Mindfulness-Based Stress Reduction in the Management of Chronic Pain and Its Comorbid Depression

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Context: Chronic pain (CP) is a common and serious medical condition, with an estimated 100 million people affected in the United States. In the 1990s, opioids were increasingly prescribed to manage chronic pain, and this practice contributed to the opioid epidemic of the 21st century. To combat this epidemic, multidisciplinary approaches to chronic pain management are being researched and implemented.

Objective: To evaluate the clinical effectiveness of an 8-week mindfulness-based stress reduction (MBSR) course implemented in a semi-rural population with chronic pain.

Methods: Participants were recruited from a community-based teaching hospital in Corvallis, Oregon, for a pre-post study. Participants aged 34 to 77 years who reported having chronic pain lasting for at least 1 year before enrollment were included. Participants took an 8-week group MBSR course in 2.5-hour weekly sessions taught by an experienced MBSR instructor. Techniques were self-practiced between sessions with a goal of 30 minutes per day, 6 days per week. Pre- and post-survey measurements of pain, depression, and functional capacity were taken via online surveys using the patient health questionnaire (PHQ-9), the Pain Catastrophizing Scale (PCS), and a shortened version of the Modified Oswestry Disability Index (MO). Participants were asked about their satisfaction with the program content, instructor, timing, and location.

Results: Twenty-eight participants were included in the study. Paired *t* tests found significant improvements in PHQ-9, PCS, and MO percent scores from before to after the course. PHQ-9 scores decreased by a mean of 3.7 points (95% CI, -5.5, -1.8), PCS scores decreased by a mean of 4.6 points (95% CI: -7.2, -2.0), and MO percent score decreased by a mean of 9.4% (95% CI: -14.2%, -4.6%). Results showed an overall downward shift in the distribution of depression, disability, and pain scores after the course.

Conclusions: MBSR classes were found to benefit participants with chronic pain and depression in this setting, fostering significant improvement in participant perceptions of pain, mood, and functional capacity.

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Chronic pain (CP) is a common and serious medical condition, with an estimated 100 million people affected in the United States, correlating with annual costs of approximately \$635 billion.¹ In the 1990s, the medical community responded to the growing concern about chronic pain by increasing prescriptions for opioid pharmacotherapy, which was an additive factor leading to the current opioid crisis.² The Centers for Disease Control and Prevention has since recognized the danger of overprescribing opiates and has taken a firm stance that opioids should not be considered first-line or routine therapy for CP.³ This stance has inspired new efforts to take a multidisciplinary approach to the management of chronic pain and to explore nonpharmacologic treatment strategies for people with chronic pain.⁴

Mindfulness-based stress reduction (MBSR) is one such strategy, originally designed in the 1970s by Jon Kabat-Zinn, PhD, for patients with chronic pain (**eAppendix**).⁵ MBSR is a systematic educational program based on training people to have an awareness of the self in the present moment and a nonjudgmental manner through the intensive instruction of mindfulness meditation and mindful hatha yoga during an 8-week period.⁶ This technique has demonstrated measurable and long-lasting improvements in medical and psychologic well-being for various conditions including pain, depression, addiction, and anxiety.⁷⁻⁹ A review of 10 controlled trials^{1,6-14} noted that the effect of MBSR was better than passive controls but about as well as active control groups. However, these studies^{1,6-14} were limited by small sample size and heterogeneity. One study⁹ has been published comparing MBSR with other nonpharmacologic interventions that are structurally similar but do not involve mindfulness. Physiologic effects of MBSR have been seen in the regions of attention control, emotion regulation, and self-awareness through the use of functional magnetic resonance imaging.¹⁵⁻¹⁷ MBSR has also been shown to be effective in clinical scenarios relating to attention, depression, anxiety, stress, and addiction.¹⁰ MBSR has been shown to reduce pain effectively in a variety of

studies and clinical scenarios, including lower back, upper back, shoulder, and cervical pain, as well as headaches and fibromyalgia.^{11,12,14}

This study aimed to explore the benefits of an 8-week course on MBSR and assess whether it could successfully foster reductions in depression and pain symptoms as well as improvements in functional capacity for a semi-rural population with chronic pain in Oregon where there are issues of affordability and access to adjunctive treatment modalities.¹³ This study addresses pain, depression, anxiety, and stress reduction in semi-rural populations in a way that is economical and provides autonomous and flexible management options.

Methods

Participants

This study was approved by the regional institutional review board. Participants were recruited from a community-based teaching hospital through physician referral, advertising at local clinics, and word of mouth. The study was open to eligible participants who reported having chronic pain lasting for at least 1 year. Individuals were excluded if they were younger than 18 years or had pain related to cancer, terminal illness, surgery, or fractures. The study's goal was to assess adults with long-term pain deemed amenable to alternative pain management methods that were not transient, end-stage, or definitively required opioids. Accepted medical diagnoses for self-reported chronic pain included fibromyalgia, chronic back pain, chronic headache, osteoarthritis, chronic pain syndrome, and somatic pain. Participants were offered a \$50 gift card for participating in the study as compensation for their time and travel expenses.

Design

This study included 2 cohorts of MBSR classes, both of which met once per week for 2.5 hours for 8 weeks. The first cohort had 19 participants who completed the course in the fall of 2017, and the second cohort had 9

participants who completed the course in the spring of 2018. Both cohorts were combined for this study. The course material was based on the University of Massachusetts Mindfulness-Based Practice protocol.^{5,6} Our protocol was modified to reduce the length of classes by removing the all-day class but included all 8 original classes of the program to allow more people to participate in the entirety of the study.^{5,6} Course topics focused on MBSR and were presented in a graduated weekly fashion that included a didactic and practical portion (Figure 1). The class instructor had 7 years of experience leading meditation and mindfulness courses.

Data were collected via electronic surveys 1 week before the first class session and 1 week after the final class session. The presurveys included a demographic questionnaire, the Patient Health Questionnaire (PHQ-9)¹⁸ to measure depression, the Pain Catastrophizing Scale (PCS)¹⁹ to measure pain perception, and a shortened version of the Modified Oswestry Disability Index (MO)²⁰ to measure disability. The postsurvey included the PHQ-9, PCS, MO, and a course evaluation questionnaire to measure participant satisfaction with the class location, timing, instructor, and content understandability and applicability. These study instruments were chosen based on ease of administration, reproducibility to other studies, and conjugate markers of the overall effect. Other surveys, such as the General Anxiety Disorder-7, were not used to prevent survey fatigue. The PHQ-9, PCS, and MO surveys were better markers of our direct question concerning management of chronic pain, depression, and functional status than other surveys.

Outcome Measures

PHQ-9 and PCS scores were calculated using published guidelines.^{18,19} The PHQ-9 has 9 questions and scores can range from 0 to 27, with higher scores indicating higher depression.¹⁸ The PCS has 13 questions and scores range from 0 to 52, with higher scores indicating higher pain.¹⁹ The original MO contains 10 questions,

Week 1:	Mindfulness of the body using body scan meditation including physical sensations (see eAppendix for more details).
Week 2:	Mindfulness of breathing using seated meditation as the foundation to observe the physical sensation of the breath.
Week 3:	Mindfulness of the body with movement including gentle yoga and stretches.
Week 4:	Mindfulness of the breath and body together, including formal introduction of noticing unpleasant phenomena like stress/pain and their manifestations in the body.
Week 5:	Mindfulness of sounds and thought with additional teaching on noticing thoughts, sensations associated with stress/pain.
Week 6:	Mindfulness of speech and communication, including specifically exploring how stress and somatic pain affect the way we communicate.
Week 7:	Loving kindness meditation to develop kindness, acceptance, compassion to complement and support mindfulness.
Week 8:	Loving kindness and mindfulness explored together to support and develop a personally tailored meditation practice by each participant.

Figure 1.

Mindfulness-based stress reduction (MBSR) curriculum by week. Course topics focused on MBSR and were presented in a graduated weekly fashion that included a didactic and practical portion.

but to reduce the burden for participants, this study only included 5 questions that covered pain intensity, self-care, sleeping, social life, and employment/home-making.²⁰ MO percent scores were calculated using published guidelines, but the total possible score was adjusted from 50 to 25.²⁰ MO percent scores range from 0% to 100%, with higher scores indicating higher functional disability.²⁰

Statistical Analysis

Participants who completed both the pre- and postsurvey and who attended at least 6 out of the 8 weekly sessions were included in the analysis. Scores had normal distribution (assessed using the Anderson–Darling test) and equal variance across groups (assessed with Levene test). Paired *t* tests were used to compare PHQ-9, PCS, and MO percent scores from before the MBSR course to after.^{18–20} Boxplots were created to visualize the distribution of scores

before and after the course. This analysis was adequately powered (80%) to detect a medium effect size (Cohen $d=0.55$) at α level of .05. Descriptive statistics were used to summarize participant satisfaction and experience. The software R version 3.5.1 (CRAN) was used for analysis.

Results

Of the original participants (N=38), 5 never attended a class and were excluded. An additional 5 participants were excluded because they missed more than 3 out of 8 classes ($n=4$) or had missing survey data ($n=1$). Therefore, 28 participants were included in the analysis (Table 1). Participants were predominantly women (21 [75%]), white (24 [86%]), college graduates (21 [75%]), and currently retired (17 [61%]) with a mean age of 59 years. Paired t tests found significant improvements in PHQ-9 (Cohen $d=0.77$), PCS (Cohen $d=0.68$), and MO (Cohen $d=0.76$) percent scores from before to after the course (Table 2). PHQ-9 scores decreased by 3.7 points (95% CI, -5.5 , -1.8), PCS scores decreased by 4.6 points (95% CI, -7.2 , -2.0), and MO percent score decreased by 9.4% (95% CI, -14.2% , -4.6%). Boxplots showed an overall downward shift in the distribution of scores from before to after the course (Figure 2).

All participants agreed that the class instructor was knowledgeable and that the information on mindfulness was presented in a clear and easy to follow manner. Fifteen respondents (50%) agreed that the information on chronic pain was clear and easy to follow, 11 were neutral (32%) and 7 disagreed (18%). Twenty-nine respondents (89%) felt the information on movement was clear and easy to follow, 2 (7%) were neutral, and 2 (4%) disagreed. Twenty-one respondents (64%) agreed that this program helped them better understand their pain, 10 (29%) were neutral, 2 (7%) disagreed. Most (29; 89%) respondents agreed that this program helped them find ways to better cope with their pain (4 [11%] were neutral).

Table 1.
Demographic Characteristics of Participants Who Completed a Mindfulness-Based Stress Reduction Course to Manage Chronic Pain (N=28)

Demographics	n ^a
Gender	
Men	6 (21)
Women	21 (75)
Other or prefer not to answer	1 (4)
Race/ethnicity	
Not Hispanic or Latino	27 (96)
Hispanic or Latino	1 (4)
White or Caucasian	24 (86)
Asian or Asian-American	2 (7)
American Indian or Alaska Native & White or Caucasian	1 (4)
Mixed Race	1 (4)
Highest education	
Some elementary, middle, or high school	1 (4)
High school graduate or GED	1 (4)
Some college or trade/technical school	5 (18)
College graduate or more	21 (75)
Employment status	
Full-time	3 (11)
Part-time	2 (7)
Not employed	6 (21)
Retired	17 (61)
Age,^b mean	59

^a Data given as No. (%) unless otherwise specified.

^b Minimum age 34 years, maximum age 77 years.

Abbreviation: GED, general education development.

Discussion

This study examined the combined benefit of MBSR on patients with chronic pain and depression. As osteopathic physicians, we understand the crucial importance of treating the entire patient; the first tenet of osteopathic medicine is that a person is a unit of body,

Table 2.
Changes in Outcome Measures From Pre- to Postcourse After Participation Mindfulness-Based Stressed Reduction Course From Paired T Tests, (N=28)

Outcome Measure Scores	Precourse, Mean (SD)	Postcourse, Mean (SD)	Mean Change	95% CI for Change	P value	Effect Size (Cohen d)
PHQ-9	8.1 (4.9)	4.4 (4.2)	−3.7	(−5.5, −1.8)	<.001	0.77
PCS	12.6 (7.2)	8.0 (8.5)	−4.6	(−7.2, −2.0)	.001	0.68
MO, %	26.3 (16.9)	16.9 (16.5)	−9.4	(−14.2, −4.6)	<.001	0.76

Abbreviations: MO, Modified Oswestry Disability Index; PCS, Pain Catastrophizing Scale; PHQ-9, Patient Health Questionnaire.

mind, and spirit.²¹ Our study suggests that there may be a benefit to MBSR to reduce self-reported pain and depression, which addresses the whole patient.

Compared with other studies,^{1,8-13} our results found similar outcomes, though we had a small number of participants. This finding helps expound on the current literature and suggests that mindfulness improves depression in those with chronic pain, which is a topic lacking in the literature.

The present study has several strengths, including common and well-validated diagnostic and assessment tools, which allows easy comparisons with existing literature. The use of a standardized MBSR curriculum helped ensure consistency in exposure to MBSR and this study's reproducibility. We have taken these results along with those from other studies to develop programs throughout the Samaritan Health Services of Lincoln, Benton, and Linn counties in Oregon. These programs offer 6 to 8 week MBSR courses in the primary care clinics and the mental health clinics to help manage chronic pain, chronic illness, and mental and behavioral health concerns as additional tools for management. MBSR has been very well received and offered alternatives to common illnesses traditionally managed with medications and other modalities.

Our study had several limitations. Selection bias was likely present in our cohort as participants with chronic pain self-selected to participate in the study. They also had to be available for weekday, daytime gatherings, which suggests that they had limited work schedules

and may have been more likely to have severe work-limiting chronic pain. Additionally, the MBSR course's effect might be influenced by the social support aspect of the group class sessions. Response bias could have been present if participants exaggerated their symptom improvement to show their support for the instructor or the course. Furthermore, there was no control group to compare with, and the single instructor was not blinded to participants' status. The sample size was small, and several participants dropped out or chose not to participate after enrolling. Finally, there was a potential for bias derived from the token payments throughout the program.

To reproduce this 8-week course on MBSR, course facilitators must be trained in teaching meditation and familiar with the standardized MBSR curriculum developed by Jon Kabat-Zinn, PhD.⁵ A quiet location with an environment conducive for meditation and free of visual and auditory interruptions is ideal for participants to successfully complete the 8-week course. Finally, research participants meeting inclusion criteria who are willing to participate can be referred by their health care providers to established MBSR courses as adjuvant therapy for chronic pain.

Future studies should recruit a larger study population with more homogeneity in the population groups. Future work should have active and passive control groups, which would require a significant outlay of resources and a population pool large enough to support recruitment efforts.

Figure 2. Boxplots of mean (A) PHQ-9, (B) PCS, and (C) MO survey scores show an overall downward shift in the distribution of scores between pre- to postsurvey scores from participants in a mindfulness-based stress reduction course. *Abbreviations:* PCS, Pain Catastrophizing Scale; PHQ-9, Patient Health Questionnaire-9; MO, modified Oswestry.

Conclusions

This study suggests that MBSR classes benefitted participants with chronic pain and depression in a small, group-class setting and fostered significant improvement in participant perceptions of pain, depression, and functional capacity. This study bolsters current evidence that MBSR can be a useful adjunctive treatment for chronic pain while improving perceived depression. MBSR can be used in conjunction with pharmacologic and interventional methods to treat pain of chronic medical conditions. In this era of high prevalence of chronic pain disorders, MBSR may be a viable modality for treating patients without the use of pharmacotherapy.

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Author Contributions

Drs Marske, Shah, Chavira, Hedburg, and Kaiser and Ms Pipitone provided substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data; Drs Marske, Shah, Chavira, Hedburg, Fulmer, and Mr Clark drafted the article or revised it critically for important intellectual content; all authors gave final approval of the version of the article to be published; and all authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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