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Yoga for Chronic Neck Pain: A Pilot Randomized Controlled Clinical Trial

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Abstract: **Yoga has been found effective in the treatment of chronic low back pain. We aimed to evaluate the effectiveness of Iyengar yoga in chronic neck pain by means of a randomized clinical trial. Seventy-seven patients (aged 47.9 ± 7.9, 67 female) with chronic neck pain who scored >40 mm on a 100-mm visual analog scale (VAS) were randomized to a 9-week Iyengar yoga program with weekly 90-minute classes (n = 38) or to a self-care/exercise program (n = 38). Patients were examined at baseline and after 4 and 10 weeks. The primary outcome measure was change of mean pain at rest (VAS) from baseline to week 10. Secondary outcomes included pain at motion, functional disability, quality of life (QOL), and psychological outcomes. Twelve patients in the yoga group and 11 patients in the self-care/exercise group were lost to follow-up, with higher study nonadherence in the self-care group (5 versus 10 patients). Mean pain at rest was reduced from 44.3 ± 20.1 to 13.0 ± 11.6 at week 10 by yoga and from 41.9 ± 21.9 to 34.4 ± 21.1 by self-care/exercise (group difference: −20.1, 95% confidence interval: −30.0, −10.1; $P < .001$). Pain at motion was reduced from 53.4 ± 18.5 to 22.4 ± 18.7 at week 10 by yoga and from 49.4 ± 22.8 to 39.9 ± 21.5 by self-care/exercise (group difference: −18.7, 95% confidence interval: −29.3, −8.1; $P < .001$). Significant treatment effects of yoga were also found for pain-related apprehension, disability, QOL, and psychological outcomes. Sensitivity analyses suggested minimal influence of dropout rates. Both programs were well tolerated. In this preliminary trial, yoga appears to be an effective treatment in chronic neck pain with possible additional effects on psychological well-being and QOL. The effectiveness of yoga in chronic neck pain should be further tested by comparative effectiveness studies with longer observation periods.**

Perspective: ***This article presents the results of a randomized controlled trial on the clinical effects of a 9-week yoga program or self-care exercise in patients with chronic neck pain. Yoga led to superior pain relief and functional improvements and might be a useful treatment option for chronic neck pain.***

Key words: *Exercise, neck pain, randomized trial, treatment, yoga.*

Chronic neck pain is a common medical complaint with a high socioeconomic impact. Recent studies estimate its point prevalence to be between 6 and 22%, which increases with age.[3,9,11] The 12-month prevalence is estimated to be between 30 and 50%.[11] Suffering from neck pain is costly due to increased demand for health care.[2]

Chronic neck pain can be caused by the dysfunction of a variety of structures in the neck.[1] Often symptoms persist, causing a substantial deterioration in quality of life (QOL) and loss of work time.[6] Conventional conservative treatment options comprise exercise, massage, physical therapy, education, local anesthetic infiltration, and systemic drug use.[12,21] There are systematic reviews for many treatment modalities; however, there is still a lack of evidence, or demonstration of only modest effect sizes for most therapies,[20] and a multimodal approach is increasingly favored.[14] Evidence for the effectiveness of nonsteroidal anti-inflammatory drugs,

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which remain the mainstay of conservative treatment, are contradictory while their adverse effects are well known.[21] Because standard treatments for chronic neck pain are less than satisfactory, other treatment modalities should be further evaluated.

Yoga has been found effective in chronic low back pain[22,26-28,34] and other chronic pain conditions.[5] Among the various yoga styles, Iyengar yoga has been found to be specifically feasible for patients with pain syndromes, as it uses supportive props and the sequences of postures can be tailored individually to the underlying medical condition. So far, no randomized controlled clinical trials have been published in the peer-reviewed literature to evaluate the effectiveness of yoga for adults with chronic neck pain. Therefore, we designed this trial to evaluate the effectiveness of a 9-week Iyengar yoga program and compared it to a standard self-care exercise/education program. This study was designed to provide preliminary evidence of whether a yoga intervention provides clinical benefits compared to a self-care education/exercise group for reduction in neck pain and improvement in neck function. Due to the study design and structural differences between the interventions, the study does not allow estimation of the specific effects of yoga.

Methods

This study was designed as a randomized controlled clinical trial. All study participants gave their informed consent. The study protocol was reviewed and approved by the Ethics Committee of the Charité-University Medical Center, Berlin, Germany. All study procedures and collection of data were carried out at the outpatient department of the Immanuel Hospital Berlin, Department of Internal and Integrative Medicine.

Study Procedures

We recruited participants by means of a press release offering participation in a study for chronic neck pain. Potential participants were screened for eligibility by telephone interview, and eligible candidates were scheduled for enrollment visits. A study physician (L.M.) performed the participants' physical examinations, and trained and blinded research staff administered measures. Thereafter, each eligible participant was randomly assigned to either the 9-week Iyengar yoga group with interventions once a week over 90 minutes, or a self-care/exercise program with an additional waiting list yoga offer after 10 weeks. The written and personal study information emphasized that both treatments might be useful for treatment of chronic neck pain. Patient recruitment took place between February and June, 2010.

Study Participants

Patients of both sexes between the ages of 18 and 60 who were suffering from a minimum score of neck pain at rest or at motion of >40 mm on a 100-mm visual analog scale (VAS) and self-reported painful restriction of cervical spine mobility for at least 3 months were eligible for participation in the study.

We excluded subjects if they had undergone invasive treatment (surgery, facet joint nerve blocks, epidural injections, neurotomy) within the last 6 weeks or had such treatment planned within the next 10 weeks. We also excluded subjects whose neck pain was complicated (for example, spinal stenosis or herniated vertebral disk) or attributable to specific underlying diseases (for example, congenital anomalies in the cervical spine area or fractured bones). We also excluded subjects who had whiplash injury, frozen shoulder syndrome, a coexisting serious comorbidity, or those who were participating in another study or had previously experienced treatments with yoga.

Randomization

Patients were randomly allocated to a treatment group by a nonstratified block randomization with varying block lengths and by preparing sealed, sequentially numbered opaque envelopes containing the treatment assignments. Randomization was based on the ranuni pseudo-random number generator of the SAS/Base statistical software (SAS Inc, Cary, NC), and the envelopes were prepared by the study biostatistician (R.L.). When a patient fulfilled all enrollment criteria, the study physician (L.M.) opened the lowest numbered envelope to reveal that patient's assignment.

Interventions

Subjects were asked to participate once a week over 9 weeks in a 90-minute Iyengar yoga class or to adhere to a standardized self-care/exercise program with a waiting-list yoga offer.

Yoga

The yoga group participated in the weekly 90-minute yoga classes according to the Iyengar style[13] in a fully equipped yoga studio. Within the Iyengar yoga style, classical yoga poses are applied and adapted specifically to health problems including neck and back pain. A wide range of postures and the supporting use of props employed by this method are thought to enhance flexibility, alignment, stability, and mobility in muscles, joints, and tendons. The use of props such as stickymats, belts, blankets, blocks, and chairs is thought to support the safety of the yoga practice. For the list of poses, see Supplement Table 1.

Yoga classes were led by a certified Iyengar yoga instructor and physician (H.T.) and by an experienced assistant. The intervention and sequence of postures specifically addressed neck pain complaints and was developed specifically for the study by experienced yoga instructors in personal communication with B.K.S. Iyengar. Each class built up on the previous ones. Subjects were requested to practice selected postures at home for 10 to 15 minutes, 2 to 3 times a week. In pre-study interviews with yoga instructors, an 8- to 10-week intervention was regarded as being long enough for allowing relevant treatment effects in chronic neck pain.

Self-Care/Exercise and Waiting List

Participants in the exercise group received a standard self-care manual that specifically addressed exercise and education for chronic neck pain. The manual was developed by a large statutory German health insurance company[10]; there are no published data on the evidence of this intervention. The manual carefully described and depicted a sequence of seated exercises for the neck and shoulder region, some using a towel as an aid. A total of 12 exercises were described focusing on muscle stretching and strengthening, and joint mobility. Proper posture was depicted. Patients were required to practice at home for 10 to 15 minutes at least 3 times a week. They were additionally offered participation in the yoga classes after termination of the 10-week study period (waiting list).

Outcomes

Primary Outcome

All subjects were asked to complete standardized questionnaires at the outset of the study (baseline, day 0), after 4 weeks (day 28 $\pm$ 5), and after 10 weeks (day 70 $\pm$ 5). The primary outcome was change of average neck pain at rest from baseline to day 70 as derived from a 100-mm VAS asking for the average pain intensity within the last 7 days. The VAS was anchored by the descriptors "no pain" and "most severe pain imaginable."

Secondary Outcomes

Pain at motion and pain-related bothersomeness were assessed by a 100-mm VAS.[4,7] Further secondary outcomes included 2 validated instruments to assess functional impairment and disability. The Neck Disability Index (NDI) consists of 10 questions, each scaled on a 6-point Likert scale (0–5 points) and primarily focusing on the physical aspects of neck pain disability.[31] The NDI summary score ranges from 0 with a minimum disability of 0% to 50 with a maximum disability of 100% (higher scores indicate higher disability). It has been shown to be valid and reliable in a 1-week follow-up. The Neck Pain and Disability Questionnaire (NPAD) is a 20-item measure that gauges pain intensity and its interference with vocational, recreational, social, and functional aspects of living.[33] Patient's response to each item is done along a 10-cm VAS. Item scores range from 0 to 5, and the total score (possible range, 0–200) is the sum of the item scores.

Prespecified other secondary outcomes included QOL, as measured by the Medical Outcomes Study 36-Item-Short-Form (SF-36)[32] and measures of emotional and psychological well-being, ie, the Center for Epidemiologic Studies Depression Scale (CES-D)[23] and the German version of the Profile of Mood States (POMS) with its 4 dimensions of depression, anger/hostility, vigor, and fatigue.[17] Global ratings of the effectiveness of interventions by physician and patient were assessed at the end of study using Likert scales. Outcome expectation was rated by patients on a 5-point Likert scale ranging from 0 (expecting no pain relief) to 4 (expecting considerable pain relief) immediately after they had been informed of their assigned treatment so as to statistically enable assessment of the impact of expectation on outcomes.

Prespecified lists filled in by the study physician assessed adverse effects. Additionally, subjects were asked to keep a diary recording any adverse effects of their treatment and their use of oral rescue medication. Patients were contacted by telephone by trained nonblinded research assistants of the study to organize study visits. Record forms and questionnaires were collected during each study visit and issues related to the intervention were otherwise not addressed. Research personnel blinded to group allocation entered and monitored the data.

Sample Size Determination and Statistical Analysis

Based on the results of a subgroup analysis of an as yet unpublished yoga trial on stress reduction, this study was powered to detect a difference of 17 mm on the main outcome criterion between both treatment groups, with 80% power on the basis of a standard deviation of 24 mm and a 2-sided significance level of α = 5%. This yielded a minimum of 66 patients to be included. To account for a 10% dropout rate we decided to include a minimum of 75 patients.

All outcome criteria were analyzed by intention-to-treat, including all randomized subjects, irrespective whether or not they adhered to the protocol or gave a full set of data. For each outcome we fitted a generalized estimation equation, analysis of covariance (ANCOVA), which included treatment group (binary covariate), the respective baseline value (linear co-variable), the patients' expectation (linear co-variable), and time (repeated measurement factor) as independent variables. The within-patient correlation was assumed to be autoregressive of first order. Treatment effects were estimated within these models and reported as adjusted group differences including their respective 95% confidence intervals (CIs) and *P* values.

A sensitivity analysis regarding missing data was conducted with a 3-step process: 1) the ANCOVA was calculated only for the per-protocol population; 2) in a worst-case scenario the missing values were imputed with means of the control group; and 3) in a third model, missing values were imputed by the last observation carried forward method. These models were calculated for the primary outcome and the secondary outcome, "pain at motion."

Results

Recruitment yielded approximately 300 telephone calls from interested individuals. In the majority of cases, nonconsideration for the study was due to time and travel restrictions for participation in the yoga classes or for study visits. A total of 77 subjects were included into the study. Of these, 38 were randomly allocated to the yoga group and 39 to the exercise group. The dropout rate was higher than anticipated. Twenty-four subjects withdrew from the study and were lost to the 70-day follow-up, resulting in 25 patients in the yoga group

and 28 patients in the self-care exercise group completing all measurements (Fig 1). Thirteen subjects in the yoga group did not complete the study: One subject withdrew consent before the first intervention. Five participants did not further adhere to the study within the first 4 study weeks due to personal reasons or lack of time and did not want to complete the postintervention assessment. Five subjects withdrew from the study due to other complaints, among them bronchitis and sinusitis, migraine, and, in 1 case, low back pain. Two further subjects withdrew due to life events (death of relative, change of workplace). Thus, most likely only 1 event—low back pain—was possibly in connection with the intervention. In the self-care/exercise group, 11 subjects did not complete the study: 10 subjects withdrew because of lack of study adherence (wish to immediately start additional yoga or similar treatment), and 1 subject had earlier than expected elective surgery of the hip joint.

Baseline Data

Subjects' ages ranged from 29 to 61 years. The majority of subjects were female (87%). Baseline characteristics were balanced between both groups (Table 1). There was heterogeneity in the study sample regarding pain severity because frequently, only 1 of the 2 pain characteristics (pain at rest and pain at motion) was dominant. This led to larger standard deviations for pain at rest and motion, and to the fact that some patients had pain intensity at rest <40 mm despite all study participants' meeting inclusion criteria. Mean duration of illness was about 6.6 years in both groups. As expected, treatment outcome expectation was higher in the yoga group ($P < .001$).

Subjects in the yoga group attended a mean of 6.1 ± 3.0 of scheduled 9 yoga classes, and reported to practice at home for a mean of 34 ± 24 minutes per week. Seventy percent reported practicing at least >2 times a week. All participants in the self-care/exercise group reported reading of the manual. Patients in this group reported practice at home for a mean of 48 ± 35 minutes per week. Seventy-two percent reported practicing at least >2 times a week the suggested exercises.

Outcome Measures

Primary Outcome

The yoga program was more beneficial than the exercise and education program with regard to neck pain intensity (VAS) at week 10 (Fig 2A). Mean neck pain score at week 10 was reduced from 44.3 ± 20.1 to 13.0 ± 11.6 in the yoga group and from 41.9 ± 21.9 to 34.4 ± 21.1 in the exercise group. This resulted in a highly significant adjusted group difference (–20.1, 95% CI: –30.0, –10.1; $P < .001$).

Secondary Outcomes

Pain at motion score was reduced from 53.4 ± 18.5 mm to 22.4 ± 18.7 mm in the yoga group, and from 49.4 ± 22.8 mm to 39.9 ± 21.5 mm in the exercise group, resulting in an adjusted between-group difference of −18.7 mm (95% CI: −29.3, –8.1; $P < .001$; Fig 2B). A significant group difference favoring yoga over exercise was also evident for pain-related apprehensions (Table 2).

Functional Status and QOL

Disability and functional impairment improved rapidly with yoga and the effect was maintained at week 10

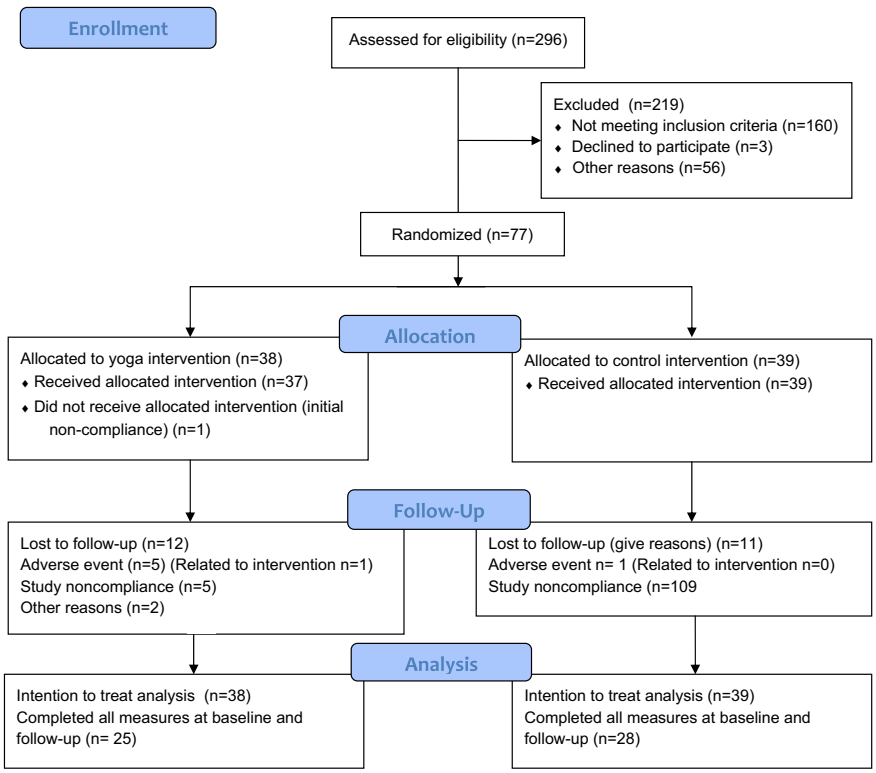

Figure 1. CONSORT trial flow-chart.

Table 1. Baseline Characteristics of Study Patients

	Yoga Group (N = 38)	Exercise/Education Group (N = 39)	P value
Sociodemographic characteristics			
Age (mean ± SD)	48.3 ± 11.0	47.5 ± 12.4	.976
Female/male, n	35/3	32/7	.762
Employment			.718
Unemployed,%	18.4	12.8	—
Currently disabled, %	2.6	7.7	—
Disabled and off work in the last 6 months, %	55.3	59.0	—
Mean SF-36 physical quality of life ± SD	40.9 ± 7.0	43.0 ± 7.3	.201
Mean SF-36 mental quality of life ± SD	44.3 ± 11.4	43.0 ± 10.4	.401
Outcome expectation (0–5)	4 ± .6	3 ± .8	<.001
Neck pain characteristics			
Mean duration of neck pain, y ± SD	6.5 ± 5.1	6.6 ± 5.5	.828
Mean neck pain intensity at rest ± SD, VAS 0–100	44.3 ± 20.6	41.9 ± 21.9	.565
Mean neck pain at motion ± SD, VAS 0–100	53.4 ± 18.5	49.4 ± 22.8	.349
Treatments previously used			
Pain medication, %	50.0	41.0	.423
Spinal surgery, %	2.6	2.6, 5	.985
Physical therapy, %	60.5	56.4	.812
Injections, %	26.3	30.8	.561

Abbreviation: SD, standard deviation.

resulting in significant adjusted group differences. QOL was moderately reduced at baseline in both groups and improved significantly to a relevant extent in the yoga group only (Table 2).

Psychological Outcomes and QOL

Most psychological outcomes assessed were largely improved by yoga, ie, depression ($P < .001$), POMS fatigue (.004), POMS depression ($P = .005$), and POMS anger/hostility ($P = .021$; Table 3). The physical sum score of QOL remained unchanged in the exercise group (−.1 ± 8.1) but improved largely in the yoga group (7.5 ± 8.0) (group difference $P = .003$). Psychological QOL was marginally improved by yoga ($P = .053$). Overall, psychological assessments indicated a mood enhancing as well as an anxiolytic and antidepressant effect of yoga.

The use of rescue medication was comparable in both groups throughout the study. On average, recourse to rescue medication was used on <5% of study days (.2 ± .3 versus .3 ± .5 days per week in the yoga and self-care/exercise groups, respectively) without significant differences between the groups.

At week 10, about 68% of subjects in the yoga group compared to 26% in the self-care/exercise group rated the effectiveness of the intervention as good or very good using a 5-point Likert scale.

Sensitivity Analyses

There were no relevant changes in the results when the sensitivity analyses were performed, suggesting minimal influence of the study dropout. For the primary outcome—pain at rest—the mean between-group difference at week 10 within the 3 applied models (per protocol, worst-case scenario, last observation carried forward) varied between −14.9 and −20.0, each P value <.001. Mean group differences for pain at motion varied accordingly, between −13.1 and −16.6, respective P values .002, .002, and .005.

Safety

There were no serious adverse events in either group. One patient experienced low back pain after the first yoga class. Some patients reported muscle soreness after some yoga classes. None of the patients in either group reported any other complaints directly related to the study interventions.

Discussion

Neck pain is a common condition in all developed societies and has a high medical and socioeconomic

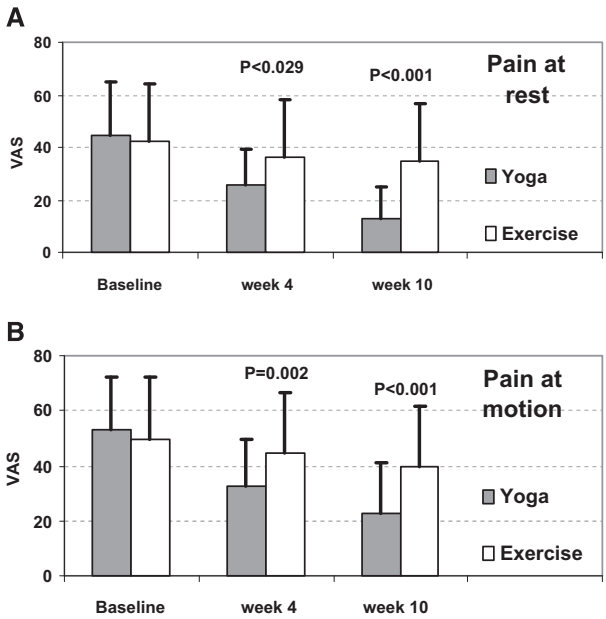

Figure 2. Pain scores. Mean + SD of change of pain at rest **(A)** and pain at motion **(B)** in both groups in the study course. P value for adjusted between-group differences.

Table 2. Functional Disability, Bothersomeness of Pain and Quality of Life in Both Study Groups (Unadjusted Values) With Group Differences for Change on Treatment (Adjusted Values)

	Baseline	*Week 4*	*Week 10*
NDI score (0–50)			
Yoga (mean ± SD)	25.4 ± 5.2	23.1 ± 4.1	18.4 ± 4.0
Exercise (mean ± SD)	25.8 ± 5.5	26.0 ± 6.5	24.5 ± 6.0
Group difference (95% CI); *P* value		−2.3 (−5.0, .4); *P* = .092	−4.6 (−6.8, −2.3); *P* < .001
NPAD score (0–200)			
Yoga (mean ± SD)	77.6 ± 31.4	59.3 ± 25.8	35.0 ± 18.1
Exercise (mean ± SD)	81.7 ± 30.3	75.0 ± 36.1	71.3 ± 42.1
Group difference (95% CI); *P* value		−10.9 (−21.8, .0); *P* = .049	−25.9 (−41.7, −10.0); *P* = .001
Bothersomeness			
Yoga (mean ± SD)	56.8 ± 19.4	34.5 ± 20.9	21.8 ± 18.9
Exercise (mean ± SD)	55.1 ± 20.5	44.3 ± 20.4	38.4 ± 20.3
Group difference (95% CI); *P* value		−9.9 (−20.6, .9); *P* = .073	−14.9 (−24.6, −5.3); *P* = .002
Physical quality of life			
Yoga (mean ± SD)	38.5 ± 7.1	41.3 ± 7.6	46.5 ± 7.3
Exercise (mean ± SD)	40.7 ± 6.0	39.8 ± 7.3	41.3 ± 6.4
Group difference (95% CI); *P* value		2.3 (−1.2, 5.8); *P* = .195	6.1 (2.1, 10.1); *P* = .003
Mental quality of life			
Yoga (mean ± SD)	44.3 ± 11.7	44.1 ± 10.4	47.6 ± 10.4
Exercise (mean ± SD)	43.0 ± 10.4	41.2 ± 11.4	40.6 ± 10.7
Group difference (95% CI); *P* value		.9 (−2.9, 4.8); *P* = .634	4.2 (−.1, 8.5); *P* = .053

impact. The principal findings of this randomized clinical trial suggest that yoga might be an effective treatment for chronic neck pain. In addition, yoga appears to beneficially affect psychological well-being and overall QOL. The benefits do not appear to be attributable to baseline differences in prognostic factors. According to the IMMPACT consensus statement, pretreatment versus posttreatment changes of 2 points (or 30–36%, using a VAS) show that subjects reported feeling "much better" or "meaningfully improved"; a decrease of ≥4 points or ≥50% represents their feeling substantially ("very much") improved.[8] In the present trial, for the yoga group compared to the control group, there was a significant and clinically important adjusted reduction of pain intensity of ∼20-mm VAS. Within the yoga group, the pre- to posttreatment reduction of ∼30-mm VAS also represents a significant and clinically important pain reduction, which corresponds to a mild-to-moderate effect size. The beneficial outcomes of the yoga intervention are particularly of interest given participants' long history of neck pain.

The mechanisms by which yoga induces such physical and psychological improvements are not fully

Table 3. Psychological Well-Being as Assessed by POMS and CES-D in Both Study Groups (Unadjusted Values) With Group Differences for Change on Treatment (Adjusted Values)

	Baseline	*Week 4*	*Week 10*
Depression, CES-D			
Yoga (mean ± SD)	17.7 ± 10.3	15.3 ± 9.1	8.4 ± 5.6
Exercise (mean ± SD)	17.1 ± 8.2	19.7 ± 10.5	18.0 ± 10.4
Group difference (95% CI); *P* value		−3.7 (−7.4, −1); *P* = .055	−7.7 (−11.9, −3.5); *P* < .001
POMS depression			
Yoga (mean ± SD)	1.3 ± 1.5	1.3 ± 1.3	.6 ± .7
Exercise (mean ± SD)	1.2 ± 1.0	1.7 ± 1.5	1.4 ± 1.3
Group difference (95% CI); *P* value		−.3 (−.8, .2); *P* = .180	−.7 (−1.2, −.2); *P* = .005
Fatigue			
Yoga (mean ± SD)	2.6 ± 1.3	2.4 ± 1.1	1.4 ± 1.1
Exercise (mean ± SD)	2.5 ± 1.3	2.6 ± 1.4	2.4 ± 1.4
Group difference (95% CI); *P* value		−.2 (−.7, .3); *P* = .502	−.9 (−1.5, −.3); *P* = .004
Vigor			
Yoga (mean ± SD)	2.6 ± 1.1	2.8 ± 1.1	3.3 ± 1.0
Exercise (mean ± SD)	2.4 ± 1.1	2.7 ± 1.1	2.6 ± 1.1
Group difference (95% CI); *P* value		.0 (−.4, .4); *P* = .901	.4 (−.2, 1.0); *P* = .229
Anger/hostility			
Yoga (mean ± SD)	1.4 ± 1.3	1.3 ± 1.1	.6 ± .8
Exercise (mean ± SD)	1.4 ± 1.0	1.8 ± 1.4	1.5 ± 1.3
Group difference (95% CI); *P* value		−.4 (−.9, .2); *P* = .215	−.7 (−1.2, −.1); *P* = .021

understood. Principally, the practice of Hatha yoga (of which Iyengar is a form) comprises physical movements that go along with isometric muscle strengthening, stretching, and flexibility components, but also with a mental focus and an emphasis on mindfulness of body movements and consideration of breathing patterns.[13] Therefore, the practice of yoga might enhance both toning of muscles and release of muscle tension. The induced relaxation response may further reduce stress-related muscle tension and modify neurobiological pain perception.

Moreover, yoga is also thought to help recognize and change habitual patterns of posture, thereby leading to correction of maladaptive body positions and muscle tension in daily life.[15] A subjective increase in awareness of body movements and posture after yoga practice has been described in patients suffering from chronic musculoskeletal pain.[26,29] Nonspecific effects may largely contribute to the effectiveness of yoga and, particularly in light of the control intervention used, to the observed between-group differences. These potential nonspecific factors comprise setting and attention effects, meaning, and belief responses of the participants and social effects due to the group intervention.

Our results are in line with the demonstrated beneficial effects of yoga in the treatment of chronic low back pain.[22,24,27,34,35] Previous research has also found that yoga may lead to mood enhancement, stress reduction, and improvements in depression and anxiety in patients with depressive syndromes and with musculoskeletal pain.[16,18,25]

Strengths of this study include the rigorous randomization procedure, our use of validated assessment tools and outcome measures, and the high-quality development of yoga protocols.

Limitations of our study relate to the small sample size, as smaller studies may overestimate effect sizes.[19] Therefore, our results should be interpreted in view of the more exploratory nature of the trial. Due to the observation period of only 10 weeks, the longevity of effects also remains unknown. A further major limitation is due to the difference between the 2 interventions regarding treatment time, attention, and social interaction. In contrast to the yoga group, the self-care/exercise group received no active attention by exercise instructors and had no social support through other group members. These formal differences between the 2 treatment types in our study may have introduced a bias favoring the yoga intervention. Furthermore, subjects in the self-care/exercise group may have felt the offered control therapy to be not beneficial enough, leading to disappointment and also to more dropouts due to nonadherence. To avoid disappointment effects in the control group, we selected an already successfully established self-care/exercise program and offered additionally a wait-list yoga treatment. Of note, the yoga group had a higher study dropout rate due to lack of study adherence or minor complaints that did not exclude their continued participation in the study. Therefore, the higher-than-expected number of participant dropouts in both groups may also reflect the generally limited motivation of chronic pain patients in maintaining physical activity. Finally, it is not unusual for trials with exercise interventions to have a relevant proportion of initially motivated subjects rapidly lose interest in continuation of the activity.

Because an intention-to-treat analysis was used, the high dropout rate should not significantly affect the results. We furthermore conducted a sensitivity analysis to investigate the influence of participant dropout on the result. Here, the results were comparable to the intention-to-treat analysis, and confirm the robustness of data.

A further limitation relates to the data's being collected by nonblinded research assistants, which may have introduced a bias leading to a potential overestimation of the effects. Furthermore, as with studies with self-applied physical interventions, it was impossible to mask study participants to treatment group. Therefore, the nonspecific effects in the yoga group might have added to group differences and the effectiveness of yoga. However, the effect of yoga on pain intensity was clinically relevant, while nonspecific effects on chronic neck pain normally are not in this range.[30] Finally, according to our inclusion criteria, subjects were required to have a minimum score of neck pain at rest or neck pain at motion of >40 mm, leading to the fact that some patients had a baseline pain intensity less than 40 mm for the primary outcome.

It remains unclear whether a different yoga style would have produced similar benefits. There are various styles of yoga practiced in the Western world and not all approaches seem appropriate for patients with neck pain and chronic pain syndromes. As yoga appears to be a promising treatment option in chronic neck pain, physicians should consider it as a treatment option, while encouraging their patients to choose yoga instructors and settings with licensed training and experience in subjects with chronic neck pain.

In conclusion, this study suggests that Iyengar yoga might be an effective and safe treatment option in chronic neck pain. However, as the control treatment was not comparable with regard to time intensity, attention, and social interaction, the value of Iyengar yoga should be further evaluated in comparative effectiveness trials including exercise forms with similar intensity and group setting and longer observation periods.

Supplementary Data

Supplementary data accompanying this article are available online at www.jpain.org and www.sciencedirect.com.

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