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Elizabeth Cruze

Indiana State University, femalebeliever@yahoo.com

Kenneth E. Games

Indiana State University, kenneth.games@indstate.edu

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Mindfulness Training's Effect of Pain Outcomes in Musculoskeletal Pain: A Systematic Review

Elizabeth Cruze DAT, LAT, ATC; Kenneth E. Games PhD, LAT, ATC
Indiana State University

Purpose: Athletic trainers frequently address and treat musculoskeletal pain (MSK). Complementary and alternative techniques for treating pain are becoming more widely accepted and utilized in clinical practice. Mindfulness based stress reduction (MBSR) is a meditation-based program that is designed to help patients learn to feel things in a non-judgmental way. Previous systematic reviews on mindfulness training have focused a range of conditions including IBS, fibromyalgia, and migraines. The purpose of this systematic review was to examine if the literature supports the use of MBSR as an intervention for MSK pain. **Methods:** We completed a systematic review utilizing PRISMA guidelines. Inclusion criteria were English language, human subjects, peer reviewed, randomized controlled trial, mindfulness training as an intervention, and MSK pain as an outcome measure. An electronic search was conducted using the single phrase “mindfulness training and musculoskeletal pain”. PubMed, Cochran Database, EBSCOhost, and Google Scholar were searched. Articles were first eliminated by title, and then by abstract contents. Remaining articles were given a full review and articles not meeting inclusion criteria were eliminated. Articles were assessed using the PEDRO scale with a cutoff score of 6 used to determine inclusion in the systematic review. Final analysis included 19 articles. **Results:** Study populations included patients diagnosed with cancer, nonspecific low back pain, chronic MSK pain, chronic tension headache, Gulf War illness, upper extremity injury, and one study employed healthy subjects and used experimentally induced pain. Intervention lengths ranged from single day to 10 weeks. Of the 19 studies in the analysis, nine of them indicated statistically significant results in favor of the meditation group for pain outcomes. Other studies noted improvement in the meditation group, but results did not reach statistically significant levels. **Conclusion:** MBSR has the potential to provide a beneficial effect in the treatment of MSK pain. The results of this systematic review indicate that the benefits of MBSR treatment may depend on the specific patient population and type of MSK pain. Further research is needed, but the systematic review suggests that MBSR may be an effective tool as part of a larger, complementary, and patient-centered care plan. **Key Words:** *complementary health, therapeutic intervention, pain management*

INTRODUCTION

Athletic trainers play a key role in returning athletes to competition following an injury.¹ There are many different modalities and manual therapy techniques that are used by healthcare providers to help patients reduce their pain.² However, psychological interventions are another potential modality to help patients achieve their goals.¹ Athletic trainers are in a position to educate the patients they treat on the benefits and uses of various psychological methods to improve recovery and reduce pain.¹ Mindfulness training is an effective method for pain reduction, especially for chronic pain.^{3,4,5}

Mindfulness training is not commonly used in athletic training but could be a beneficial treatment for the patients that athletic trainers treat.

Mindfulness can be defined as “a mental state that can be achieved by focusing one’s conscious awareness purposefully and non-judgmentally to the unfolding of the moment by moment experience”.⁴ The goal is to be able to separate the emotions connected with pain from the pain itself. If an individual can work to accept the pain, then their tolerance for the pain will increase, even if the overall intensity of the pain is not decreased.⁴ Having this

mindset can help patients cope with their own pain, especially chronic pain.⁵

For some individuals with chronic pain, there may be no cure, but if athletic trainers can help people live better with pain and improve their overall life, then progress has been made.⁶ Although the scope of this research focuses on pain intensity, pain catastrophizing and pain interference are also important aspects of pain. Pain catastrophizing and pain interference refer to the way in which pain affects someone's emotional and mental well-being. When treating a patient, it is important to focus on the whole patient, not just the physical aspect. Addressing pain from an emotional and mental standpoint is just as important as the physical aspect.⁷ Athletic trainers commonly treat pain, both acute and chronic. Since athletic trainers are commonly treating painful conditions, they are in a position to help patients manage their pain. Many athletic trainers work with younger physically active populations, including adolescent athletes.¹⁰ A 2018 salary survey by the National Athletic Trainers Association showed that 25% of all athletic trainers surveyed worked with high school or middle school athletes.⁹ This puts athletic trainers in a position to be able to address chronic pain preventatively and to help patients implement strategies to manage pain for a lifetime, not just for the present injury. As adults, the patients may not have access to an athletic trainer that would be free to them, so if pain management strategies are implemented at a young age, then athletic trainers can set the patient up to better handle any chronic pain that may come in the future.

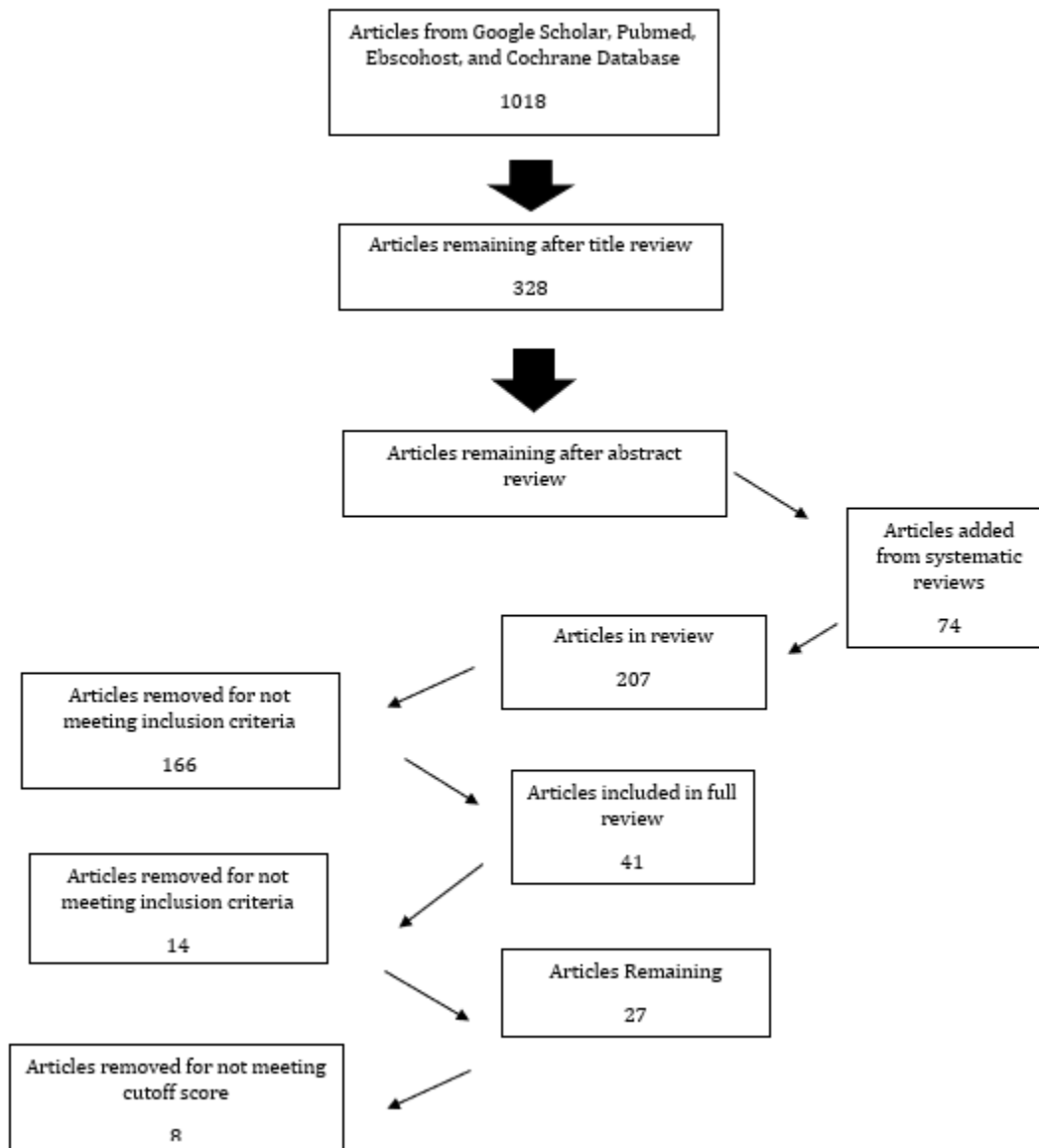
A recent study showed that mindfulness training can be a cost-effective way of treating chronic low back pain.⁷ Mindfulness training was also shown to be effective at reducing acute pain in experimentally induced pain settings.⁸ A variety of studies and systematic reviews have examined the potential benefits of mindfulness training.^{5,11,12} Much of this

research has examined the mental health benefits of mindfulness training, such as reducing symptoms of anxiety, depression, and stress.^{1,3} Studies that have examined mindfulness training for treating pain have focused primarily on chronic pain patients as their primary population.^{5,11,12} Systematic reviews are a critical step in the development of future studies to evaluate the effectiveness of mindfulness-based training.⁵ Although many previous systematic reviews have examined mindfulness training, there is little evidence of what effect mindfulness training has on musculoskeletal pain specifically. This review will specifically examine pain that is musculoskeletal in nature. Other types of bodily pain, such as neurological or psychosomatic will not be reviewed as previous systematic reviews have examined those conditions.¹³

METHODS

A database search was conducted using Google Scholar, Pubmed, Cochrane, and Ebscohost. The search terms were "mindfulness training" and "musculoskeletal pain". The initial search resulted in 1018 articles, which was narrowed to 328 articles following a review of titles, and further narrowed to 133 articles after reviewing the article abstracts. Systematic reviews were examined for additional sources which resulted in an additional 74 articles. After removing 166 articles due to not meeting the inclusion criteria, there were 41 articles. After a full review, there were 27 articles as 14 articles were removed for not meeting inclusion criteria. Each article was examined for quality using the Physiotherapy Evidence Database (PEDro) scale.¹⁴ A cutoff score of 6 of 11 was used for analysis. Those articles falling below the cutoff score were deemed to be of fair or low quality.¹⁴ The article would also classify a score of 6 as being fair, but it was decided to include those articles as a score of 6 would be at least 50%. Eight articles were removed from analysis for falling below 6.

Nineteen articles remained for final analysis.
Figure 1 shows this process.



Inclusion/Exclusion Criteria

Articles were selected based upon the following criteria: English language, human subjects, peer reviewed, randomized controlled trial, mindfulness training as an intervention, and musculoskeletal pain as an outcome measure. We chose to only include English language articles to avoid any translation errors. We chose to examine musculoskeletal pain as that is a primary patient complaint for athletic trainers. We

decided not to limit the type of mindfulness training as the type was not as important as the overall concept of doing mindfulness training. We also did not limit the platform in which the training was delivered, so long as mindfulness training was the intervention that was used. Mindfulness training could also be used in conjunction with other interventions. We did not exclude articles based upon the disease that was treated. The only requirement was that the study

examined some type of musculoskeletal pain. The different populations treated were extracted for data analysis.

Methodological Quality

Each article was scored using the PEDro Scale.¹⁴ The scale is composed of 11 items. Each item is scored as either a “yes” or “no”. The article must clearly articulate an item to receive a yes. If the article did not meet the criteria or did not mention it in the article, they were not given a point.

Data Extraction:

The data that was extracted for analysis included PEDro score, study population, study count, study interventions, study length, outcomes measured, and overall results. Data was collected and stored in an excel file.

RESULTS

The average PEDro score for the articles was 7. In all included studies, there were a total of 2283 patients with an average of 120 patients per trial. The characteristics of the studies are detailed in Table 1.

Study populations included cancer, chronic low back pain, upper extremity injuries, chronic musculoskeletal pain, chronic tension headache, Gulf War Illness, and healthy subjects.¹⁵⁻³³ The two cancer studies included were on breast cancer patients specifically. The reason these were included is because breast cancer in particular can cause musculoskeletal pain.³⁴ Gulf War Illness is a cluster of symptoms, with musculoskeletal pain being one of the symptoms that patients experience. The one study with healthy subjects used experimentally induced pain. All studies included some type of mindfulness-based treatment as the intervention.

Mindfulness based stress reduction was used 9 times. This is the original treatment program developed by Jon Kabat Zinn.³⁵ It is an 8-week program that has different techniques that are taught throughout the program. Each week focuses on a different

topic. Some of the techniques that may be taught in the program include body scan, hatha yoga, sitting meditation, and walking meditation. The course will also help you learn how to be present in all situations, how to deal with stressful events, and learning to incorporate mindfulness as a lifelong pursuit. Other types of mindfulness training have been adapted from this original program to incorporate some other components or to shorten the treatment length. Other experimental interventions included mindfulness training, physical, cognitive, and mindfulness training, meditation with chronic low back pain specific cognitive behavioral therapy, mindfulness-oriented recovery enhancement (MORE), body scan technique, and mindfulness based cognitive therapy (MBCT).¹⁵⁻³³ Control groups consisted of psychoeducation, support groups, wait list control groups, or treatment as usual. The most common study length was 8 weeks, but interventions length ranged from a single point in time to 10 weeks. Follow up periods ranged from 1 month to a year. All included studies had to measure musculoskeletal pain in some form.

Pain was measured via NPRS, VAS, Brief Pain Inventory, Short-Form McGill Pain Questionnaire, Graded Chronic Pain Scale, and Headache diary.¹⁵⁻³³ Some studies used multiple means to assess pain. One study used experimentally induced pain and used the heat pain threshold as one of the pain measurements.

Overall, 8/19 (42%) of the studies reported significant differences between the treatment group and the control group in the area of pain. It should be noted that in all studies, patients improved with mindfulness training, but there were only statistically significant results in 8 of the studies.

Authors	Year	Article Title	PEDro Score	Population	Study Length	Interventions	Pain Measurement	Overall Results
Lengacher et al	2016	Examination of broad symptom improvement resulting from mindfulness-based stress reduction in breast cancer survivors: A randomized controlled trial	7	Breast cancer survivors who had completed treatment from 2 weeks to 2 years; N=322	6 weeks; 6 week follow-up	MBSR and usual care	Brief Pain Inventory	No significant differences between groups on pain measurement
Reich et al	2017	Mindfulness-based stress reduction in post-treatment breast cancer patients: immediate and sustained effects across multiple symptom clusters	6	Breast cancer survivors; N=322	6 weeks; 6 week follow-up	MBSR and usual care	Brief Pain Inventory	No significant differences between groups on pain measurement
Monroe et al	2016	A mind-body program for older adults with chronic low back pain: a randomized clinical trial	10	Chronic low back pain patients; N=282	8 weeks; 6 month follow-up	MBSR and an educational group	Numeric Pain Rating Scale (NPRS)	NPRS scores did not differ between the intervention and control group
Morone et al	2009	A mind-body program for older adults with chronic low back pain: results of a pilot study	8	Chronic low back pain at least 3 months; N=40	8 weeks; 4 month follow-up	MBSR and health education group	Short-Form McGill Pain Questionnaire	No significant differences between MBSR and education group on pain scores
Cherkin et al	2016	Effect of mindfulness-based stress reduction vs. cognitive behavioral therapy or usual care on back pain and functional limitations in adults with chronic low back pain: a randomized controlled trial	8	Chronic low back pain patients; N=342	8 weeks; 6 month and 1 year follow-up	MBSR, CBT, and usual care	Graded Chronic Pain Scale	Patients in both the MBSR and CBT group had significant improvements in pain scores compared to the usual care group; no differences between MBSR and CBT groups
Zgierska et al	2016	Mindfulness meditation and cognitive behavioral therapy intervention reduces pain severity and sensitivity in opioid-treated chronic low back pain: pilot findings from a randomized controlled trial	8	Patients with chronic low back pain who had been treated with opioids; N= 35	8 weeks; 4.5 month follow-up	Meditation and chronic low back pain specific CBT and a wait-list control	Brief Pain Inventory	Meditation group improved pain ratings across the study; no other significant differences between the groups

Morone et al	2008	Mindfulness meditation for the treatment of chronic low back pain in older adults: a randomized controlled pilot study	6	Patients older than 65 with chronic low back pain; N=37	8 weeks; 3 month follow-up	Mindfulness meditation and wait-list control	McGill Pain Questionnaire Short Form	Pain acceptance improved significantly for the meditation group, but McGill pain questionnaire did not
Westenberg et al	2018	Does a brief Mindfulness Exercise Improve Outcomes in Upper Extremity Patients? A Randomized Controlled Trial	10	Patients with an upper extremity injury; N=125	Single point in time; 60 seconds later	Mindfulness based video and a time matched pamphlet	NPRS	No significant differences between groups in pain measurement
Plews-Ogan et al	2005	A Pilot Study Evaluating Mindfulness-Based Stress Reduction and Massage for the Management of Chronic Pain	6	Musculoskeletal pain for at least 3 months; N=30	8 weeks	MBSR, massage, and standard care groups	NPRS	No significant differences between groups in the pain measurement, but the MBSR group did have a positive effect on mental health
Jay et al	2015	Effect of Individually Tailored Biopsychosocial Workplace Interventions on Chronic Musculoskeletal Pain and Stress Among Laboratory Technicians: Randomized Controlled Trial	9	Female Lab Techs with chronic pain in low back, upper back, neck, shoulder, elbow, or hand. Pain for at least 3 months; N=112	10 weeks	Physical, Cognitive, and Mindfulness group-based training and reference group	Visual Analog Scale (VAS)	Experimental group had significant improvement in pain measurement compared to the reference group
Ussher et al	2014	Immediate Effects of a Brief Mindfulness Based Body Scan on Patients with Chronic Pain	7	Chronic pain patients; N=55	Single point in time	Body scan technique and a control group	Brief Pain Inventory	No significant differences between groups for pain measurement; the body scan group did have a significant impact on pain related distress and pain interference
Garland et al	2014	Mindfulness-Oriented Recovery Enhancement (MORE) for Chronic Pain and Prescription Opioid Misuse: Results from an	8	Chronic pain patients that had been prescribed opioids; N=115	8 weeks; 3 month follow-up	MORE and a support group	Brief Pain Inventory	MORE patients had a significant decrease in pain severity that was maintained at follow-up

		Early-Stage Randomized Controlled Trial						
Howarth et al	2019	Pilot Randomized Controlled Trial of a Brief Mindfulness-Based Intervention for Those with Persistent Pain	6	Patients with pain for more than 3 months; N=147	Audio recording done once in clinic and then self administered 3x/week for 1 month	Mindfulness meditation and a control group	Brief Pain Inventory	No significant differences between groups in pain measurement
Cathcart et al	2014	Brief Mindfulness-Based Therapy for Chronic Tension-Type Headache: A Randomized Controlled Pilot Study	7	Patients with chronic tension-type headache; N=58	3 weeks, 2X/week	Mindfulness based meditation and a wait list controlled	Headache Diary with intensity	No significant
Omidi et al	2014	Effect of Mindfulness-Based Stress Reduction on Pain Severity and Mindful Awareness in Patients with Tension Headache: A Randomized Controlled Trial	7	Patients with tension headaches; N=66	8 weeks	MBSR and treatment as usual	Headache diary with intensity	MBSR group had significant improvements in pain intensity
Day et al	2014	Mindfulness Based Cognitive Therapy (MBCT) for the Treatment of Headache Pain: A Pilot Study	6	Patients with headache pain for at least 3 months	8 weeks	MBCT and treatment as usual	VAS, Brief Pain Inventory	No significant differences in pain severity, but the MBCT group did have significant reduction in pain interference
Bakhshani et al	2016	The Effectiveness of Mindfulness-Based Stress Reduction on Perceived Pain Intensity and Quality of Life in Patients with Chronic Headache	7	Patients with chronic headache	8 weeks	MBSR and control group	NPRS	Pain intensity was significant lower in the MBSR group
Kearney et al	2016	Mindfulness-Based Stress Reduction in Addition to Usual Care is Associated with Improvements in Pain, Fatigue, and Cognitive Failures Among Veterans with Gulf War Illness	7	Veterans with Gulf War Illness	8 weeks; 6 month follow-up	MBSR and treatment as usual	Short Form McGill Pain Questionnaire	MBSR did not significantly reduce pain at end of study, but did at the 6 month follow-up

Reiner et al	2016	A Brief Mindfulness Meditation Training Increases Pain Threshold and Accelerates Modulation of Response to Tonic Pain in Experimental Study	6	Healthy Subjects	Single Learning Session in Clinic for 20 minutes, then at home practice for 2 weeks	Mindfulness training and control group	Heat Pain Threshold, NPRS	Heat Pain Threshold significantly increased in the mindfulness training group; No differences in NPRS scores
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Table 1. Table of Study Characteristics; Mindfulness Based Stress Reduction (MBSR), Numeric Pain Rating Scale (NPRS), Visual Analog Scale (VAS), Cognitive Behavioral Therapy (CBT), Mindfulness Oriented Recovery Enhancement (MORE), Mindfulness Based Cognitive Therapy (MBCT)

DISCUSSION

The purpose of this review was to determine if mindfulness training was an effective treatment for those experiencing musculoskeletal pain. The results from this review are mixed. Mindfulness training may be effective with some patients, but not all. It may be a good compliment to traditional therapeutic interventions but may not provide complete pain relief on its own.

Overall, 42% of the studies in this review had significant results in favor of doing mindfulness training for treatment of musculoskeletal pain.^{19,20,24,26,27,31,32,33} This review is consistent with results from other similar reviews.^{36,37} One factor to consider when deciding if this is an appropriate treatment, is treatment length. As mentioned previously, most studies lasted eight weeks. In the field of athletic training, eight weeks is a lengthy period to be treating a single injury.³⁶ In a study in high school athletes, the most common injuries were non-time loss injuries accounting for 70% of all visits.³⁶ The average non-time loss injury only had 3.47 visits to the athletic training facility.³⁶ Time loss injuries were slightly higher with 7.76 visits per injury, but that is still significantly lower than 8 weeks.³⁶ However, there were two studies in this review that looked at the immediate effects of mindfulness training on pain.^{22,25} An immediate effect could be more useful in the secondary school, collegiate, and professional settings. If mindfulness training can have an effect in only 1 or 2 weeks, then it could benefit the injuries that have short turnaround times. Both studies had improvement in the experimental group, but the improvement was not statistically significantly more than the control group. As Westenberg points out, "it remains unknown what the minimal effective dose...is for mindfulness-based interventions to lower a patient's distress or pain levels".²³ Shorter periods of time could be more beneficial for athletic trainers in the traditional settings. In the industrial setting, where athletic trainers are typically treating older populations that

are more prone to overuse and chronic type injuries, mindfulness training may provide benefits to these patients without the need to shorten the traditional treatment length.

There were two studies that examined musculoskeletal pain in cancer patients.^{15,16} Neither of these studies had significant results in favor of mindfulness training. There were five studies that examined chronic low back pain in patients.¹⁷⁻²¹ Three out of five of those studies had positive results in favor of mindfulness training. Another five studies looked at overall chronic musculoskeletal pain.²³⁻²⁷ Again, three out of five studies had significant improvements in the groups that participated in mindfulness training. Four studies looked at patients with chronic tension type headaches.²⁸⁻³¹ Half of the studies showed a significant effect with mindfulness training. There was one study with upper extremity injuries and those subjects did have a bigger improvement in pain management than the control group, but these improvements were not statistically significant.²² One study with gulf war illness patients did not have an improvement at the end of the study, but there was a significant improvement at the six-month follow-up.³² Another study with healthy subjects underwent experimentally induced pain and there was an increased heat pain threshold.³³ This review shows that the overall results from a study are not necessarily dependent upon the type of musculoskeletal pain examined. More research is needed to better understand if the benefits of mindfulness training are specific to a particular condition or injury. The need for more research is consistent with previous research on this topic. In 2015, Bawa et al did a systematic review on mindfulness and chronic pain and concluded that more research was needed.³⁷ However, their review included chronic pain that was not musculoskeletal in nature. Similarly, in 2017, Hilton et al conducted a systematic review and meta-analysis and concluded that although there was evidence of a positive effect of mindfulness training on

chronic pain, higher quality studies were needed in this area.³⁸ The Hilton study also examined chronic pain conditions that included non-musculoskeletal diseases. Research has shown that having good psychological skills is essential in the successful rehabilitation of an injured athlete.^{1,3} Mindfulness training could play a key part in the injury recovery process. Even if the patient does not necessarily experience a reduction in pain intensity, mindfulness training may improve self-awareness and coping.³⁶ Another research study showed that mindfulness training can increase a person's tolerance to pain.⁴ There is also some evidence that mindfulness meditation may affect the way the brain processes pain.³⁹ As the authors of the article point out mindfulness training could be, "a potentially important adjunct to current treatment options for acute and chronic pain."³⁹ So although mindfulness training has not necessarily been shown to reduce pain intensity, it does appear to have an effect of the overall pain experience of a patient.

Conclusion:

Future research should aim to examine the issue of pain catastrophizing and pain interference in patient populations with musculoskeletal pain. Although mindfulness may not directly impact the pain intensity in a patient, it may still improve a patient's overall experience of pain and their ability to cope with the pain they are feeling. The mental and emotional parts of a patient are just as significant as the physical part of a patient. As mentioned previously, the exact amount of training needed to see a therapeutic effect remains unclear so more research would be needed in that area. Knowing the minimum treatment length would help clinicians determine if the treatment would be beneficial for a given patient case. Future research should also focus on the effects of mindfulness training on acute pain vs. chronic pain. In conclusion, mindfulness training for the treatment of musculoskeletal pain may be

beneficial for patients of athletic trainers, but more research of higher quality is needed to answer that question more fully.

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