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Effectiveness of Jyoti Meditation for Patients With Chronic Neck Pain and Psychological Distress—A Randomized Controlled Clinical Trial

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Neck pain has a high 12-month prevalence of about 30–50%.[23] Studies identified a point prevalence between 6% and 22%, which increases with age.[3,15,23] Chronic pain can seriously affect the quality of social and working life of patients and lead to serious comorbidities such as depression. A recent survey revealed that 20% of patients with chronic pain conditions are also diagnosed with depression.[4] Recurrent and chronic pain accounts for a significant portion of health-related absenteeism, decreased work performance, and loss of employment. Furthermore, chronic neck pain is highly cost-intensive because of the increased demand for health care.[2]

There is increasing evidence that psychological stress (distress) contributes to the pathogenesis, progression, and chronification of chronic pain syndromes. A recent survey of one of the large German health insurance companies revealed that 80% of surveyed people feel stressed frequently and 30% feel stressed most of the time.[14] Patients with chronic neck pain frequently experience distress, and chronic neck pain and stress are interrelated and have had fewer treatment options.[7,8,47]

In the recent past, meditation has been increasingly used in the adjunctive treatment of chronic disease conditions. Short-term programs of mindfulness meditation and mindfulness-based stress reduction (MBSR) have been introduced for supportive treatment of chronic pain patients.[26-28] Mindfulness programs have demonstrated beneficial clinical effects for various health problems, including anxiety disorders,[22] mood, and quality of life in cancer patients[6] and the prevention of relapse of depression,[36] among others. Another meditation technique, transcendental meditation, has been investigated mainly in cardiovascular disease and depression. Meta-analyses on mindfulness meditation or related programs indicate small to medium effects in chronic pain or chronic low back pain.[11,38,51] In a meta-analysis on the psychological effects of meditation, the effect sizes pointed to a medium average effect but also showed that findings may vary among the different meditation techniques.[43] There are several mechanisms that may contribute to the putative pain-relieving effect of meditation, for example, central neuromodulatory effects that reduce pain perception, psychological effects that allow a dissociation of pain and its emotional and affective experience, and somatic effects on muscle tension and tissue perfusion by release of stress hormones. Mindfulness programs and other meditation techniques such as transcendental meditation, zen, or jyoti may differ in their health-related effects. MBSR, besides including meditation, puts a strong emphasis on cultivating a mindful and acceptance-based attitude and applying this to any experience in daily life, whereas other forms such as jyoti and transcendental meditation focus on the meditation experience and its relaxing effects in particular. So far, there have been only a few studies investigating the effects of meditation in chronic pain patients, most of them using mindfulness meditation. Most of these studies are limited by a retrospective design, the lack of a control group, or a heterogenous study sample with mixed diagnoses. Two randomized pilot studies with smaller sample sizes investigated the effects of mindfulness meditation in community-dwelling older adults with lower back pain.[34,35] No study so far has investigated patients with chronic neck pain. Against this background, we aimed to evaluate the effectiveness of a meditation program in patients with chronic neck pain by means of a randomized controlled clinical trial. As previous research has shown that a stress-relieving effect of meditation[18] and chronic pain is frequently associated with distress,[1,25] we further aimed to focus on patients with underlying distress and to compare the effects of the meditation program on pain, perceived stress, and psychological well-being. We hypothesized that an 8-week meditation program will decrease pain better than a standard exercise program and that pain relief will be paralleled by stress reduction.

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 Centre, Berlin, Germany. Patients were enrolled between May 2010 and February 2011; interventions and follow-up were completed by June 2011. All study procedures and data collection were carried out at the outpatient department of the Immanuel Krankenhaus Berlin, Department of Internal and Complementary Medicine.

Study Procedures

We recruited participants by means of press releases offering cost-free participation in a study for chronic neck pain. Potential participants were screened for eligibility by telephone interview, and eligible candidates were scheduled for an enrollment appointment. A study physician performed the candidates' physical examinations. Thereafter, each eligible participant was randomly assigned to either an 8-week meditation group or a home-based exercise program with an additional offer to join a meditation class after 8 weeks without further evaluation (wait list offer). The written and verbal study information emphasized that both treatments might be useful for the treatment of chronic neck pain.

Study Participants

Patients of both sexes were eligible if they were between 18 and 65 years old and for at least 3 months had been having neck pain at rest or neck pain at motion. Chronic neck pain had to be diagnosed as nonspecific (tension neck syndrome; cervical spondylosis). Pain intensity needed to have minimum intensity of >40 mm on the 100-mm visual analog scale (VAS) in the last 7 days and a minimum intensity of self-perceived distress of >35 mm on a 100-mm VAS. This VAS asked "How stressed you feel generally?" and had the anchors "not at all" and "as bad as it could be."[21,32] Assessment of pain and

stress for the inclusion criteria and assessments for the baseline study visit were separately performed.

Participants should have had no previous experience in meditation. We excluded subjects if they had undergone invasive treatment within the last 6 weeks or had it planned within the next 10 weeks, and whose neck pain was complicated (spinal stenosis, herniated vertebral disk) or attributable to specific underlying diseases (eg, congenital anomalies in the cervical spine area, fractured bones), as these may need further specific treatments. We also excluded subjects if they had whiplash injury, frozen-shoulder syndrome, and serious comorbidity or were participating in another study.

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. When a patient fulfilled all enrollment criteria, the study physician opened the lowest-numbered envelope to reveal that patient's assignment.

Interventions

Subjects were asked to participate once a week over a period of 8 weeks in a 75- to 90-minute meditation group class or to adhere to a standardized home-based exercise program after initially receiving personal information by a physician.

Meditation

Subjects were taught a traditional meditation technique (jyoti meditation).[48] Jyoti meditation is a technique for controlling and directing attention away from the physical body and sensations, from the emotions and thoughts to a place of relaxation within the organism. Jyoti meditation has the characteristics of (1) sitting motionless, (2) repeating a mantra, and (3) visual concentration while keeping the eyes closed. The mantra is used to support the handling of potential ruminative and distractive thoughts. Participants were asked to repeat a silent mantra of individual choice; it was only known to the participant himself/herself. The mantra should have a pleasant connotation or meaning with regards to the general personal or spiritual background and having no pain connotation. When repeating the mantra, the subjects were asked to close the eyes and to withdraw attention from thoughts and focus it at the still point between the eyes and behind the forehead and to concentrate on what can be seen in the darkness and on emerging visions.

The meditation teachers had longstanding experience with the method. During the weekly open meditation class, participants practiced the method for 15 minutes initially with stepwise prolongation to 30 minutes. Thereafter, they could exchange opinions and speak about problems they might have had following the technique and the handling of chronic pain while meditating during the remaining 45 minutes. Patients were recommended to practice meditation at home for 15 to 30 minutes every day when they had spare time. Adherence was checked by an interview at the last study visit.

Exercise

Participants in the exercise group received an established and previously used self-care manual for specific exercise and education for chronic neck pain.[33] A large statutory German health care insurance company developed the manual.[19] A total of 12 exercises were described focusing on muscle stretching and strengthening and joint mobility. Proper posture was depicted. After an initial introduction, patients were recommended to practice these exercises for at least 15 minutes daily. This program was chosen as it has shown good feasibility and is well accepted among patients with chronic neck pain. Adherence was checked by an interview at the last study visit.

Outcomes

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 8 weeks (day 56 $\pm$ 5). The first questionnaire was filled out at the study site before patients were informed about the group allocation; all subsequent questionnaires were sent to participants by mail and were brought back by the participants to the study site. The participants further received a diary and were asked to document practice time and medication. In interviews at the last study visit, the participants were additionally asked about the general effectiveness of the intervention and its safety.

Primary Outcome

The primary outcome was the mean group difference of change of average neck pain intensity at rest during the last 7 days from baseline to week 8 as assessed by VAS (0 = no pain and 100 = worst imaginable pain).

Secondary Outcomes

Pain at motion and pain-related bothersomeness ("Please rate the discomfort you have experienced from your neck pain in the last 7 days" with the anchors 0 = not at all bothersome and 100 = extremely bothersome[44,45]) were accordingly assessed by 100-mm VAS. Further secondary outcomes included scores of validated instruments for disability, stress, and emotional well-being: The Neck Pain and Disability Questionnaire, a 20-item questionnaire, was used to measure the intensity of neck pain and its interference with vocational, recreational, social, and functional aspects of living.[17,41] Patients respond to each item by marking along a 10-cm VAS. Item scores range from 0 to 5, and the total score (possible range 0–100) is the sum of the item scores, with higher scores indicating higher disability. Quality of life was measured by the widely used Medical Outcomes Study 36-Item Short Form, with higher scores indicating

a higher quality of life.[5,16] Depression was assessed by the 20-item Center for Epidemiological Studies Depression Scale,[20,37] with higher scores indicating higher levels of depression. Anxiety was measured by the 40-item State-Trait Anxiety Inventory, with higher scores indicating higher levels of anxiety.[30,49,50] Perceived stress was assessed by the 14-item Cohen Perceived Stress Scale, with higher scores indicating higher levels of stress.[9,31]

To control nonspecific treatment effects, outcome expectation was rated by all patients on a 5-point Likert-type scale ranging from 4 (expecting considerable pain relief) to 0 (expecting no pain relief) immediately after they had been informed of their randomly assigned treatment. Patients' global rating of the general effectiveness of the received intervention was additionally assessed by 5-point Likert-type scales at the end of the study.

Adverse effects were assessed by prespecified lists to be filled in by the study physician during the final study interview. Additionally, subjects were asked to keep a diary to record any adverse effects of their treatment as well as any use of oral rescue medication. Trained, blinded research assistants collected patient-reported data, and research personnel blinded to group allocation entered and monitored the data.

Sample Size Calculation and Statistical Analysis

Data from previous trials on neck pain and meditation were not available for sample size calculations. Based on 2 previous trials on yoga and neck pain[33] and qigong and neck pain,[39] with 1 trial using the same exercise program as in the present study,[33] we anticipated a group difference of –17 mm for pain at rest. The study thus 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% drop-out rate, we decided to include a minimum of 75 patients.

After recruitment of 50 patients, we had documented a clearly higher early drop-out rate than anticipated and decided to increase the sample size to at least 85 patients to ensure the statistical power.

All outcome criteria were analyzed by intention-to-treat, including all randomized subjects, irrespective of whether or not they adhered to the protocol or gave a full set of data. For each outcome we fitted a generalized estimating equation analysis of covariance that included a treatment group (binary covariate), the respective baseline value (linear covariate), the patient's expectation (linear covariate), 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 respective 95% confidence intervals (CIs) and *P* values. The generalized estimating equation technique considers the structure of missing values implicitly. Effect sizes were calculated with Hedges' g for the intention-to-treat population and the per protocol population.

Results

Telephone screening yielded 162 calls from subjects interested in study participation. One hundred ten participants were invited for further screening at the study site. A total of 89 subjects fulfilled all entry criteria and were enrolled in the study. Of these, 45 were randomly allocated to the meditation group and 44 to the exercise group and included in the intention-to-treat analysis (Fig 1). The dropout rate was higher than anticipated. Thirty-four (38%) subjects withdrew from the study over the 8-week period, resulting in completion of all measurements from 27 patients (40% dropouts) in the meditation group and 28 patients (36% dropouts) in the exercise group.

Eighteen subjects in the meditation group did not complete the study: 2 subjects withdrew consent before the first intervention (timetable problems), 15 participants did not further adhere to the study within the first 5 study weeks because of personal reasons or perceived lack of time and did not want to complete the postintervention assessment, and 1 subject withdrew because of health problems not related to the intervention (bursitis of shoulder joint).

Sixteen subjects in the control group did not complete the study: 3 subjects did not participate at all (unsatisfied with randomization result), 11 subjects withdrew because of lack of perceived benefit of study intervention, and 2 subjects withdrew because of health problems not related to the intervention (common cold).

Baseline Data

Subject's age mean age was 50, with the majority of study participants being female (Table 1). Mean duration of neck pain was about 11 years. Baseline characteristics were comparable in the 2 groups, with the exception of previous rehabilitation treatment (which did not affect results when adjusted Table 2).

Treatment outcome expectation was nearly balanced between the 2 groups (Table 1).

Outcome Measures

Fifty-eight percent of the meditation group attended at least 6 of the 8 meditation classes. The majority of participants did not practice meditation at home for the recommended amount of time. All participants in the exercise group reported having read the book. About 66% reported practicing the suggested neck pain exercise techniques at least several times a week.

Primary Outcome

The meditation program was more beneficial than the exercise program regarding the primary outcome, neck pain intensity at rest (VAS). Mean neck pain score was reduced from 45.5 $\pm$ 23.3 mm to 21.6 $\pm$ 17.2 mm at week 8 in the meditation group and from 43.8 $\pm$ 22.0 mm to 37.7 $\pm$ 21.5 mm in the exercise group, resulting in a significant group difference of 13.2 mm

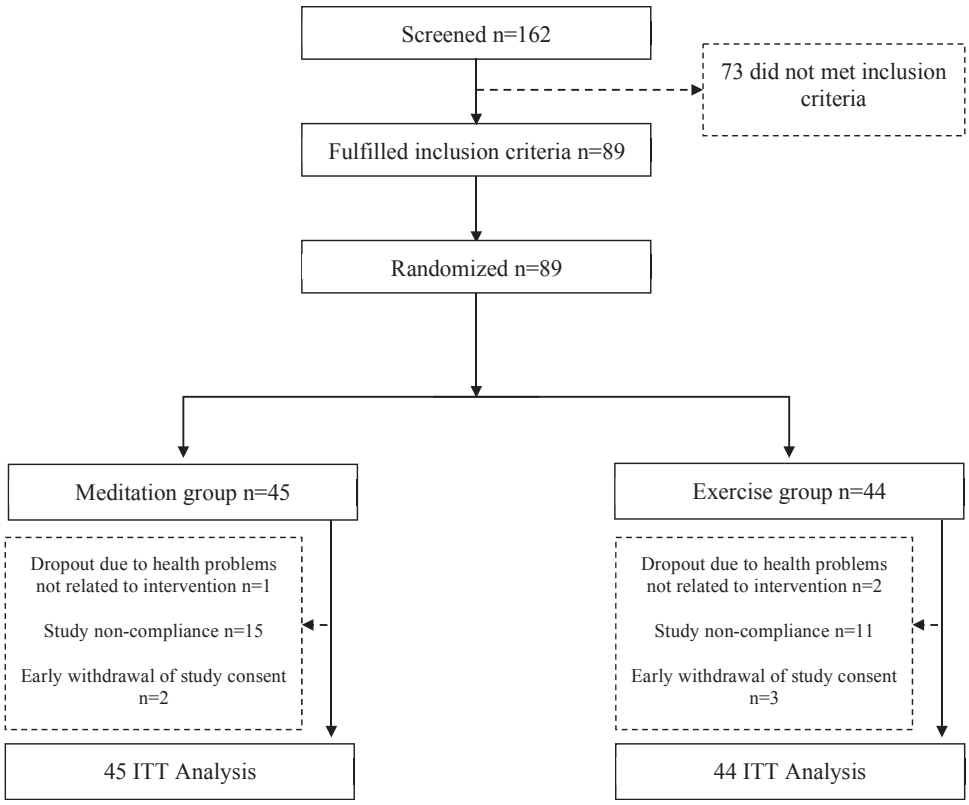

Figure 1. Trial flow chart. Abbreviation: ITT, intention-to-treat.

(95% CI: 2.1, 24.4; *P* = .02) (Fig 2) and an effect size Hedges' g of .58.

Secondary Outcomes

For pain at motion, no significant group difference was observed (mean difference 7.5 mm, 95% CI: –2.3, 17.3; *P* = .13). A significant group difference favoring meditation over exercise was documented for pain-related bothersomeness (mean difference 11 mm, 95% CI: 1.0, 21.0; *P* = .031) (Table 2). For the scores of the Cohen Perceived Stress Scale, State-Trait Anxiety Inventory, Center for Epidemiologic Studies Depression Scale, Medical Outcomes Study 36-Item Short Form, and Neck Pain and Disability Questionnaire we did not find any significant between-groups differences. There were only minimal reductions in both groups, although the meditation group consistently showed somewhat greater nonsignificant improvements compared to the control group (Table 2).

Additional Results

We analyzed effect sizes also for the per-protocol population. Here, effect sizes were slightly larger (pain at rest: Hedges' g = .66, *P* = .011; bothersomeness: Hedges g = .64, *P* = .007).

The use of rescue medication was twice as high in the control group compared to the meditation group; however, only 50% of subjects filled out the diary completely during the whole study period. The use of medication data should be interpreted with caution given the degree of missing data.

The global effectiveness of the intervention at the end of the study was rated as good or very good by 58% of subjects in the meditation group (32% moderate, 0% low or not at all) compared to 40% in the exercise group (36% moderate, 24% low or not at all).

Given the unexpectedly high dropout rate, we further compared completers with dropouts independent of group assignment with respect to their baseline demographic, clinical, and outcome values. This analysis revealed that completers had longer duration of pain compared to noncompleters (14.6 ± 9.6 years vs 9.1 ± 8.7; *P* = .01).

The mean practicing time amounted to 45 minutes per week in the exercise group and to 140 minutes per week in the meditation group.

Correlations

Correlations between variables were analyzed for intensity of pain at rest and the time that exercise/meditation was performed. In the meditation group, reduction in self-reported pain intensity was not correlated with practicing time (r = –.33, *P* = .15). For the exercise group, the correlation was even weaker (r = .19; *P* = .40).

Safety

There were no serious adverse events in either group. Two subjects reported an increase of an already existing tinnitus during the first weeks of meditation. One patient reported slightly increased dizziness and headache during the meditation classes. None of the patients in either group reported any other complaints directly related to the study interventions.

Table 1. Baseline Characteristics of Study Patients

Characteristics	Meditation (N = 45)	Exercise (N = 44)	P Value
General characteristics			
Age	49.6 ± 9.3	49.7 ± 11.2	.693
Sex (n)			
Female	38	35	.547
Male	7	9	
Employment status			
Working	64.4	65.9	.716
Unable to work	4.4	2.2	
Unemployed	11.1	13.6	
Retired	17.7	11.3	
Student	2.2	6.8	
BMI	24.3 ± 3.6	23.6 ± 3.6	.286
Previous rehabilitation	33.3	13.6	.029
Practicing any exercise	82.2	77.2	.566
Unable to work in the past 6 mo	55.5	68.1	
Neck pain characteristics			
Duration of neck pain (y)	12.4 ± 10	9.6 ± 8.8	.154
Frequent use of rescue medication for pain relief	55.5	54.5	.830
Pain at rest (VAS 100-mm)	45.5 ± 23.3	43.8 ± 22.0	.725
Pain at motion (VAS)	47.2 ± 20.8	46.9 ± 24.2	.986
Pain bothersomeness (VAS)	50.2 ± 21.2	50.4 ± 20.7	.888
Treatments previously used			
Physical therapy	77.7	72.7	.453
Injections	40.0	34.0	.564
Relaxation	22.2	29.5	.316
Spinal surgery	11.1	2.2	.096
Expected effectiveness			
Ineffective	2.2	2.2	.38
Less effective	31.1	38.6	
Effective	57.7	45.4	
Very effective	2.2	2.2	
Not specified	6.6	11.3	

Abbreviation: BMI, body mass index.
NOTE. Values are percentages or mean ± standard deviation, unless otherwise noted.

Discussion

To our knowledge, this is the first study that evaluated the effects of a meditation program in patients with chronic neck pain by means of a randomized controlled trial.

The results of our study were surprising because on the one hand, there were significant and clinically relevant group differences for pain at rest, the primary outcome, and pain-related bothersomeness. On the other hand, no significant differences were found for more functional and psychological outcomes such as pain at motion, function and disability, stress, psychological well-being, and quality of life. For these outcomes, the meditation group showed only nonsignificant greater improvements compared to the exercise group.

According to the Initiative on Methods, Measurement, and Pain Assessment in Clinical Trials (IMMPACT) consensus statement, pre- and posttreatment differences of >50% using a VAS are associated with patient ratings of "very much improved" or "substantially" improved.[13] In this trial, mean pain at rest decreased by 52% (within-group difference) and 39% (between-groups difference), with the latter decrease reflecting a moderately important difference.

The documented benefits of meditation are not attributable to baseline differences in prognostic factors or outcome expectation, as the analyses were adjusted for these factors. However, factors such as attention time and the group setting favored the meditation group and may have introduced a bias due to nonspecific effects. The study population was comparable overall to those in trials with chronic neck pain[12,33,39,40,46] with regard to sociodemographic characteristics but was slightly more distressed and psychologically distressed.

Possible explanations for the mismatch between pain and the other outcomes include a too-short intervention period, as functional and quality of life outcomes may need longer intervention times in chronic pain patients to show improvement. Another reason for selective pain reduction might be in the mechanism of meditation-induced effects. Neuromodulatory interventions such as meditation may predominantly modify cortical structures and processes involved in attention, emotional responding, and pain.[24]

We are not aware of other existing randomized trials examining the effects of meditation on chronic neck pain patients. A recent randomized trial that investigated the effects of MBSR on fibromyalgia patients found no significant group differences in pain, mood, stress, depression, and anxiety compared to active controls[42]; in addition, a meta-analysis described small to moderate effects.[29] A recent systematic review on MBSR on lower back pain found 3 randomized trials with a total of 117 included patients. Results showed only inconclusive evidence of pain reduction through mindfulness meditation but limited evidence of improved pain acceptance.[10] Two of these studies investigated low back pain in community-dwelling older adults (>65 years). The first study compared 37 patients practicing mindfulness meditation to a wait list control group, and modest but significant improvements in pain acceptance were observed.[34] In the second study with 40 patients, mindfulness meditation was compared to a health education program.[35] No significant differences were found between the 2 groups.

Wong et al conducted a randomized controlled trial on 99 community-dwelling older adults to compare the effects of mindfulness meditation with a multidisciplinary intervention group on chronic pain.[53] This trial found that participants of both groups had improved perceptions of pain intensity and pain-related distress, with no statistically significant difference between groups 6 months after intervention. Also, for mood anxiety and depression, mindfulness meditation was not more beneficial than the control intervention. The authors argued that the mindfulness meditation group failed to practice regularly, and that the therapists had

Table 2. Means ± SDs (Unadjusted Values) for All Outcome Parameters With Mean Group Differences and 95% CIs for Change on Treatment (Baseline Adjusted Values)

Outcomes	*Baseline*	*Week 4*	*Week 8*
Pain at rest (VAS 0–100)			
Meditation (mean ± SD)	45.5 ± 23.3	32.4 ± 16.8	21.6 ± 17.2
Exercise (mean ± SD)	43.8 ± 22.0	38.1 ± 20.3	37.7 ± 21.5
Group difference (95% CI); *P* value		5.3 (–4.2, 14.8); .272	13.2 (2.1, 24.4); .020
Effect size (Hedges' g)		.23	.58
Pain at motion (VAS 0–100)			
Meditation (mean ± SD)	47.2 ± 20.8	36.8 ± 19.1	25.4 ± 18.9
Exercise (mean ± SD)	46.9 ± 24.2	40.4 ± 19.3	35.6 ± 22.0
Group difference (95% CI); *P* value		2.1 (–7.1, 11.3); .649	7.5 (–2.3, 17.3); .133
Effect size (Hedges' g)		.09	.33
Bothersomeness (VAS 0–100)			
Meditation (mean ± SD)	50.2 ± 21.2	34.2 ± 18.1	22.7 ± 18.2
Exercise (mean ± SD)	50.4 ± 20.7	42.6 ± 18.0	35.6 ± 21.5
Group difference (95% CI); *P* value		6.9 (–2.2, 16.0); .137	11 (1.0, 21.0); .031
Effect size (Hedges' g)		.33	.52
NPAD score (0–200)			
Meditation (mean ± SD)	83.9 ± 33.4	69.0 ± 31.6	63.4 ± 33.0
Exercise (mean ± SD)	86.4 ± 33.6	77.6 ± 38.5	67.6 ± 34.8
Group difference (95% CI); *P* value		.7 (–14.9, 16.4); .926	.4 (–14.4, 15.2); .96
Effect size (Hedges' g)		.02	.01
CPS Score (0–56)			
Meditation (mean ± SD)	30.3 ± 8.2	28.2 ± 8.8	25.2 ± 8.1
Exercise (mean ± SD)	31.6 ± 7.7	30.5 ± 7.5	27.8 ± 8.0
Group difference (95% CI); *P* value		.5 (–4.4, 5.4); .849	1.3 (–2.0, 4.7); .438
Effect size (Hedges' g)		.06	.16
SF-36 Mental Component Score (0–60)			
Meditation (mean ± SD)	41.1 ± 10.7	44.5 ± 7.9	45.6 ± 9.4
Exercise (mean ± SD)	36.7 ± 13.1	40.7 ± 11.8	43.2 ± 10.9
Group difference (95% CI); *P* value		–3.3 (–8.5, 1.8); .20	–1.9 (–7.0, 3.3); .476
Effect size (Hedges' g)		.28	.16
SF-36 Physical Component Score (0–60)			
Meditation (mean ± SD)	40.1 ± 8.5	43.2 ± 9.2	43.8 ± 8.8
Exercise (mean ± SD)	43.3 ± 7.6	42.6 ± 7.0	45.3 ± 7.2
Group difference (95% CI); *P* value		–1.8 (–5.6, 2.1); .364	–.4 (–4.2, 3.5); .85
Effect size (Hedges' g)		.22	.04
Depression CES-D (0–60)			
Meditation (mean ± SD)	18.0 ± 8.9	15.1 ± 7.4	14.2 ± 9.0
Exercise (mean ± SD)	19.3 ± 8.3	18.2 ± 10.9	16.8 ± 9.8
Group difference (95% CI); *P* value		1.2 (–3.9, 6.3); .647	.5 (–3.6, 4.7); .803
Effect size (Hedges' g)		.14	.06
State Anxiety STAI (20–80)			
Meditation (mean ± SD)	45.7 ± 11.0	44.1 ± 9.4	41.9 ± 10.9
Exercise (mean ± SD)	48.3 ± 12.8	47.8 ± 14.8	45.9 ± 11.5
Group difference (95% CI); *P* value		2.2 (–4.6, 9.0); .526	2.3 (–3.4, 8.0); .436
Effect size (Hedges' g)		.18	.19
Trait Anxiety STAI (20–80)			
Meditation (mean ± SD)	46.9 ± 9.8	46.5 ± 7.5	42.5 ± 9.8
Exercise (mean ± SD)	48.5 ± 11.1	46.7 ± 13.9	44.9 ± 10.0
Group difference (95% CI); *P* value		–1.7 (–7.5, 4.2); –.572	.4 (–4.0, 4.8); .848
Effect size (Hedges' g)		.16	.04

Abbreviations: SDs, standard deviations; NPAD, Neck Pain and Disability Index; CPS, Cohen Perceived Stress Scale; SF-36, 36-Item Short Form Health Survey; CES-D, Center for Epidemiologic Studies Depression Scale; STAI, State-Trait Anxiety Inventory.

limited experience in treating chronic pain patients. Finally, a recent meta-analysis on meditation and distress showed that mindfulness meditation programs had moderate evidence of improving anxiety and depression and low evidence of improving distress and mental health–related quality of life.[18] Furthermore, the authors found no evidence that meditation programs were better than any active treatment (ie, exercise and other behavioral therapies).

Our study has several limitations, including an observation period of only 8 weeks with no long-term follow-up and a higher than expected attrition rate in both groups. The main limitations are that the time spent in meditation intervention was not matched to the exercise group

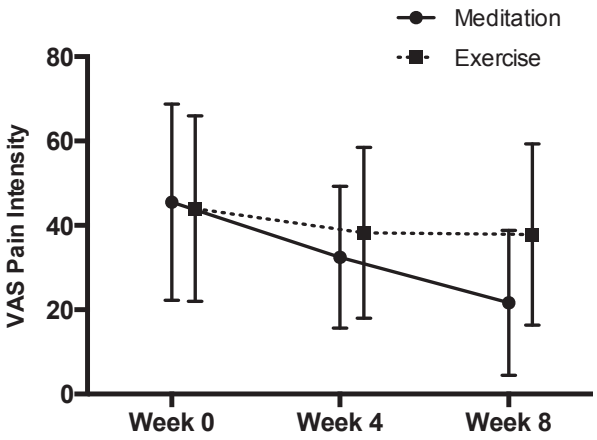

Figure 2. Change of pain at rest (VAS 0–100; primary outcome) for the 2 study groups at 4 and 8 weeks.

time; that an instructor facilitated the meditation intervention weekly, whereas the control group was left to administer exercise on their own; and that there was some social support in the meditation group only. Thus, it is possible that the better outcomes of the meditation group are at least partly attributable to the effects of attention and social support. Furthermore, the didactic component how to handle pain in relation to meditation may have contributed to the treatment effect. However, the documented effect size of meditation on pain intensity seems to be rather large, whereas nonspecific effects of chronic neck pain do not normally exceed the small to medium range.[52] Generally, subjective outcomes may be influenced by the wish of the participants to please the investigator. However, the general effectiveness ratings and the interviews at the end of the study confirmed the results on pain relief.

Furthermore, the high dropout rate is an important limitation of our study and may have biased the results. A further analysis revealed 1 significant difference between completers and dropouts: dropouts had neck pain for an average of 5 years longer than those who completed the study. In telephone interviews, the majority of dropout patients reported being stressed and having an unexpected lack of time; however, we found no difference in the perceived stress score in dropouts versus completers. The high drop-out rate may also indicate that the chosen meditation intervention is not acceptable to all patients. Furthermore, for both groups, the high attrition may indicate that patients' expectations were not met. However, the higher than expected number of participant dropouts as well as the lower than expected adherence with practice time in both groups may also reflect the generally limited motivation of chronic pain patients in maintaining self-efficient activities. A minor limitation is related to the mailing of the questionnaires to the subjects, as the nonstandardized setting where patients filled out the questionnaire could account for changes across subjects. Furthermore, adherence was only checked by interview.

Strengths of our study include the rigorous randomization procedure, our use of recommended and validated assessment tools and outcome measures, well-defined inclusion and exclusion criteria, and an active control group practicing exercise as an evidence-based intervention.

Most participants rated the effectiveness of meditation as "good" and it was also well tolerated. There were only a few minor adverse events, which might be associated with the relaxation response. Meditation as a therapeutic method can be regarded as safe. Adherence to the recommended daily meditation practice time was moderate. Our results may have been affected by the extent of subjects' adherence to recommended practice.

In contrast to the mindfulness meditation and MBSR, recently evaluated for a number of indications, the jyoti meditation program used in this trial lasted only 75 to 90 minutes weekly. This seemed to be acceptable for most subjects. However, the practice time may not have been long enough to induce sustainable effects. Furthermore, our course did not offer a retreat or additional exercise such as yoga or body scan techniques that are commonly used in mindfulness programs. It is unclear whether a different meditation style would have produced similar benefits. Most likely, the practice of jyoti meditation may reduce rumination and distraction; the induced relaxation response may further reduce stress-related muscle tension and modify the neurobiological pain perception. Furthermore, jyoti meditation is a nonsecular technique, and the potential use of spiritual terms within the mantra may be associated with nonspecific effects. In contrast, mindfulness programs are secular and have a strong impact on developing a mindful and acceptance attitude and applying this to any experience and disease conditions. This might explain the frequently found smaller effects on pain scores but stronger effects on psychological outcomes with mindfulness programs, whereas we found an opposite pattern in the present trial. The failure of the meditation-induced pain relief to translate into improvements in other domains may be also explained by the unimodal nature of the intervention. Patients were not asked to apply their meditation strategies to daily life stressors, nor were other functional and cognitive pain management strategies addressed that might have facilitated reducing disability or improving their mood. Thus, it might be of interest to include jyoti meditation within the context of a multimodal intervention or a more comprehensive approach.

In conclusion, this study suggests that meditation might be an effective treatment for reducing chronic neck pain and pain-related bothersomeness while not affecting function, disability, and psychological outcomes. Further well-designed studies on meditation in chronic neck and back pain are needed and should include longer intervention and follow-up periods, more active controls, and matched attention time.

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