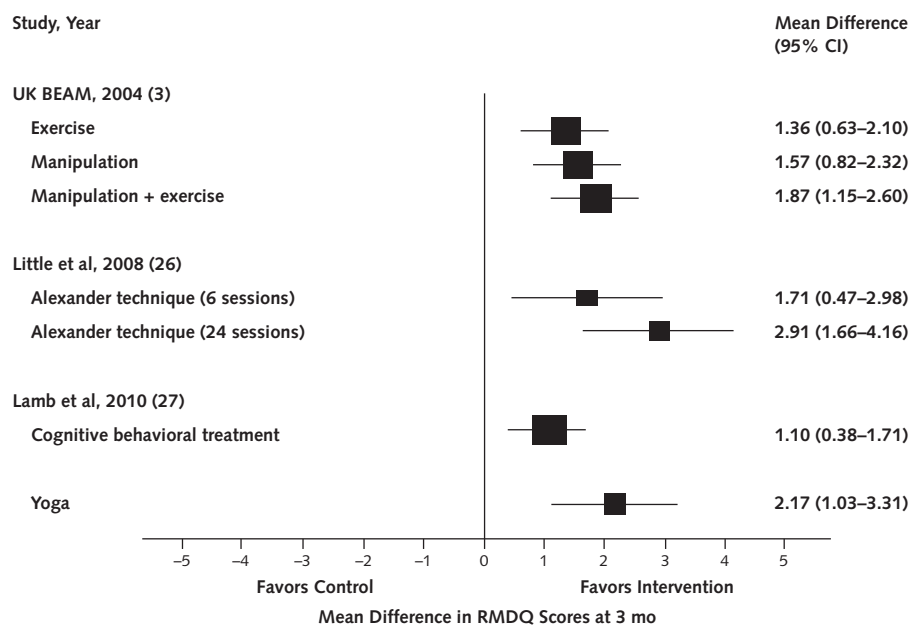
Twelve of 156 (8%) yoga participants and 2 of 157 (1%) usual care participants reported adverse events (**Table 4**). In the yoga group, 1 adverse event was classified as serious and possibly or probably related to yoga (the participant experienced severe pain but had a history of severe pain after any physical activity); the remaining 11 were classified as nonserious and mostly related to increased pain. In the usual care group, 2 serious adverse events occurred.

DISCUSSION

This trial found that offering a 12-week yoga program to adults with chronic or recurrent low back pain led to greater improvements in back function than usual care. The improvements in back function were observed across the 12-month follow-up period but were more pronounced at 3 months, immediately after the intervention. Although there was no evidence of pain reduction at 12 months, confidence in performing normal activities despite pain improved more in the yoga group than usual care group at 3 and 6 months. We found little change in back pain and general health scores at 3, 6, and 12 months. Yoga seemed to be a safe form of activity, with only 8 participants reporting adverse events that were possibly or probably related to yoga.

Although there is no consensus, a change of 1.1 to 2.5 on the RMDQ has been recommended as clinically important (26, 27). In this trial, we found that individuals offered yoga benefited from, on average, 2.17 fewer limited activities at 3 months and by 1.57 fewer limited activities at 12 months. The activities measured by the RMDQ include, for example, walking more slowly than usual, standing for only short periods, and not doing any of the usual jobs around the house. The fact that the benefits dimin-

Figure 3. **Forest plot comparing yoga with other interventions for low back pain evaluated in high-quality randomized, controlled trials.**



RMDQ = Roland–Morris Disability Questionnaire; UK BEAM = United Kingdom Back Pain Exercise and Manipulation.

ished over time, after the classes had finished, may indicate that additional classes would be required to maintain the improvement in back function.

Some participants in the yoga group reported that they attended other yoga classes after the 12-week program had finished, and others reported that they continued with home practice (**Appendix Tables 1** and **2**, available at www.annals.org). The frequency of home practice was 82% in the first 3 months and then decreased to 65% at 6 months and 60% at 12 months; however, 13% of the yoga group did not provide home practice data at any of the follow-up points. The reported figures of home practice may explain why we observed some improvement in back function in the long term. Of note, some participants who did not adhere to the yoga program still reported home practice at 12 months.

Sixty percent of participants offered yoga adhered to the program: Of the remaining participants, 26% attended at least 1 class but did not fully adhere, and 15% did not attend any classes. Reasons for nonattendance varied: withdrawal by physician, work commitments, child care, and other health problems. For 21 of the 40 participants who partially adhered, we could not ascertain reasons for nonattendance. There were missing data for all outcomes, and differential rates of missing data were observed for secondary outcome measures. Hence, it is possible that such imbalances may have biased the results.

When departures from the missing-at-random assumption were assessed in the primary outcome model, the results were consistent with those of our primary analysis under the best-case scenario but were inconsistent under the worst-case scenario. These analyses are useful because they demonstrate the largest and smallest effect estimates compatible with the observed data; however, they are both unlikely scenarios. Unfortunately, the implications of missing data for the analysis depend on the missing-value mechanism, and this is rarely known.

Ours was a large randomized trial with long-term follow-up, including multiple teachers ($n = 12$) delivering classes in 5 geographic areas. The program was acceptable to and taught by teachers from 2 yoga associations. Checks were made to ensure fidelity to the program. A recent review identified 7 other randomized, controlled trials evaluating yoga for low back pain (6–12), but all had design limitations, including small sample sizes, a single yoga teacher delivering the program, and short-term follow-up. Most of the studies found differences in favor of yoga, and our results are consistent with their findings.

Other interventions for low back pain that have been evaluated in high-quality randomized, controlled trials include exercise and manipulation (3), the Alexander technique (26), and cognitive behavioral treatment (27). Comparing the findings of this study with these other interventions suggests that group yoga may improve back function (as measured by the RMDQ) more than exercise and manipulation, cognitive behavioral treatment, and 6 sessions of 1-to-1 Alexander technique but not as much as 24 sessions (**Figure 3**). However, we must be cautious about overanalyzing these results because the comparisons are indirect. Future research should compare yoga directly with these other treatments.

In summary, we found that offering a 12-week yoga program to adults with chronic or recurrent low back pain led to greater improvements in back function than usual care for up to 12 months. Yoga seems to be a safe and effective activity that clinicians could consider recommending for patients with a history of low back pain.

From the University of York, Heslington, York, United Kingdom; University of Manchester, St. Mary's Hospital, Manchester, United Kingdom; Yoga in York, York, United Kingdom; and SBRCP-Yoga Walsingham Clinic, Truro, Cornwall, United Kingdom.

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Requests for Single Reprints: Helen E. Tilbrook, BSc, MSc, York Trials Unit, Department of Health Sciences, Lower Ground Floor, ARRC Building, University of York, Heslington, York YO10 5DD, United Kingdom; e-mail, helen.tilbrook@york.ac.uk.

Current author addresses and author contributions are available at www.annals.org.

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Current Author Addresses: Ms. Tilbrook, Ms. Cox, Dr. Hewitt, Mr. Kang'ombe, Dr. Chuang, and Ms. Jayakody: University of York, Heslington, York YO10 5DD, United Kingdom.

Dr. Aplin: Manchester Academic Health Science Centre, University of Manchester, St. Mary's Hospital, Manchester M13 9WL, United Kingdom.

Ms. Semlyen: Yoga in York, 24 Grange Street, York YO10 4BH, United Kingdom.

Ms. Trewhela: SBRCP-Yoga Walsingham Clinic, 2 Walsingham Place, Truro, Cornwall TR1 2RP, United Kingdom.

Dr. Watt: Department of Health Sciences, University of York, Area 2, Seebohm Rowntree Building, Heslington, York YO10 5DD, United Kingdom.

Dr. Torgerson: Hull York Medical School, York Trials Unit, Lower Ground Floor, ARRC Building, Department of Health Sciences, University of York, Heslington, York YO10 5DD, United Kingdom.

Author Contributions: Conception and design: H.E. Tilbrook, H. Cox, J.D. Aplin, A. Semlyen, A. Trewhela, I. Watt, D.J. Torgerson.

Analysis and interpretation of the data: H.E. Tilbrook, C.E. Hewitt, A.R. Kang'ombe, J.D. Aplin, A. Semlyen, A. Trewhela, I. Watt, D.J. Torgerson.

Drafting of the article: H.E. Tilbrook, C.E. Hewitt, A.R. Kang'ombe, I. Watt, D.J. Torgerson.

Critical revision of the article for important intellectual content: C.E. Hewitt, L.H. Chuang, J.D. Aplin, A. Semlyen, A. Trewhela, I. Watt, D.J. Torgerson.

Final approval of the article: H.E. Tilbrook, H. Cox, C.E. Hewitt, A.R. Kang'ombe, J.D. Aplin, A. Semlyen, A. Trewhela, I. Watt, D.J. Torgerson.

Provision of study materials or patients: A. Semlyen, A. Trewhela.

Statistical expertise: C.E. Hewitt, A.R. Kang'ombe.

Obtaining of funding: J.D. Aplin, A. Semlyen, I. Watt, D.J. Torgerson.

Administrative, technical, or logistic support: H. Cox, J.D. Aplin, A. Semlyen.

Collection and assembly of data: H.E. Tilbrook, H. Cox, D.J. Torgerson.

Appendix Table 1. **Summary Data on Whether Participants Practiced Yoga at Home and How Often They Practiced Over Time**

Variable	Yoga Group, *n/n (%)*				Usual Care Group (*n* = 157), *n/n (%)*
	Offered Yoga (*n* = 156)*	Adherent (*n* = 93)*	Partial Attenders (*n* = 40)*	Nonattenders (*n* = 23)*	
Month 3					
Practicing yoga at home	102/125 (82)	83/89 (93)	15/27 (56)	4 (50)	3/19 (16)
Not practicing yoga at home	23/125 (18)	6/89 (7)	12/27 (44)	4 (50)	16/19 (84)
Missing data on use of yoga at home	31/156 (20)	4/93 (4)	13/40 (33)	15/23 (65)	138/157 (88)
How often practicing yoga at home?					
Daily	9/101 (9)	7/82 (9)	2/15 (13)	–	1/3 (33)
Every other day	21/101 (21)	17/82 (21)	2/15 (13)	2/4 (50)	–
Twice a week	40/101 (40)	35/82 (43)	5/15 (33)	–	–
Once a week	23/101 (23)	18/82 (22)	3/15 (20)	2/4 (50)	1/3 (33)
Less than once a week	8/101 (8)	5/82 (6)	3/15 (20)	–	1/3 (33)
Missing (did not provide frequency of yoga home use)	1/102 (1)	1/83 (1)	–	–	–
Month 6					
Practicing yoga at home	82/126 (65)	72/88 (82)	7/26 (27)	3 (27)	17/128 (13)
Not practicing yoga at home	44/126 (35)	16/88 (18)	19/26 (73)	8 (73)	111/128 (87)
Missing data on use of yoga at home	30/156 (19)	5/93 (5)	14/40 (35)	10/23 (43)	29/157 (19)
How often practicing yoga at home?					
Daily	6/82 (7)	6/72 (8)	–	–	1/7 (6)
Every other day	10/82 (12)	9/72 (13)	1/7 (14)	–	3/7 (18)
Twice a week	25/82 (31)	21/72 (29)	2/7 (29)	2/3 (67)	6/7 (35)
Once a week	21/82 (26)	16/72 (22)	4/7 (57)	1/3 (33)	4/7 (24)
Less than once a week	20/82 (24)	20/72 (28)	–	–	3/7 (18)
Missing (did not provide frequency of yoga home use)	–	–	–	–	–
Month 12					
Practicing yoga at home	76/126 (60)	61/89 (69)	10/25 (40)	4 (36)	16/136 (12)
Not practicing yoga at home	50/126 (40)	28/89 (31)	15/25 (60)	7 (64)	120/136 (88)
Missing data on use of yoga at home	30/156 (19)	4/89 (4)	15/40 (38)	12/23 (52)	21/157 (13)
How often practicing yoga at home?					
Daily	5/76 (7)	5/62 (8)	–	–	–
Every other day	8/76 (11)	7/62 (11)	1/10 (10)	–	3/16 (18)
Twice a week	28/76 (37)	21/62 (34)	6/10 (60)	–	3/16 (18)
Once a week	17/76 (22)	12/62 (19)	2/10 (20)	1/4 (25)	5/16 (31)
Less than once a week	18/76 (24)	17/62 (27)	1/10 (10)	3/4 (75)	5/16 (31)
Missing (did not provide frequency of yoga home use)	–	–	–	–	–

* Total number in each group. Offered yoga: all participants randomly assigned to yoga; adherent: participants who attended at least 3 of the first 6 classes and at least 3 other classes; partial attenders: participants who attended at least 1 class but did not meet the definition of adherent; nonattenders: participants who did not attend any of the yoga classes offered.

Appendix Table 2. **Summary Data on Whether Participants Regularly Attended Yoga Classes After the Intervention***

Variable	Yoga Group	Usual Care Group
Month 3		
Attending a regular yoga class, *n/n (%)*	1/17 (6)	4/132 (3)
Not attending a regular yoga class, *n/n (%)*	16/17 (94)	128/132 (97)
Mean classes attended over past 12 wk (SD), *n*	7.14 (3.70)	3.50 (3.89)
Median classes attended over past 12 wk (range), *n*	7.50 (1.00–12.00)	3.00 (0.00–8.00)
Missing (did not provide attendance data at 3 mo), *n*†	119	9
Month 6		
Attending a regular yoga class, *n/n (%)*	19/125 (15)	5/134 (4)
Not attending a regular yoga class, *n/n (%)*	106/125 (85)	129/134 (96)
Mean classes attended over past 12 wk (SD), *n*	5.52 (4.17)	3.80 (5.90)
Median classes attended over past 12 wk (range), *n*	5.00 (0.00–12.00)	1.50 (0.00–18.00)
Missing (did not provide attendance data at 6 mo), *n*†	13	3
Month 12		
Attending a regular yoga class, *n/n (%)*	11/126 (9)	7/136 (5)
Not attending a regular yoga class, *n/n (%)*	115/126 (91)	129/136 (95)
Mean classes attended over past 12 wk (SD), *n*	9.89 (10.24)	5.53 (7.23)
Median classes attended over past 12 wk (range), *n*	10.00 (0.00–30.00)	1.00 (0.00–20.00)
Missing (did not provide attendance data at 12 mo), *n*†	9	4

* Only self-reported postintervention class attendance is summarized.
† These participants completed the questionnaires but did not provide the attendance data; 36, 38, and 38 participants did not complete the 3-, 6-, and 12-month questionnaires, respectively.