Abstract

Mindfulness and Migraine:

Exploring the Daily Use of Mindfulness-Based Cognitive Therapy for Migraine

Objective: To determine the use of mindfulness practice following mindfulness-based cognitive therapy for migraine (MBCT-M) in people with migraine.

Methods: This is a mixed-methods study and secondary analysis of a parallel assignment, single blind, randomized clinical trial for MBCT-M where 60 participants with migraine were randomized to receive 8-week individual MBCT-M (n = 31) or waitlist/treatment-as-usual (WL/TAU) (n = 29). Participants completed the Five Facet Mindfulness Questionnaire (FFMQ) and Headache Disability Inventory (HDI) at baseline and Months 1, 2, and 4. Linear mixed effects models were conducted to determine changes in facets of mindfulness over time, and longitudinal mediation was used to examine the effect of changes in mindfulness on the relationship between disability and time. A total of 6 participants with episodic migraine and 6 with chronic migraine from the MBCT-M treatment group completed phenomenological interviews following participation in the parent study.

Results: The 60 participants in the parent study were an average age of 40.1 (SD = 11.7), mostly female (n = 55/60, 91.7%), White (n = 49/60, 81.7%) and had a graduate degree (n = 33/60, 55.0%). Linear mixed effects models showed significant increases over time in mindfulness Total scores ($P = .001$), and mindfulness subscales of Observing ($P < .001$), and Nonreactivity to Inner Experience ($P = .006$) in the MBCT-M group compared to WL/TAU group. FFMQ Total scores significantly mediated changes in HDI scores over time (indirect effect $B = 7.56$, 95% CI = 2.36, 13.69); no FFMQ subscales mediated changes. A total of 10

themes emerged from qualitative interviews. Strengths of mindfulness included: Mindfulness Practice Provides Control, Mindfulness Improved Acceptance, Mindfulness as Acute Treatment, Mindfulness as Preventive Treatment, Increased Awareness of Emotions/Thoughts/Bodily Sensations, Mindfulness Helped Migraine Management/Problem Solving During Migraine, and MBCT-M Study Increased Accountability for Mindfulness Practice; weaknesses included: Discomfort Practicing Mindfulness, Routine Mindfulness Practice is Difficult, and Feelings of Guilt.

Conclusion: Certain aspects of mindfulness change during MBCT-M treatment. All five facets of mindfulness are needed to mediate changes between migraine-related disability and time. People with migraine use mindfulness to aide in treatment decision making. Treatment for migraine should include mindful awareness.

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Exploring the Daily Use of Mindfulness-Based Cognitive Therapy for Migraine

by

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Dedication

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To all patients with migraine: My hope is that my dissertation project will continue to promote and enhance treatment options to improve outcomes.

Table of Contents

List of Tables

List of Figures

List of Appendices

CHAPTER I

INTRODUCTION

Migraine is a prevalent, chronic, and disabling neurological condition characterized by attacks of moderate to severe pain, unilateral head pain, sensitivity to light and sound, and nausea or vomiting (The International Classification of Headache Disorders, 3rd edition, 2018). Approximately 12% of adults in the United States have migraine, with higher rates in females than among males (Lipton et al., 2011; Lipton, Stewart, Diamond, Diamond, & Reed, 2001). Migraine is characterized as episodic or chronic, in which episodic migraine (EM) is defined as 14 or less headache days per month, and chronic migraine (CM) is classified as 15 or more headache days per month (The International Classification of Headache Disorders, 3rd edition, 2018). Approximately 2.5% of people with episodic migraine experience a progression into chronic migraine (Bigal et al., 2008). Increasing headache attack frequency from episodic to chronic migraine is associated with decreased quality of life (Meletiche et al., 2001).

Migraine is the second leading cause of disability worldwide (James et al., 2018). Migraine has only continued to increase in the rankings of the leading causes of disability globally, rising from the seventh leading cause in 2010 to the second in 2017 (James et al., 2018). Disability outcomes in people with migraine are thus worsening over time. Additionally, migraine is the leading cause of years living with disability globally in individuals who are 15 to 49 years old, representing the most productive years in terms of education, work, and family life (James et al., 2018). Migraine is associated with economic

burden, disability, reduced quality of life, depression, and anxiety (Smitherman, Burch, Sheikh, & Loder, 2013; Zwart et al., 2003). More than half of people with migraine report missing work and family or social events due to migraine onset (Lipton et al., 2011).

BACKGROUND AND SIGNIFICANCE

The prevalence and burden of migraine call for enhanced options for migraine treatment. People with migraine are often undertreated or are not receiving optimal care to reduce migraine attack frequency (Lipton, Silberstein, Saper, Bigal, & Goadsby, 2013; MacGregor, Brandes, & Eikermann, 2003). Most people with migraine use acute treatment, or treatment that is used to treat individual migraine attacks with the goal of eliminating attack symptoms within 2 hours of treatment (Cady, 2008). Acute treatment may consist of triptans, nonsteroidal anti-inflammatory drugs, or acetaminophen. Studies have found acute treatment is most effective when medication is taken early, yet people with migraine report delaying medication use to limit risk of medication overuse, save costs, or to determine migraine severity (Foley et al., 2005).

A large portion of people with migraine would benefit from preventive treatment for migraine, or treatment that is used on a routine (often daily) basis to reduce headache attack frequency, severity, and overall burden. Preventive migraine treatment may consist of antiepileptic drugs, antidepressants, beta-adrenergic blockers, Botox injections, Calcitonin gene-related peptide injections, infusions, or other pharmacological options or devices. The American Migraine Prevalence and Prevention (AMPP) Study found 40% of people with migraine are in need of preventive treatment based on the qualification of having three or more migraine attacks in one month that interfere with overall functioning (Lipton et al.,

2011). However, only 12% of people with migraine in the study were actually receiving preventive treatment (Lipton et al., 2011).

Pharmacological treatment options for both acute and preventive care are typically recommended for people with migraine who present in tertiary care headache clinics. However, only about half of people with migraine find preventive medication use effective, with people reporting adverse side effects to these medications, along with an increase in costs and economic burden in the long run (Shamliyan et al., 2013). Pharmacological treatment for migraine also presents barriers when people have other comorbid conditions requiring medical treatment or are pregnant (Silberstein et al., 2007). Reducing symptoms with pharmacological treatment does not always improve functioning as well. People with migraine need other treatment options available to them to improve overall functioning.

Behavioral treatments for migraine are a favorable preventive treatment option to improve migraine outcomes due to low costs and side effects (Schafer et al., 2011). Behavioral treatments provide people with tools to cope with and manage migraine. The bio-psychosocial model provides the foundational rationale for behavioral treatments: multifaceted relationships exist between biological factors and psychological and social dynamics, such that intervening with psychological and social factors can influence biological conditions (Engel, 1977). Migraine fits well as a biological factor within this model since research has demonstrated that migraine symptoms are influenced by psychological and social stressors (Brown, Newman, Noad, & Weatherby, 2012, Nash & Thebarge, 2006, Wacogne, Lacoste, Guillibert, Hugues, & Le Jeunee, 2003). Migraine attacks are often triggered by psychological stressors, and migraine may in turn increase psychological stressors (Brown, Newman, Noad, & Weatherby, 2012). Incorporating

psychological interventions into the management of migraine can consequently be an effective treatment option to lower headache frequency and to improve quality of life outcomes. Research findings support integrating behavioral treatment for migraine with more common pharmaceutical approaches; for example, one large randomized clinical trial found the combination of preventive drug treatment and behavioral migraine management produced the greatest reduction in migraine days per month compared to either treatment alone (Holroyd et al., 2010).

Relaxation training, biofeedback, and cognitive behavioral therapy have all been identified as having Grade A evidence for the prevention of migraine (Campbell & Penzien, 2000). These behavioral treatments for migraine demonstrate efficacy in the reduction of migraine frequency, severity, and disability (Campbell & Penzien, 2000; Sullivan et al., 2016). Systematic reviews of behavioral treatments for migraine suggest cognitive behavioral therapy is more effective at lowering headache intensity and headache days per month when compared to a waitlist group (Harris, Loveman, Clegg, Easton, & Berry, 2015). Cognitive behavioral therapy combined with relaxation training led to greater decreases in headache pain and frequency when compared to relaxation training alone (Harris, Loveman, Clegg, Easton, & Berry, 2015). Self-management interventions demonstrated a moderate effect size for improvements in mood and a small effect size for improvements in disability and in headache intensity compared to usual care in people with migraine (Probyn et al., 2017). Behavioral interventions that consisted of group-based settings, mindfulness techniques, and educational tools significantly reduced headache intensity (Probyn et al., 2017). Overall, findings from studies examining the use of behavioral treatments for migraine provide support in improving migraine-related outcomes and quality of life in people with migraine.

People with migraine are increasingly using mindfulness-based therapy approaches to improve migraine management. Mindfulness is paying attention to the present moment with a non-judgmental and observant outlook (Kabat-Zinn, 1982). The 2007 National Health Interview Survey revealed that about 13.5 million adults with migraine (49.5% of all adults with migraine) were using complementary and alternative medicine therapies, with the most common being mind-body therapies, such as mindfulness meditation (Wells et al., 2011). For the past decade, the practice of mindfulness has grown in popularity. Currently, about 1,300 mobile applications are available for mindfulness practice, and it is estimated that the leading application ("Headspace") has more than 2 million users (Creswell, 2017). Given the accessibility of mindfulness, it is important to determine if this practice is effective for relevant migraine outcomes. The present study helped to answer this question by qualitatively evaluating people's experience with mindfulness and migraine, and by quantitatively examining associations between mindfulness, clinical characteristics of migraine, and migraine-related outcomes.

Background and Theories on Mindfulness. The concept of mindfulness originated from Buddhist practices that highlighted awareness of present events (Karunamuni & Weerasekera, 2017). The word mindfulness was derived from the Pali word, "sati," which means "to remember" (Levman, 2017). The act of remembrance in Buddhist practice translates to a conscious act of awareness and paying attention to present experiences as they arise (Levman, 2017). Mindfulness involves both awareness, or the conscious perception of sensory stimuli, events, or thoughts, and paying attention, meaning actively focusing towards a particular object or event (Thera, 2005). Both of these acts involve flexibility, or being able to divert attention across different events or thoughts. Mindfulness also involves the

observation of thoughts, feelings, or bodily arousals as they occur in the moment. Operationally, mindfulness has been defined as having two components: self-regulation of attention, and a sense of curiosity and observation of experiences (Bishop et al., 2004). Paying attention and observation of present events allows for individuals to respond to occurrences, rather than react, and to process thoughts and let them pass, which are key elements to the practice of mindfulness. The act of responding rather than reacting facilitates behavioral regulation, and allows for an active choice in the response to the event, instead of reacting in a habitual manner (Bishop et al., 2004).

Mindfulness as a construct conceptually fits in to self-regulation and meta-cognition theories. In the self-regulation model, cognitions are directed towards achieving goals (Carver & Scheier, 1990). Individuals may experience negative affect when thoughts, behaviors, or feelings are not in line with the attainment of goals. Self-regulation theory proposes individuals attempt to reduce this discrepancy between thoughts and goals to create a more balanced mode leading to increased positive affect (Carver & Scheier, 1990). Rumination results when this discrepancy cannot be reduced and cognitions are not congruent with goals. Rumination is a repetitive thinking pattern focused on thoughts, feelings, or problems without a resolution (Smith & Alloy, 2009). Rumination is a key element that generates worry, depressive episodes, or anxiety, and often is a lengthy process that continues until goals are met (Martin & Tesser, 1989; Smith & Alloy, 2009). Mindfulness allows one to recognize and observe these thoughts, while letting them pass. Mindfulness practice of taking an observer and curious stance to thoughts as they arise in the present moment can deplete rumination, and lead to more positive outcomes and lessening the chance of relapse of a depressive episode (Teasdale et al., 2000). Additionally, the act of

paying attention to thoughts and goals in mindfulness practice enhances self-regulation (Greenberg et al., 2004). Mindfulness has been associated with the attainment of personal and educational goals as a result of a potential mechanism of paying attention to these goals (Howell & Buro, 2011).

Meta-cognition has been coined as “thinking about thinking” (Flavell, 1979). Meta-cognition involves both the acknowledgement of thoughts as they occur and the ability to then monitor and control these cognitions (Flavell, 1979). Mindfulness produces changes in metacognitive awareness, which is the ability to let thoughts pass and believe that thoughts are not facts (A. M. Hayes & Feldman, 2004). Metacognitive awareness can also decrease rumination, which may result in enhanced psychological functioning (Teasdale, 1999). Mindfulness includes the act of detaching from thoughts, similar to meta-cognition, where one is an observer of their own thoughts, and also depends on the meta-cognitive skill of being aware of thoughts.

Mindfulness Trait vs. State and Measurement. Mindfulness can be conceptualized as a trait, seen as a long-lasting ability to have a mindful outlook, or as a state, meaning temporarily achieving awareness in the present moment (S. R. Bishop, 2004; K. W. Brown et al., 2007). The measurement of mindfulness has been informed by the conceptualization of mindfulness as a trait or state. Bishop et al. (2004) defined mindfulness as a mental activity, and viewed mindfulness as a state that changes based on practice. Researchers have used the theoretical approach of mindfulness as a state to inform measurement by examining the changes in mindfulness levels following a mindfulness-based treatment and by comparing mindfulness levels between individuals recently learning mindfulness practice and individuals who have been practicing mindfulness for several years (Bishop et al., 2004).

State mindfulness, as measured by the State-Mindful Attention Awareness Scale or the Toronto Mindfulness Scale, involve questions pertaining to the present moment or a recent time period assessing the practice of mindfulness in daily activities (K. W. Brown & Ryan, 2003; Lau et al., 2006).

Other theorists consider mindfulness as a dispositional trait which allows individuals to readily enter into states of mindfulness. Mindfulness traits may be flexible and are capable of changing over time with increased practice (Tang et al., 2015). The Mindful Attention Awareness Scale is a unidimensional measure that includes 15 questions assessing the awareness and attention aspects of mindfulness (K. W. Brown & Ryan, 2003). The Freiburg Mindfulness Inventory is a 14-item validated questionnaire assessing for trait mindfulness that produces a total summary score of mindfulness levels (Walach, Buchheld, Buttenmüller, Kleinknecht, & Schmidt, 2006). The Five Facet Mindfulness Questionnaire (FFMQ) was established as a trait measure of mindfulness that consists of five facets developed from a factor analysis of five different mindfulness questionnaires (Baer et al., 2006). The subscales of the FFMQ consist of Observing, Describing, Acting with Awareness, Nonjudging of Inner Experience, and Nonreactivity to Inner Experience. Observing refers to the awareness of sensory information, Describing is identifying and expressing experiences in words, Acting with Awareness refers to being aware of experiences in the present moment, Nonjudging of Inner Experience is the ability to refrain from critiquing emotions, thoughts, and behaviors, and Nonreactivity to Inner Experience is the acceptance of experiences and the ability to then respond, rather than react to experiences. The FFMQ was used in the present study to assess mindfulness levels in a sample of people with migraine since using this questionnaire permits a greater understanding of specific areas of mindfulness that may be related to change in

outcomes (Baer et al., 2006). While the Mindful Attention Awareness Scale only provides information about acting with awareness and the Freiburg Mindfulness Inventory only results in a summary mindfulness score, the FFMQ offers information on five different aspects of mindfulness (Carlson & Brown, 2005). Given the complex nature of mindfulness, the FFMQ can inform people with migraine and practitioners on specific areas of mindfulness that may be most important to practice and incorporate into treatment.

Mindfulness Interventions. In 1979, Jon Kabat-Zinn adapted and expanded his theory on mindfulness to form mindfulness-based stress reduction (MBSR) therapy, which he initially tested with a sample of patients with chronic pain. Jon Kabat-Zinn defined mindfulness as awareness of thoughts, feelings, and bodily sensations in the present moment without judgment (Kabat-Zinn, 1982). Jon Kabat-Zinn also described seven major pillars of mindfulness that are highlighted in MBSR treatment, which are non-judging, patience, beginner's mind, trust, non-striving, acceptance, and letting go (Kabat-Zinn, 2013). In MBSR, non-judging is defined as simply recognizing and being aware of the mind wandering and critiquing oneself, and to practice letting these thoughts pass without judgment. Patience means to allow things to develop over time, beginner's mind is defined as examining things with a clear mind, trust means to trust one's own judgement, acceptance entails acknowledging and receiving things as they occur, and letting go involves allowing experiences to happen as they arise in the present moment. Jon Kabat-Zinn described non-striving as eliminating a set number of goals to achieve in one's mind, and instead practicing letting oneself freely accomplish as many tasks as one was capable of completing (Kabat-Zinn, 2013). MBSR treatment includes mindfulness meditation practice, body scanning (directing attention to particular areas of the body), and yoga postures, all which strive to

promote paying attention in the present moment with non-judgmental awareness (Kabat-Zinn, 1982). MBSR is a group-based intervention that consists of 8-10 sessions. Since the development of MBSR, mindfulness practice has grown in popularity and many use it to treat both physical and mental health conditions.

Other therapy programs have also been developed that focus on mindfulness. Mindfulness-based Cognitive Therapy (MBCT), which is a major focus of this study, was first developed to help reduce the relapse of major depressive disorder, and combines concepts of being aware of automatic cognitive thoughts, acceptance, and mindfulness meditation (Felder et al., 2012; Piet & Hougaard, 2011; Segal et al., 2002). MBCT typically functions as a group intervention consisting of 8 sessions, where participants focus on metacognitive awareness skills to target depressive thoughts (Segal et al., 2002). MBCT significantly improved stress and mood in studies of populations with vascular disease or chronic pain (Abbott et al., 2014; Ball et al., 2017).

Although not a focus of the present study, other therapeutic techniques such as Dialectical Behavior Therapy and Acceptance and Commitment Therapy, highlight exercises used in mindfulness. Dialectical Behavior Therapy and Acceptance and Commitment Therapy consist of either group or individual therapy sessions. Dialectical Behavior Therapy is often used to treat patients with borderline personality disorder, and focuses on the mindfulness concept of observing thoughts and events in the present moment with a non-reactive and non-judgmental attitude (Linehan, 2018). The main goal of Acceptance and Commitment Therapy is to become aware of and accept behaviors in the present moment, which incorporates mindfulness concepts (Hayes, Luoma, Bond, Masuda, & Lillis, 2006). As

mindfulness-based interventions continue to be utilized and developed, an increased focus on research is needed to determine the effectiveness of these interventions.

Theoretical Approaches to Chronic Pain and Mindfulness. Chronic pain is any pain coming from the body, brain, or spinal cord that lasts longer than several months in duration (Treede et al., 2015). It is imperative to first examine the relationship between chronic pain and mindfulness to help later inform migraine and mindfulness theory and research given that mindfulness-based interventions were first studied in patients with chronic pain, and that migraine is a painful chronic condition.

The Gate Control Theory of pain, developed by Melzack and Wall, helps to describe the complex nature that takes place in the body when pain is processed. The theory proclaims that peripheral nerves in the dorsal horn of the spinal cord have “gates” that modulate the travel of messages about pain to the brain (Melzack & Wall, 1965). Extensions of this theory have demonstrated both top-down and bottom-up modulation of pain processing at dorsal horn, trigeminal, and cortical levels. Pain may be perceived more intensely in the context of acute injury, when thoughts about the pain occur, or when feelings about the pain arise, and may lead to an increased experience of pain (Melzack & Wall, 1965). Managing stress, meditation, relaxation techniques, and letting ruminating thoughts pass about the pain can all be used to help close the spinal nerve gates and decrease pain signals from getting sent to the brain. Hence, mindfulness techniques such as letting thoughts pass and practicing meditation, may help to lessen painful experiences by decreasing the pain messages to the brain.

The experience of pain is a common biological sign of a threat. The fear-avoidance model helps to explain how individuals respond to the threatening nature of pain. In the fear-avoidance model of pain, neural signals, or nociceptors, alert the spinal cord and brain of

painful sensations in the body, which is interpreted as a threat and may then initiate a fearful response (Vlaeyen et al., 2016). This fearful response is labeled as the conditioned response that is learned over time, which may lead to avoidant behaviors of the painful sensation. Avoiding pain consists of eliminating certain activities that may induce pain and negative affect (Vlaeyen et al., 2016). The avoidant behaviors may decrease the experience of pain in the moment, yet reinforces this behavior and may lead to a cycle that perpetuates chronic pain (Volders et al., 2015).

Mindfulness promotes the ability to pay attention in the moment and to observe painful sensations as they arise. Mindfulness thus involves exposure to pain, rather than avoidance behaviors, and may break the cycle of the fearful response to pain. One will be able to confront painful sensations by eliminating the conditioned fear response, which may lead to recovery rather than depression or increased disability (Vlaeyen & Linton, 2012). In the fear-avoidance model, the experience of pain may also lead to rumination about the pain. Metacognitive awareness and mindfulness help to lessen rumination, which may then result in a reduction of perceived pain and distress (Tang, Hölzel, & Posner, 2015). Additionally, studies show that the fear response in the brain, which originates with amygdala activation, is lessened when mindfulness levels are higher. One study of 27 participants receiving functional magnetic resonance imaging when presented with threatening, negative visual stimuli of fearful facial expressions found that participants with higher mindfulness scores on the Mindful Attention Awareness Scale had reduced amygdala activation and increased prefrontal cortical activation (Creswell et al., 2007). The prefrontal cortex area of the brain is associated with self-regulation, signaling that individuals with higher dispositional

mindfulness levels also have enhanced self-regulation abilities that lessen the fear response of pain.

The fear-avoidance model of pain purports that individuals often avoid pain since it is uncomfortable to attend to painful stimuli. Mindfulness helps to break this cycle by attending to and paying attention to the pain. Researchers suggest that attending to the pain with an observer stance, or sensory focusing, is beneficial rather than taking an interpretive mode, or paying attention to the emotional distress or thoughts about the pain (Leventhal et al., 1979). One study of healthy adults found support for attending to painful sensations by having participants experience cold pressor pain (Cioffi, 1993). Participants who attended to pain by rating pain intensity had a quicker recovery period than participants who were distracted by or suppressed the pain (Cioffi, 1993). This shows that practicing mindfulness and attending to pain, instead of avoiding painful stimuli, may be beneficial in both patients with chronic pain and healthy controls.

Mindfulness and Chronic Pain Research. Studies demonstrate associations between mindfulness and lower/less limiting pain sensations. Higher levels of mindfulness are correlated with higher levels of self-esteem and life satisfaction, and decreased levels of depression, rumination, anxiety, and pain (K. W. Brown & Ryan, 2003; Cash & Whittingham, 2010; Raes & Williams, 2010). Studies examining the use of mindfulness and treatment of chronic pain conditions, like low back pain, neck and shoulder pain, and headache pain found that mindfulness improved both quality of life and overall functioning (Kabat-Zinn et al., 1985; la Cour & Petersen, 2015). John Kabat-Zinn (1982) examined a 10-week stress reduction and relaxation program that focused on mindfulness meditation and was completed by 51 patients with chronic pain. Following treatment, half of the participants

experienced more than or equal to a 50% decrease of their initial overall pain ratings (Kabat-Zinn, 1982).

One study consisting of 105 patients with chronic pain at a medical center who completed the Mindful Attention Awareness Scale found that higher mindfulness levels were associated with improved functioning, decreased pain intensity, decreased levels of depressive symptoms, and decreased levels of disability (McCracken et al., 2007). A study including 4986 patients with fibromyalgia, which is characterized by chronic pain, used the FFMQ to measure mindfulness levels (Jones et al., 2015). Findings suggested higher mindfulness levels on each subscale, except for the Observing subscale, were associated with decreased levels of fibromyalgia pain impact (Jones et al., 2015). The FFMQ has been used in research on chronic pain and fibromyalgia to determine relationships between specific facets of mindfulness, but this information is lacking in migraine research (Boer et al., 2014; Jones et al., 2015). Given the complex nature of mindfulness, the FFMQ can inform patients and practitioners on specific areas of mindfulness that may be most important to practice and incorporate into treatment. Additionally, the evidence that mindfulness is useful in reducing pain levels and improving outcomes in chronic pain populations signals the importance of investigating mindfulness for migraine specific populations to determine if there are similar benefits to inform treatment options.

Theoretical Approaches to Migraine and Mindfulness. Theories and hypotheses exist surrounding mindfulness and its effects on pain and migraine. However, the specific mechanisms of mindfulness that may be valuable to migraine remain unknown. As previously reviewed, mindfulness fosters meta-cognitive awareness, helps to decrease rumination, and may break the fear-avoidance model of pain in patients with chronic pain,

which also may lead to improved outcomes in people with migraine. Migraine differs from chronic pain in that migraine attacks may be episodic in nature, are often more disabling, and may not be associated with specific injury, so it is important to study migraine as its own entity as well. More research explicitly focusing on migraine populations is necessary to establish if and how mindfulness can be used for migraine treatment. Given the highly disabling nature of migraine, studying the use of mindfulness in daily life is imperative to enhance daily functioning in this population.

The fear-avoidance model has been used by previous researchers to investigate mindfulness in migraine. A recent study with a sample of 217 people with self-reported chronic headache or migraine examined the relationship between mindfulness and the fear-avoidance model of pain (Komandur et al., 2017). The Mindful Attention Awareness Scale and FFMQ were given to participants to assess mindfulness levels, and questionnaires on fear of pain, headache frequency, disability, and affect were completed. Researchers found lower levels of mindfulness were strongly associated with experience of negative emotions, a core component of the fear-avoidance model that leads directly to developing the fear of pain (Komandur et al., 2017). More specifically, lower levels of mindfulness in the awareness and nonjudging factors were strongly associated with negative affect (Komandur et al., 2017). Individuals practicing mindfulness learn to shift their attention away from negative thoughts or emotions that disrupts the fear-response, which may result in improved outcomes in people with migraine (Komandur et al., 2017). Mixed methods research in the present study is necessary to provide a clearer explanation as to how mindfulness is used for migraine to improve treatment.

Mindfulness and Migraine Research. In 2014, the first study to assess the feasibility of a mindfulness-based intervention for adults specifically with migraine was conducted (Wells et al., 2014). The trial consisted of 19 adults with episodic migraine who were randomized to receive MBSR and found that mindfulness treatment for people with migraine is both safe and feasible. Participants kept paper daily diaries of migraine characteristics throughout the duration of the study. While the study was inadequately powered due to a small sample size, results showed non-statistically significant decreases in migraine frequency and severity ($P = .38$ and $P = .053$, respectively), and statistically significant decreases in disability and increases in general self-efficacy ($P = .017$ and $P = .035$, respectively) (Wells et al., 2014). Studies with larger sample sizes are needed to determine the effects of mindfulness levels on migraine-related outcomes.

Other studies examining mindfulness-based training found positive changes in migraine frequency after practicing mindfulness. One study of 44 patients diagnosed with chronic migraine-medication overuse headache found 6 weekly sessions of a mindfulness-based training significantly reduced headache frequency and disability as measured by the Migraine Disability Assessment (MIDAS) ($P < .001$ and $P < .001$, respectively) (Grazzi et al., 2017). Another randomized trial consisting of 40 patients with migraine and chronic tension-type headache determined participants had significant improvements in level of pain and quality of life after receiving mindfulness-based stress reduction therapy and practicing mindfulness techniques outside of training ($P = 0.001$) (Bakhshani et al., 2016). Both studies did not include measures of mindfulness and did not examine mindfulness changes over time throughout the course of mindfulness-based training. The present study addressed this limitation by including the FFMQ to measure mindfulness changes over time.

Additionally, a randomized trial to assess the feasibility of MBCT for headache pain in a sample of 36 people found participants with any primary headache pain type, including migraine, tension-type headaches, and cluster headaches, had significant improvements in pain acceptance (P = .02), and of pain catastrophizing (P = .03) after completion of MBCT (Day et al., 2013). While completion of MBCT did not significantly reduce headache diary outcomes in the above trial possibly due to small sample size, there were still evident decreases in headache frequency, duration, and severity (Day et al., 2013). Given this trend, it is plausible to hypothesize that with an increased sample size, the practice of mindfulness may significantly decrease migraine days and severity. Significant changes in pain catastrophizing suggest there are cognitive changes taking place with the practice of mindfulness. People who practice mindfulness may have changes in their thinking patterns that help to then alter their migraine-related outcomes.

More recent larger MBSR studies confirm that MBSR can reduce migraine activity and migraine-related disability. One randomized clinical trial in a sample of 98 participants with episodic migraine found larger reductions in headache days and headache-related disability in participants who received 8 weeks of group MBSR, plus additional bi-weekly group MBSR for 8 weeks, compared to participants who received stress management for headache (Seminowicz et al., 2019). MRI results revealed cognitive network changes in participants who received MBSR (Seminowicz et al., 2019). A greater understanding of mindfulness and how mindfulness components work to influence migraine-related outcomes is critical to improve existing mindfulness treatments, and to inform both practitioners and patients on the usefulness of mindfulness to treat migraine.

RATIONALE

Research on mindfulness and migraine is imperative to inform treatment and improve outcomes for people with migraine. Most research conducted on mindfulness and migraine has focused on quantitative data analysis and the use of self-report measures. Qualitative data and semi-structured interviews can be a beneficial addition to quantitative data results to better inform treatment for people with migraine. Only one previous study used a mixed methods design to compare people with headache conditions that responded to an MBCT treatment versus non-responders (Day et al., 2014). Responders to MBCT treatment were categorized as having greater than or equal to 50% reduction in pain intensity or pain interference ratings (n = 14), and non-responders to MBCT treatment were categorized as having less than 50% reduction in pain intensity or pain interference ratings (n = 7) (Day et al., 2014). Participants completed a semi-structured interview following MBCT treatment where they were asked questions about what they learned, how they felt about mindfulness practice, and how they felt about participating in the study. Major themes and subthemes consisted of headache outcomes and psychosocial outcomes, where more treatment responders reported mindfulness was broadly helpful for headaches and improved emotions than treatment non-responders. Themes also entailed cognitive process variables, common/non-specific factors, and barriers, where more treatment responders reported improved headache management self-efficacy, positive pre-treatment expectations, and barriers to practicing mindfulness which consisted of time commitment, and difficult to practice at first (Day et al., 2014). Participants in this study were not asked how they were using mindfulness in their daily lives and the impact of mindfulness practice following study participation, which were questions included in the present study. No previous study has used

a mixed methods approach examining the use of MBCT specifically for people with migraine.

The parent study, a phase 2b clinical trial for MBCT for Migraine (MBCT-M) (IRB#: 2015-4684), was conducted to examine the effectiveness of MBCT-M to lower migraine-related disability in people with migraine (Seng et al., 2019). Participants in this study were randomized to receive 8-10 individual sessions of MBCT-M (n = 31) or randomized to a waitlist/treatment-as-usual (WL/TAU) control (n = 29). Headache disability was measured both with the Headache Disability Inventory (HDI) and the Migraine Disability Assessment (MIDAS). The parent study found disability scores on the HDI significantly decreased more in the MBCT-M group compared to the WL/TAU group ($p < .001$), but not for scores on the MIDAS ($p = .027$). There were no differences found between groups for pain intensity and headache days/30 days (Seng et al., 2019).

The present study is a mixed methods design to examine the relationship between mindfulness and migraine-related outcomes, and to better understand how people with migraine are using mindfulness in their daily lives and for migraine treatment. A secondary analysis of a randomized clinical trial on MBCT for Migraine (IRB#: 2015-4684) was conducted using the Five Facet Mindfulness Questionnaire (FFMQ) to assess for mindfulness levels at baseline, month 1, month 2, and at month 4 following MBCT-M treatment. Correlations between mindfulness and migraine-related outcomes such as pain severity, days, and migraine-related disability were also assessed using electronic daily diary data to increase accuracy of information provided. The present study determined changes in mindfulness levels over time in the mindfulness-based cognitive therapy for migraine group compared to the waitlist-control group. The examination of changes in trait mindfulness

following a mindfulness-based intervention provides information on mechanism changes. Both qualitative and quantitative data findings in the present study can advance behavioral treatments for migraine and provide tools for people with migraine to use in their daily lives to improve migraine-related outcomes and quality of life.

AIMS/HYPOTHESES

Aim 1: To evaluate relationships between levels of mindfulness and migraine-related outcomes. Baseline questionnaire data were used to assess bivariate relationships between mindfulness and migraine-related outcomes, e.g. disability, days, and severity.

- Hypothesis 1: Higher scores on FFMQ would be associated with lower migraine-related disability, fewer migraine days, and less severe migraine.

Aim 2: To evaluate whether mindfulness changes in participants who completed the mindfulness-based treatment were greater than participants who were in the waitlist control group.

- Hypothesis 2: Mindfulness scores would increase more between baseline and post-MBCT treatment in the MBCT-M group compared to a waitlist control group.
- Exploratory: To evaluate whether levels of mindfulness, as measured by the FFMQ, mediated changes in the HDI, the primary outcome of the parent study, in the MBCT group and in the WL/TAU group.

Aim 3: To understand and describe ways in which mindfulness was applied and used in daily life in participants with migraine who completed a full course of MBCT-M. This aim is qualitative in nature.

CHAPTER II

QUANTITATIVE METHODS

Design Considerations. The first and second aim of the present study used baseline data from the parent MBCT for Migraine study, and the third aim used participants from the parent study to conduct phenomenological interviewing. The design of the parent research study was a parallel assignment, single blind, randomized clinical trial for MBCT for migraine in which participants were randomized to receive an 8-week MBCT-M treatment or wait-list control. The secondary analyses of this trial took advantage of the well-established measure for mindfulness, the FFMQ, given to participants at baseline, month 1, month 2, and month 4, and the daily diary data to collect migraine-related characteristics. The Institutional Review Board (IRB) of the Albert Einstein College of Medicine and Montefiore Medical Center approved this trial (IRB #: 2015-4684). See Figure 2 for the study design from the main study paper (Seng et al., 2019).

Procedure. ***Recruitment.*** Participants from the parent study were recruited through IRB-approved flyers posted in doctor's offices, coffee shops, college campuses, yoga studios, Twitter, Craigslist, and through referrals from Montefiore Headache Center providers, local psychologists, and neurologists. Total sample size for the parent study is 60 participants (91.7% female, 81.7% White, 16.7% Hispanic or Latino, and 90% with a college graduate degree or higher). See Figure 1 for study flow for parent study and Table 2 for demographic characteristics of participants from the parent study.

Eligibility Criteria. Participants were included in the parent study if they were between the ages of 18-65, had an International Classification of Headache Disorders 3rd Edition (ICHD-3 beta) headache diagnosis of migraine (The International Classification of

Headache Disorders, 3rd edition (beta version), 2013), had 6 or more headache days per month (per recommendations stating that preventive treatment should be offered for people reporting 6 or more headache days per month (Lipton et al., 2011), were able to read English, and had the capacity to consent. Participants were excluded from the parent study if they used a new preventive pain medication in the 4-week baseline period, planned to take a new preventive pain medication during the study, and if they had a severe psychiatric illness diagnosis such as psychotic symptoms, untreated substance abuse, or suicidal/homicidal ideation, intent, or plan. The inclusion and exclusion criteria used in the parent study was the same inclusion and exclusion criteria from the present study.

Baseline Procedures. All participants were screened for all eligibility criteria by the research coordinator and scheduled for an intake visit. Trained graduate students in Dr. Seng's research lab conducted all intake appointments. Intake appointments consisted of signing informed consent, a structured interview assessing for medical and psychological history, gathering demographic information, and assessing for headache symptoms, migraine-related disability, cognitive functioning, anxiety, and depression. Following the intake visit, participants were given online baseline surveys to complete using REDCap (P. A. Harris et al., 2009), a secure, HIPAA-compliant web application for handling surveys, which included the FFMQ, Migraine Disability Assessment (MIDAS), and the Headache Disability Index (HDI). Participants also began completing a daily electronic headache diary, consisting of questions about headache symptoms, severity, disability assessed by the Migraine Disability Index (MIDI), and lifestyle impact for the duration of the study. Following 4 weeks of baseline daily diary data collection, participants were reassessed for all study eligibility including headache days per month, and if eligible were randomized to the

MBCT-M group or WL/TAU group. Participants received up to $60 in Amazon gift cards for completing questionnaires and headache diaries.

Intervention. In the MBCT-M group, participants received an 8-week manualized treatment adapted for migraine (Singer, Buse & Seng, 2017) based on the protocol developed by Day and Thorn (Day et al., 2013). The treatment consisted of teaching concepts of mindfulness, completing mindfulness meditations, and at home practice. Participants randomized to the WL/TAU group continued standard care as usual for 2 months, and then were eligible to receive MBCT-M treatment. Trained graduate student therapists who received weekly individual supervision by the PI, Dr. Seng, and monthly group supervision by another licensed clinical psychologist, provided MBCT-M sessions. Table 1 provides an overview of MBCT-M sessions.

Measures. Demographic data, including age, gender, race/ethnicity, and education level, were all captured at intake appointments and through baseline questionnaire data. Clinical characteristics such as episodic migraine vs. chronic migraine were captured through use of an electronic daily diary.

Mindfulness - Five Facet Mindfulness Questionnaire (FFMQ). The FFMQ is a self-report measure that consists of 39 questions to evaluate trait mindfulness. The FFMQ includes five sub-scales: Observing, Describing, Acting with Awareness, Nonjudging of Inner Experience, and Nonreactivity to Inner Experience. The questionnaire is rated on a 5-point Likert scale ranging from 1 (never) to 5 (very often or always true), and higher scores denote greater levels of mindfulness (Baer et al., 2006). FFMQ Total scores range from 39-195, with higher scores indicating higher levels of mindfulness. FFMQ Observing, Describing, Acting with Awareness, and Nonjudging of Inner Experience subscale scores

range from 8-40, with higher scores indicating higher levels of mindfulness. FFMQ Nonreactivity to Inner Experience subscale scores range from 7-35, with higher score indicating higher levels of mindfulness. Examples of items from the FFMQ consist of: “I perceive my feelings and emotions without having to react to them,” “I watch my feelings without getting lost in them,” and “I pay attention to sensations, such as the wind in my hair or fun on my face.” A sample question from the Observing subscale is “I intentionally stay aware of my feelings;” a sample question from the Describing subscale is “My natural tendency is to put my experiences into words;” a sample question from the Acting with Awareness subscale is “I easily get lost in my thoughts and feelings;” a sample question from the Nonjudging of Inner Experience subscale is “I disapprove of myself when I have irrational ideas;” a sample question from the Nonreactivity to Inner Experience subscale is “I watch my feelings without getting lost in them.” The FFMQ demonstrates strong internal consistency ($\alpha > .70$), adequate construct validity and incremental validity, and has been used in numerous studies to assess mindfulness (e.g., Choi, 2015; Goldberg et al., 2016). In the present study, the FFMQ Total scale demonstrated excellent internal consistency ($\alpha = .91$), FFMQ Observing subscale demonstrated good internal consistency ($\alpha = .81$), FFMQ Describing subscale demonstrated good internal consistency ($\alpha = .88$), FFMQ Acting with Awareness subscale demonstrated good internal consistency ($\alpha = .89$), FFMQ Nonjudging of Inner Experience subscale demonstrated excellent internal consistency ($\alpha = .90$), and FFMQ Nonreactivity to Inner Experience subscale demonstrated good internal consistency ($\alpha = .82$).

Migraine-Related Outcomes - Migraine Disability Assessment (MIDAS). The MIDAS consists of 5 questions based on participant’s headaches and lifestyle over the past 3 months and assesses functional disability. Questions require respondents to select the number

of days they missed work or school due to headaches, had a decreased amount of productivity in work or work in the household, could not complete household work, and could not attend family, social, or leisure activities due to headaches. A score of 0-5 indicates little or no disability, 6-10 indicates mild disability, 11-20 indicates moderate disability, and a score of 21+ indicates severe disability (Stewart et al., 2000). The present study dichotomized the MIDAS using the cutoff of a score of 21 (scores less than 21 indicate mild-moderate disability, and scores 21+ indicate severe disability). The MIDAS has high internal consistency (α = .83), good test-retest reliability (*r* = .77), high face validity, and good construct validity (*r* = .63) (Stewart et al., 2000). In the present study, the MIDAS demonstrated acceptable internal consistency (α = .76).

Headache Disability Inventory (HDI). The HDI consists of 25 questions assessing for functional and emotional headache disability with no specified timeframe. Sample response items consist of: “Because of my headaches I feel handicapped,” “I avoid traveling because of my headaches,” and “My headaches make me feel frustrated.” Response options are “yes” (4 points), “sometimes” (2 points), and “no” (0 points). A score of 0-10 denotes no disability, 10-28 denotes mild disability, 30-48 denotes moderate disability, 50-68 denotes severe disability, and 72-100 denotes complete disability (Gary P. Jacobson et al., 1994). The HDI has strong internal consistency (α = .89), test-retest reliability (*r* = .78 following one week, *r* = .83 following 2 months), and high construct validity (G. P. Jacobson, Ramadan, Norris, & Newman, 1995; Gary P. Jacobson et al., 1994). In the present study, the HDI demonstrated excellent internal consistency (α = .90).

Migraine Disability Index (MIDI). The MIDI was recorded in a daily electronic dairy to assess for day-level migraine disability. The MIDI consists of 4 questions rating the

amount of interference from 0 (not at all) to 10 (totally) with social, leisure activities, and family or at-home tasks on the day of a headache attack (Nicholson et al., 2011) . The four responses were then averaged to obtain an average score per day that ranged from 0-10 with high scores indicating higher disability. The MIDI has good internal reliability and validity, and strong internal consistency (α = .91) (Nicholson et al., 2011). In the present study, the MIDI demonstrated excellent internal consistency (α = .91).

Headache days per 30 days. The number of headache days was recorded in a daily electronic diary over the course of 30 days on an iPod application called Status Post. Participants were asked, "did you have a headache today?" and then asked questions according to the ICHD-3 beta criteria (The International Classification of Headache Disorders, 3rd edition (beta version), 2013) like if the pain was worse on one side, if you felt nauseated, or if light or sound bothered you, to determine if the headache classifies as a migraine.

Average headache severity per 30 days. Over the course of 30 days, participants were asked, "how severe was the pain" on the daily electronic diary only if they recorded having a migraine that day. Response options consist of mild (1), moderate (2), or severe (3). The average headache severity rating was calculated by adding total responses and dividing by 30 days.

Analysis. SPSS Version 26 was used for statistical analysis. Data was first visually inspected. Missing items on questionnaires were imputed using mean scale imputation when the participant had completed greater than 50% of items for the questionnaire at that time point. For daily diary data, e.g. MIDI, headache days, and pain severity, missing individual diary days within months where the participant had completed 50% or more diary days were

singly-imputed using estimates derived from mixed models for repeated measures. Participant and clinical characteristics were assessed for normality. Basic descriptive statistics which included means, medians, standard deviations, interquartile ranges, distributions, and frequencies were conducted. The FFMQ was evaluated using total scores and scores from each of the five facets. The MIDAS was assessed as a dichotomous variable with the cutoff at a score of 21 (less than 21 = mild – moderate disability, and a score of greater than 21 = severe disability). Demographic characteristics such age, gender, ethnicity, race, employment, education, and marital status for total participants, and for each treatment group (MBCT-M group and WL/TAU group), were provided and assessed for baseline differences. Baseline differences between the MBCT-M treatment group and the waitlist control group for the FFMQ scores and migraine-related variables were assessed to determine any significant differences between groups. T-tests for independent samples and chi square tests were run to test differences of variable scores or demographics between groups.

Aim 1. For Aim 1, correlations were used based on linear relationships between variables after inspection. Pearson's r correlations were conducted between baseline FFMQ Total scores and HDI, average MIDI/30 days, headache days/30 days, and average headache severity/30 days. Pearson's r correlations were also conducted between each of the specific five facets of mindfulness on the FFMQ: Observing, Describing, Acting with Awareness, Nonjudging of Inner Experience, and Nonreactivity to Inner Experience, and HDI, average MIDI/30 days, headache days/30 days, and average headache severity/30 days. T-tests were used to evaluate mean differences in the FFMQ Total and subscale scores among people with Severe MIDAS Scores (21+) and Not Severe MIDAS Scores (>21).

Aim 2. For Aim 2, linear mixed-effects models for repeated measures were used to determine the slope of change for mindfulness FFMQ Total and subscale scores for the MBCT-M treatment group compared to slope of change for the WL/TAU group. The present study used mixed models for repeated measures to address any missing data from the daily diary. The best fitting covariance structure was first-order autoregressive based on visually inspecting the covariance data and Akaike's information criterion. Two sensitivity models were run for each linear mixed-effects model in the current study: 1) adjusting for age, which was significantly different between treatment groups, and 2) in completers only, for participants who provided questionnaire data at Month 4. Linear mixed-effects models were also run controlling for baseline differences between FFMQ Observing scores between the MBCT-M group and WL/TAU group.

The outcome measure in the mixed model was FFMQ Total scores to test the first hypothesis under aim 2. The fixed effects in the model were treatment group, month, and the interaction. The random effects in the model were intercept and month. Any non-significant group*month interactions were removed from the model. A larger change in FFMQ Total scores over time was predicted for the MBCT-M treatment group compared to the waitlist control group. The same models were run again with each of the five facets of mindfulness from the FFMQ: Observing, Describing, Acting with Awareness, Nonjudging of Inner Experience, and Nonreactivity to Inner Experience subscales, as the outcome variables in the model. FFMQ subscale analyses were exploratory in nature, and were included to obtain a greater understanding of how each of the five facets of mindfulness change over time over the course of MBCT-M.

To test the second exploratory hypothesis under aim 2, the SPSS Macro MEMORE, designed for mediation and moderation for repeated measures, was used (Montoya & Hayes, 2017). Model 1 was selected for simple mediation to test whether change in FFMQ Total or subscale scores from baseline to Month 4 mediated the relationship between time from baseline to Month 4 and change in HDI scores from baseline to Month 4 (*X* = Month 4 vs Baseline, *Y* = HDI Month 4 vs Baseline, *M* = FFMQ Total Month 4 vs Baseline). The mediation analysis was repeated for each of the five subscales of the FFMQ: Observing, Describing, Acting with Awareness, Nonjudging of Inner Experience, and Nonreactivity to Inner Experience, serving as the mediator (*M*) in the model. The models were first run in the MBCT-M group only to determine if FFMQ scores mediated the relationship between time and HDI within the treatment group alone. Then, the same models were run in the WL/TAU group for comparison. Estimates of indirect effects were provided and analyzed using bootstrapping confidence intervals.

QUALITATIVE METHODS

Participants. Participants were recruited over email through the list of 31 participants in the treatment group that already completed the MBCT for Migraine trial in the parent study (IRB#: 2015-4684). The email included information about a follow-up phone call interview assessing the use of mindfulness for migraine for participants that completed the MBCT study, indicating that the phone call would be about 30 minutes long. Participants were first stratified into two groups: participants with episodic migraine (EM) (n = 15) or participants with chronic migraine (CM) (n = 16). Participants were already recruited for the parent study based on a stratified randomized procedure for EM and CM. Participants were

then contacted randomly from each group until the first 6 people with EM and 6 people with CM agreed to participate in the study.

Participants were emailed a total of 3 times during a two-week period from March 17, 2020 to March 31, 2020. Out of the 31 participants contacted, 2 individuals agreed to participate but did not answer at the time of their scheduled interviews, 1 individual responded declining participation in the study, and 16 individuals did not respond. It is important to note that recruitment for interviews and phenomenological interviews took place beginning in March 2020, while in lockdown during the COVID-19 pandemic. Thus, participation and results could have been influenced by the COVID-19 pandemic. A total of 12 participants completed interviews, 6 people with EM and 6 people with CM, and were asked several questions over the phone about their mindfulness practice in daily life (See Figure 3 for study flow for qualitative study). All participants already signed the MBCT for Migraine protocol informed consent approved by the Institutional Review Board (IRB) of the Albert Einstein College of Medicine and Montefiore Medical Center (IRB#: 2015-4684). Participants also met migraine criteria for the parent research study.

Procedures. Phenomenological interviews were conducted following participant's completion of MBCT-M. A total of 12 interviews occurred with the expectation that data saturation would be met prior to the last interview. Interviews occurred from March 24, 2020 to May 12, 2020 and ranged in length from 22 minutes to 32 minutes, with an average length of 26 minutes. Lauren Rosenberg, M.A., under the supervision of the principal investigator of the parent study, Dr. Elizabeth Seng, who has received training in phenomenological interviewing, conducted the semi-structured interviews. Interviews were all performed over the telephone to minimize demand characteristics. Each individual verbally consented for

participation in the qualitative study and for permission to record interviews. After verbal consent was obtained, interviews were recorded using the Apple software GarageBand and were all de-identified. Lauren Rosenberg, M.A. had previously worked on a study using qualitative methods (Hill et al., 2013), and has experience coding qualitative data. Additionally, Lauren Rosenberg, M.A. completed a Coursera online course titled 'Qualitative Research Methods,' and read the following books on qualitative research methods before conducting interviews:

1) Moustakas, C. (1994). *Phenomenological Research Methods.* California: Sage Publications.

2) Seidman, I. (2013). *Interviewing as Qualitative Research: A Guide for Researchers in Education & The Social Sciences.* New York: Teachers College Press.

Lauren Rosenberg, M.A. transcribed each interview after all 12 interviews were completed. Transcriptions were de-identified and shared securely through email with Ronit Fallek, MPA, a first-year graduate school student at Yeshiva University who assisted with the qualitative research portion of the present study. Ronit Fallek, MPA, served as the Director of the Healing Arts Program at Montefiore Medical Center and had previous experience working on qualitative research studies.

Measures. Phenomenological interviewing, which is a type of qualitative research, objects to explain how individuals experience phenomenon or particular situations (Englander, 2012). Phenomenological interviewing is conducted with people who have lived through certain experiences to uncover themes and implications of the experience (Englander, 2012). This type of method was chosen to determine the use of mindfulness for

migraine with individuals who are actually experiencing migraine and practicing mindfulness for treatment. Participants were asked the following phenomenological interview questions:

1) What is mindfulness and what is the first time you heard about mindfulness?
2) Tell me about the first time you practiced mindfulness after you entered the MBCT study.
3) Can you tell me about a typical time you practiced mindfulness for migraine during the study?
4) Tell me about how you managed migraine attacks during the study.
5) Are you still using mindfulness now, and if so how are you using mindfulness in your daily life?
6) Can you describe whether the practice of mindfulness has affected your life and migraine outcomes?

Following the interviews, the interviewer, Lauren Rosenberg, M.A., completed a standardized measure assessing how much the participant understood mindfulness. A separate graduate student rater, Ronit Fallek, MPA, who had read the transcribed interviews, also completed this measure to obtain inter-rater reliability. The scale consisted of a single question: How much did the participant understand the concept of mindfulness? The interviewer and separate rater answered this question on a 0-10 point scale, with 0 being completely misunderstood the concept of mindfulness, and 10 being completely understood the concept of mindfulness.

Demographic information on the qualitative sample was obtained following the completion of interviews and taken from the baseline questionnaire and daily diary data from the parent MBCT for Migraine study. The following baseline demographic information was

collected: age, gender, ethnicity, race, employment, education, and marital status. Participant's migraine characteristics were also collected at baseline from the parent study: headache days/30 days, average headache severity/30 days, MIDAS, HDI, average MIDI/30 days, preventive medication use, and acute medication use information. FFMQ Total and subscale scores were collected at baseline for the 12 participants in the qualitative sample from the MBCT for Migraine study.

Analysis. Following interview transcription, Lauren Rosenberg, M.A., and Ronit Fallek, MPA, were both involved in creating a codebook through an iterative process. Both Lauren Rosenberg, M.A. and Ronit Fallek, MPA, read and coded all 12 interviews each to ensure data triangulation and that each interview was observed by two different coders. Following coding of the first 2 interviews, and again after the first 6 interviews, Lauren Rosenberg, M.A. and Ronit Fallek, MPA both had a phone call to discuss and compare codes. Following the coding of all 12 interviews, Lauren Rosenberg, M.A. and Ronit Fallek, MPA, had a discrepancy phone call to consolidate codes and finalize a preliminary codebook. The preliminary codebook consisted of 142 codes and was organized in a table consisting of codes, corresponding quotes for each code, interview number, and participant study ID.

After the completion of the preliminary codebook, a meeting took place in early August 2020 with Lauren Rosenberg, M.A., Elizabeth Seng, Ph.D., and Rebecca Wells, MD, MPH to discuss the preliminary codebook and to brainstorm preliminary themes. Rebecca Wells, MD, MPH is a member of the dissertation committee and a headache specialist at Wake Forest Baptist Health. Her research focuses on complementary and integrative medicine for headache, including a background in mindfulness. Both Dr. Seng and Dr. Wells

brought knowledge of mindfulness and migraine into the coding process, and also served as contributors on themes having been separate from the initial coding process. Prior to this meeting, no themes were generated. Ronit Fallek, MPH had sent Lauren Rosenberg, M.A. a list of preliminary themes and ideas prior to the meeting with Lauren Rosenberg, M.A., Dr. Seng, and Dr. Wells. During the meeting, the preliminary codebook was modified and initial themes were discussed.

The meeting resulted in a list of 102 finalized codes and preliminary themes. Lauren Rosenberg, M.A. and Ronit Fallek, MPH then coded the interviews again line-by-line using track changes on Microsoft Word. Ronit Fallek, MPH coded 3 interviews, and Lauren Rosenberg, M.A. coded all 12 interviews again, to compute inter-rater reliability. Cohen's Kappa statistic was used to measure inter-rater reliability.

After further conversations with Ronit Fallek, MPH and Dr. Elizabeth Seng, a list of 10 themes and subthemes were finalized, along with corresponding quotations for each subtheme. Validity was ensured through data triangulation, collaboration with external reviewers who were not part of the initial qualitative process, and by using reflections throughout interviews to check respondent validity and accuracy of understanding of participant responses.

POWER ANALYSIS

For aims 1 and 2 of the present study, G*Power 3.1 software was used for post hoc power sensitivity analysis (Faul et al., 2007). The post hoc power sensitivity analysis was based on a simple correlational model. Based on Cohen's (1988) recommendations, the α level was set to .05 (Cohen, 1988). At an α level of .05, the current study had a power of .90

with a medium effect size at .40 for the current sample size of 60 participants. Post-hoc power analysis was not calculated for mixed effects models.

There is no recommended sample size for qualitative interviews. Reviews of qualitative research show that there is a large range of participants across studies, from 2 to over 400 (Fugard & Potts, 2015). For smaller research projects, a sample size of 6-10 people is recommended (Fugard & Potts, 2015). The present study conducted 12 interviews to ensure adequate sample size, and interviews were to be performed until data saturation was met. Data saturation, which is when no other themes are uncovered, was assessed throughout the coding process. Data saturation was met after 10 interviews.

ETHICS

The MBCT for Migraine study was approved by the Albert Einstein College of Medicine Institutional Review Board (IRB 2015-4684). Individuals involved in the study have all completed appropriate research ethics training. Participants were explained the benefits and risks of the study, and participants all signed informed consent before completing any study procedures. All graduate students involved in the study were supervised by licensed clinical psychologists.

RISK AND BENEFITS

The risks and benefits in the proposed study were outlined in the informed consent for participants. Risks of participating in the study included the possible feeling of discomfort when attending to sensations during mindfulness practice. Other side effects to mindfulness meditation include flooding, which is when participants may vividly remember a past traumatic event. One study focusing on the negative side effects of meditation found that during and following meditation, participants reported side effects of fear, anxiety, sensitivity

to noise or light, and difficulties with social interaction (Lindahl, Fisher, Cooper, Rosen, & Britton, 2017). Participants were informed that they should stop mindfulness practice if their level of discomfort escalated.

The benefits of the study are possibly improving migraine outcomes following MBCT treatment. Participants may experience decreased migraine-related disability and positive changes in stress and mood.

CHAPTER III

Quantitative Results

Participant demographics and characteristics. A total of 60 people with migraine participated in the parent study and were included in secondary analyses in the present study. The MBCT-M group had 31 participants, and the waitlist/treatment as usual (WL/TAU) group had 29 participants. Participant's average age was 40.1 years old (SD = 11.7), and the WL/TAU group was significantly older (mean age of 44.2 years old) than the MBCT-M group (mean age of 36.2 years old), $p = .007$ (see Table 2).

The majority of participants were female (n = 55/60, 91.7%), non-Hispanic (n = 50/60, 83.3%), White (n = 49/60, 81.7%), and employed full-time (n = 38/60, 63.3%). Most participants also had a graduate degree (n = 33/60, 55.0%) or were a college graduate (n = 21/60, 35.0%). Almost half of participants were single (n = 28/60, 46.7%), and the other half were married or living with a domestic partner (n = 26/60, 43.3%). There were no significant differences between gender, ethnicity, race, employment, education, and marital status for participants in the MBCT-M group and participants in the WL/TAU group (see Table 2 for demographic information).

Baseline Migraine Variables. There were 31 participants with chronic migraine, and 29 participants with episodic migraine in the study. Recruitment from the parent study was stratified by episodic and chronic migraine. Within the MBCT-M group, there were 16 individuals with chronic migraine and 15 individuals with episodic migraine, and within the WL/TAU group, there were 15 individuals with chronic migraine, and 14 individuals with episodic migraine. Participants had an average of 16.0 (SD = 5.9) headache days per 30 days, during their baseline period of tracking headache days on the daily diary (see Table 3 for

participant migraine variable characteristics). Participants had an average headache severity rating of 1.7 (SD = 0.3) per 30 days on a headache severity scale of 1 being mild, 2 being moderate, and 3 being severe pain. Headache days/30 days and average headache severity/30 days did not significantly differ between the MBCT-M and WL/TAU groups.

The majority of participants reported severe migraine-related disability per the MIDAS (N = 50/60, 83.3%). The average HDI score was 51.4/100 (SD = 19.0), also indicating severe migraine-related disability. The average disability level of the MIDI per 30 days was 3.1/10 (SD = 1.8), indicating mild to moderate average attack-level disability. At baseline, disability ratings did not significantly differ between the MBCT-M and WL/TAU groups (see Table 3).

Almost half of all participants were taking preventive medication for migraine (N = 29/60, 48.3%). Most participants were taking acute medication for migraine attacks (N = 58/60, 96.7%). Preventive and acute medication use for migraine did not significantly differ between the MBCT-M and WL/TAU groups (see Table 3).

Baseline Mindfulness Characteristics. At baseline, all participants had an average mindfulness Total score of 129.4/195 (SD = 17.7), indicating agreement with most mindfulness options. There was no significant difference between mindfulness Total scores in the MBCT-M group and the WL/TAU group (see Table 4).

At baseline, total participants had an average score of 26.6/40 (SD = 5.3) on the mindfulness Observing subscale, indicating agreement with more than half of mindfulness observing options. There was a significant difference randomly at baseline in mindfulness Observing scores for the MBCT-M group (M = 24.7, SD = 5.2) and the WL/TAU group (M

= 28.5, SD = 4.8); t(54) = 2.93, p = .005, indicating higher baseline levels of Observing scores in the WL/TAU group compared to the MBCT-M group.

At baseline, total participant's average score on the mindfulness Describing subscale was 29.3/40 (SD = 5.0), indicating agreement with most mindfulness describing options. Total participant's average score on the mindfulness Acting with Awareness subscale was 26.3/40 (SD = 5.2), and the average score on the mindfulness Nonjudging of Inner Experience subscale was 27.4/40 (SD = 6.4) at baseline. The average score on the mindfulness Nonreactivity to Inner Experience was 19.9/35 (SD = 4.4), indicating agreement with more than half of mindfulness nonreactivity options. There were no significant differences between scores on the mindfulness Describing, Acting with Awareness, Nonjudging of Inner Experience, and Nonreactivity to Inner Experience subscales in the MBCT-M group and the WL/TAU group at baseline (see Table 4).

AIM 1 Results: Relationships Between FFMQ and Migraine-Related Outcomes at Baseline

The relationships between mindfulness Total scores and subscale scores and the HDI, average MIDI/30 days, headache days/30 days, and average headache severity/30 days at baseline were assessed using Pearson's r correlations (see Tables 5 – 10). Higher mindfulness Total scores were associated with decreased scores on the HDI (decreased migraine-related disability) (r = -.46, p < .001). There were no significant associations between mindfulness Total score and scores on the average MIDI/30 days, headache days/30 days, and average headache severity/30 days at baseline (see Table 5).

There were no significant associations between mindfulness Observing subscale scores and scores on the HDI, average MIDI/30 days, headache days/30 days, and average

headache severity/30 days at baseline (see Table 6). There were also no significant associations between mindfulness Describing subscale scores and scores on the HDI, average MIDI/30 days, headache days/30 days, and average headache severity/30 days at baseline (see Table 7). In summary, no significant relationship was found between mindfulness Observing and Describing subscales and migraine-related disability, headache days, and headache severity.

Higher mindfulness Acting with Awareness subscale scores were associated with decreased scores on the HDI ($r = -.38$, $p = .003$) at baseline. There were no significant associations between mindfulness Acting with Awareness subscale scores and scores on the average MIDI/30 days, headache days/30 days, and average headache severity/30 days (see Table 8). Higher mindfulness Nonjudging of Inner Experience subscale scores at baseline were associated with decreased scores on the HDI ($r = -.42$, $p = .001$). There were no significant associations at baseline between mindfulness Nonjudging of Inner Experience subscale scores and scores on the average MIDI/30 days, headache days/30 days, and average headache severity/30 days (see Table 9). In summation, higher mindfulness levels in subscales of Acting with Awareness and Nonjudging of Inner Experience were both significantly associated with decreased migraine-related disability, as measured by the HDI.

Higher scores at baseline on the mindfulness Nonreactivity to Inner Experience subscale were associated with decreased scores on the HDI ($r = -.33$, $p = .013$). There were no significant associations at baseline between mindfulness Nonreactivity to Inner Experience subscale scores and scores on the average MIDI/30 days, headache days/30 days, and average headache severity/30 days (see Table 10).

There were no significant differences between severe and not severe scores on the MIDAS and the FFMQ Total scores or any FFMQ subscale scores at baseline (see Table 11).

AIM 2 Results: Linear Mixed Effects Models for Changes in Mindfulness Over Time

Linear mixed effects models for changes in mindfulness Total scores and subscales from baseline to month 4 were conducted. For Total mindfulness scores, there was a significant group*month interaction, $F(3, 99.28) = 5.73$, $P = .001$. FFMQ Total estimated mean scores from baseline to Month 4 significantly increased more over time in the MBCT-M group (+10.4) than the WL/TAU group where Total mindfulness scores decreased slightly over time (-0.2) (Month 4 vs. baseline $B = 7.57$, 95% CI = 0.8, 14.4) (See Table 12 and Figure 4). Sensitivity analyses adjusting for age did not change results (group*month interaction, $F[3, 96.39] = 4.98$, $P = .003$; group*Month 4 vs. baseline $B = 7.40$, 95% CI = 2.0, 12.8; Table 13) as well as in completers only (group*month interaction, $F[3, 87.62] = 6.77$, $P < .001$; group*Month 4 vs. baseline $B = 8.42$, 95% CI = 2.9, 13.9; Table 14).

For mindfulness Observing subscale, there was a significant group*month interaction, $F(3, 104.75) = 6.60$, $P < .001$. The between-group difference was significant from baseline to Month 2 (Month 2 vs. baseline B = 2.38, 95% CI = 0.4, 4.3). Mindfulness Observing estimated mean scores from baseline to Month 4 significantly increased more over time in the MBCT-M group (+3.63) than the WL/TAU group where mindfulness Observing estimated mean scores decreased slightly over time (-0.29) (Month 4 vs. baseline $B = 3.98$, 95% CI = 2.0, 5.9) (See Table 12 and Figure 5). Sensitivity analyses adjusting for age did not change results (group*month interaction, $F[3, 98.28] = 6.91$, $P < .001$; group*Month 2 vs. baseline $B = 2.28$, 95% CI = 0.4, 4.1; group*Month 4 vs. baseline $B = 3.66$, 95% CI = 1.8, 5.6; Table 13) as well as in completers only (group*month interaction, $F[3, 93.33] = 6.70$, P

< .001; group*Month 2 vs. baseline *B* = 2.74, 95% CI = 0.8, 4.7; group*Month 4 vs. baseline *B* = 4.38, 95% CI = 2.4, 6.3; Table 14). Given mindfulness Observing scores randomly differed at baseline, where WL/TAU Observing scores were significantly higher than scores in the MBCT-M group, linear mixed effects models for the Observing subscale were also controlled for baseline differences. When controlling for baseline differences in mindfulness Observing scores, results showed there was a significant Group main effect, *F*(1, 33.26) = 5.11, *P* = .030, modified by a significant group*month interaction, *F*[3, 87.83] = 6.67, *P* < .001; group*Month 2 vs. baseline *B* = 2.30, 95% CI = 0.5, 4.8; group*Month 4 vs. baseline *B* = 4.10, 95% CI = 2.1, 6.1; Table 15. Overall, mindfulness Observing subscale scores significantly increased more over time in the MBCT-M group compared to the WL/TAU group, even when controlling for baseline differences in scores.

For mindfulness Describing, there was no significant group*month interaction, *F*(3, 85.05) = 0.34, *P* = .800 (Month 4 vs. baseline *B* = 0.29, 95% CI = -1.6, 2.2) (See Table 12 and Figure 6). Sensitivity analyses adjusting for age did not change results (group*month interaction, *F*[3, 81.93] = 0.50, *P* = .684; group*Month 4 vs. baseline *B* = 0.16, 95% CI = -1.8, 2.1; Table 13) as well as in completers only (group*month interaction, *F*[3, 80.83] = 1.43, *P* = .240; Table 14). The group*month interaction was then removed from the model, and the Month effect remained not significant, *F*(3, 88.00) = 1.06, *P* = .372. Results did not change when adjusting for age (month *F*[3, 87.73] = 1.07. *P* = .367) as well as in completers only (month *F*[3, 82.47] = 1.69, *P* = 1.75).

For mindfulness Acting with Awareness, a significant Month main effect, *F*(3, 96.10) = 3.14, *P* = .029, was modified by a significant group*month interaction, *F*(3, 95.89) = 5.90, *P* = .001. The significant Month main effect occurred from baseline to Month 1 (Month 1 vs.

baseline *B* = -1.37, 95% CI = -2.5, -0.2). The between-group difference was significant from baseline to Month 2, where mindfulness Acting with Awareness estimated mean scores decreased more in the MBCT-M group (-2.15) than the WL/TAU group (-0.88) (Month 2 vs. baseline *B* = -2.39, 95% CI = -4.4, -0.4) (See Table 12). Mindfulness Acting with Awareness estimated mean scores in the MBCT-M group then increased from Month 2 to Month 4 (+2.34) (See Figure 7). Sensitivity analyses adjusting for age did not change results (Month main effect, $F[3, 92.52] = 3.10$, $P = .030$, group*month interaction, $F[3, 92.63] = 5.94$, $P = .001$; group*Month 2 vs. baseline *B* = -2.31, 95% CI = -4.3, -0.4; Table 13) as well as in completers only (Month main effect, $F[3, 86.90] = 3.75$, $P = .014$, group*month interaction, $F[3, 84.12] = 6.53$, $P = .001$; group*Month 2 vs. baseline *B* = -2.79, 95% CI = -4.9, -0.7; Table 14).

For mindfulness Nonjudging of Inner Experience, a significant Month main effect, $F(3, 99.90) = 6.89$, $P < .001$, was modified by a significant group*month interaction, $F(3, 101.51) = 5.61$, $P = .001$. The significant Month main effect occurred from baseline to Month 2 (Month 2 vs. baseline *B* = 3.45, 95% CI = 1.5, 5.4). The between-group difference was significant from baseline to Month 2, where mindfulness Nonjudging of Inner Experience estimated mean scores decreased more in the MBCT-M group (-0.02) than in the WL/TAU group, where mindfulness Nonjudging of Inner Experience estimated mean scores increased (+2.95) (Month 2 vs. baseline *B* = -3.83, 95% CI = -6.6, -1.1) (See Table 12 and Figure 8). Sensitivity analyses adjusting for age did not change results (Month main effect, $F[3, 97.89] = 6.76$, $P < .001$; group*month interaction, $F[3, 99.67] = 5.23$, $P = .002$; group*Month 2 vs. baseline *B* = -3.69, 95% CI = -6.5, -0.9; Table 13) as well as in completers only (Month main

effect, F[3, 90.79] = 7.31, P < .001; group*month interaction, F[3, 89.37] = 5.34, P = .002; group*Month 2 vs. baseline B = -3.33, 95% CI = -6.2, -0.4; Table 14).

For mindfulness Nonreactivity to Inner Experience, there was a significant group*month interaction, F(3, 112.48) = 4.40, P = .006. Mindfulness Nonreactivity to Inner Experience estimated mean scores from baseline to Month 4 significantly increased more over time in the MBCT-M group (+3.51) than the WL/TAU group (0.00, no change) (Month 4 vs. baseline B = 3.17, 95% CI = 1.3, 5.02) (See Table 12 and Figure 9). Sensitivity analyses adjusting for age did not change results (group*month interaction, F[3, 109.71] = 4.02, P = .009; group*Month 4 vs. baseline B = 3.13, 95% CI = 1.3, 5.0; Table 13) as well as in completers (group*month interaction, F[3, 97.68] = 4.07, P = .009; group*Month 4 vs. baseline B = 3.04, 95% CI = 1.4, 4.7; Table 14).

Aim 2 Results: Exploratory Aim, Longitudinal Mediation

Changes in mindfulness Total scores and mindfulness subscale scores were evaluated to determine the impact on the relationship between migraine-related disability, measured by the HDI, and time, from baseline to Month 4, in both the MBCT-M group and WL/TAU group. In the MBCT-M group (n = 25), HDI scores decreased over time from baseline to Month 4 by about 14 points (B = -14.10, 95% CI = 7.34, 20.87). Mindfulness Total scores significantly mediated changes in outcomes of HDI scores over time from baseline to Month 4 in the MBCT-M group (indirect effect B = 7.56, 95% CI = 2.36, 13.69). See Figure 10.

In the WL/TAU group (n = 27), HDI scores decreased over time from baseline to Month 4 by only 1.24 points when adjusting for nothing (B = -1.24, 95% CI = -3.05, 5.54). Mindfulness Total scores did not significantly mediate changes in outcomes of HDI scores

over time from baseline to Month 4 in the WL/TAU group (indirect effect *B* = 0.16, 95% CI = -0.89, 1.63). See Appendix 6.

Further examination of mindfulness subscale scores revealed that no mindfulness subscale scores in the MBCT-M group or the WL/TAU group significantly mediated changes in outcomes of HDI scores over time from baseline to Month 4. Specifically, change in mindfulness Observing scores from baseline to Month 4 did not significantly mediate changes in outcomes of HDI scores and time in the MBCT-M group (indirect effect *B* = 3.30, 95% CI = -5.06, 13.60; Appendix 1) as well as in the WL/TAU group (indirect effect *B* = 0.02, 95% CI = -0.43, 1.34; Appendix 7). Change in mindfulness Describing scores from baseline to Month 4 did not significantly mediate changes in outcomes of HDI scores and time in the MBCT-M group (indirect effect *B* = 1.75, 95% CI = -1.08, 5.83; Appendix 2) as well as in the WL/TAU group (indirect effect *B* = 0.24, 95% CI = -0.24, 1.77; Appendix 8).

Change in mindfulness Acting with Awareness scores from baseline to Month 4 did not significantly mediate changes in outcomes of HDI scores and time in the MBCT-M group (indirect effect *B* = -1.54, 95% CI = -6.91, 2.96; Appendix 3) as well as in the WL/TAU group (indirect effect *B* = -0.47, 95% CI = -2.31, 0.72; Appendix 9). Change in mindfulness Nonjudging of Inner Experience scores from baseline to Month 4 did not significantly mediate changes in outcomes of HDI scores and time in the MBCT-M group (indirect effect *B* = 1.87, 95% CI = -2.16, 7.38; Appendix 4) as well as in the WL/TAU group (indirect effect *B* = 0.14, 95% CI = -0.63, 1.68; Appendix 10). Change in mindfulness Nonreactivity to Inner Experience scores from baseline to Month 4 did not significantly mediate changes in outcomes of HDI scores and time in the MBCT-M group (indirect effect *B* = 5.68, 95% CI =

-0.55, 11.51; Appendix 5) as well as in the WL/TAU group (indirect effect *B* = 0.01, 95% CI = -0.92, 1.02; Appendix 11).

Qualitative Results

Participant demographics and characteristics. A total of 12 people with migraine that were randomized to the MBCT-M treatment group participated in qualitative interviews. Due to the study stratification design, there was a total of 6 participants with chronic migraine, and 6 participants with episodic migraine who participated in qualitative interviews. Total participant's average age was 36.8 years old (SD = 9.4). The average age of participants with EM was 39.0 years old (SD = 12.6), and average age of participants with CM was 34.7 years old (SD = 4.9). Total participants were mostly female (N = 11/12, 91.7%), non-Hispanic (N = 9/12, 75.0%), White (N = 10/12, 83.3%), employed full-time (N = 9/12, 75.0%), had a graduate degree (N = 8/12, 66.7%), and were married or living with a domestic partner (N = 7/12, 58.4%). See Table 15 for demographic information for the qualitative study sample.

Participants with EM were mostly female (n = 5/6, 83.3%), non-Hispanic (n = 5/6, 83.3%), White (n = 5/6, 83.3%), employed full-time (n = 4/6, 66.7%), had a graduate degree (n = 4/6, 66.7%), and half were married or living with domestic partner (n = 3/6, 50.0%). Participants with CM were all female (n = 6/6, 100%), mostly non-Hispanic (n = 4/6, 66.7%), White (n = 5/6, 83.3%), employed full-time (n = 5/6, 83.3%), had a graduate degree (n = 4/6, 66.7%), and were married or living with domestic partner (n = 4/6, 66.7%). See Table 15.

Baseline Migraine Variables. Total participants had a baseline average of 15.8 (SD = 6.1) headache days per 30 days (see Table 16 for qualitative participant migraine

variables). Participants with EM had an average of 11.5 (SD = 5.8) headache days per 30 days, and participants with CM had an average of 20.0 (SD = 2.5) headache days per 30 days at baseline. Total participants had an average headache severity rating of 1.7 (SD = 0.4) per 30 days at baseline on a headache severity scale of 1 being mild, 2 being moderate, and 3 being severe pain. Participants with EM had an average headache severity rating of 1.8 (SD = 0.4) per 30 days, and participants with CM had an average headache severity rating of 1.7 (SD = 0.3) per 30 days at baseline (See Table 16).

The majority of total participants had severe migraine-related disability per the MIDAS (N = 9/12, 75.0%) at baseline. The majority of participants with EM had severe migraine-related disability per the MIDAS (n = 4/6, 66.7%), and majority of participants with CM had severe migraine-related disability per the MIDAS (n = 5/6, 83.3%). Participants had an average disability rating of 47.3/100 (SD = 19.5) on the HDI, indicting moderate migraine-related disability. Participants with EM had an average HDI score of 35.7/100 (SD = 18.9) at baseline, indicating moderate migraine-related disability, while participants with CM had an average HDI score of 59.0/100 (SD = 12.2), indicating severe migraine-related disability at baseline. This is consistent with previous literature indicating higher levels of migraine-related disability in patients with CM compared to patients with EM (Meletiche et al., 2001). For total participants, the average disability level of the MIDI per 30 days at baseline was 2.4/10 (SD = 1.5). Participants with EM had an average MIDI score per 30 days at baseline of 2.0/10 (SD = 1.6), and participants with CM had an average MIDI score per 30 days at baseline of 2.7 (SD = 1.4). See Table 16.

A total of 7/12 participants (58.3%) were not taking preventive medication for migraine, while 5/12 participants (41.7%) were taking preventive medication. A minority of

participants with EM were taking preventive medication (n = 2/6, 33.3%), while half of participants with CM were taking preventive medication (n = 3/6, 50.0%). All participants (N = 12, 100%) were taking acute medication for migraine (see Table 16).

Baseline Mindfulness Characteristics. At baseline, qualitative participants had an average FFMQ Total score of 134.4/195 (SD = 16.7), indicating agreement with most mindfulness options (see Table 17 for baseline mindfulness characteristics). Participants with EM had an average FFMQ Total score of 138.0/195 (SD = 19.7), and participants with CM had an average FFMQ Total score of 130.9 (SD = 14.0) at baseline.

Total participants had an average score of 25.7/40 (SD = 4.3) on the FFMQ Observing subscale, and an average score of 30.7/40 (SD = 3.8) on the FFMQ Describing subscale at baseline. Total participants had an average score of 29.2/40 (SD = 4.6) on the FFMQ Acting with Awareness subscale, and an average score of 29.3/40 (SD = 7.7) on the FFMQ Nonjudging of Inner Experience subscale at baseline. Total participants had an average score of 19.7/35 (SD = 4.9) on the FFMQ Nonreactivity to Inner Experience subscale at baseline (see Table 17).

Participants with EM had an average FFMQ Observing subscale score of 24.2/40 (SD = 2.9), an average FFMQ Describing subscale score of 31.8/40 (SD = 3.0), an average FFMQ Acting with Awareness subscale score of 32.8/40 (SD = 3.3), an average FFMQ Nonjudging of Inner Experience subscale score of 30.3/40 (SD = 9.2), and an average FFMQ Nonreactivity to Inner Experience subscale score of 18.8/35 (SD = 5.9) at baseline. Participants with CM had an average FFMQ Observing subscale score of 27.2/40 (SD = 5.2), an average FFMQ Describing subscale score of 29.5/40 (SD = 4.3), an average FFMQ Acting with Awareness subscale score of 25.5/40 (SD = 2.1), an average FFMQ Nonjudging

of Inner Experience subscale score of 28.2/40 (SD = 6.6), and an average FFMQ Nonreactivity to Inner Experience subscale score of 20.5/35 (SD = 4.1) at baseline. See Table 17.

AIM 3 Results: To Understand and Describe the Use of Mindfulness in Daily Life for MBCT-M Participants

The initial codebook consisted of 142 codes after line-by-line coding of 12 qualitative interviews. After a preliminary codebook meeting in early August 2020, the codebook was revised and updated to include 102 codes. Inter-rater reliability ranged from .644 to .786, indicating substantial agreement. A total of 10 themes with subsequent subthemes resulted after examination of all codes and illustrative quotes from the 12 interviews.

For 3/12 participants, the MBCT study was their first introduction to mindfulness practice. Prior to the MBCT study, 1 participant was regularly meditating. Participants were referred to the MBCT study for various reasons: 2/12 participants were recommended mindfulness practice because of a psychiatric condition, 2/12 participants were recommended to the MBCT study by their doctor or neurologist, and 2/12 participants were recommended mindfulness practice through their jobs. Participants reported first hearing about mindfulness through the media (n = 4/10) or in scientific journals (n = 1/10). Half of participants (n = 6/12) reported the definition of mindfulness is related to meditation.

Following the MBCT study, 11/12 participants reported they were practicing mindfulness in some way. A total of 5/12 participants reported intermittent formal mindfulness practice, and 4/12 participants reported continuous daily mindfulness practice. After MBCT study participation, 1 participant reported no formal mindfulness practice.

A majority of participants had a good understanding of mindfulness as evaluated by the interviewer, Lauren Rosenberg, M.A., and a separate graduate student rater, Ronit Fallek, MPA. On a scale from 0-10, with 0 being completely misunderstood the concept of mindfulness, and 10 being completely understood the concept of mindfulness, participants had an average rating of 8.92, indicating good understanding of the concept of mindfulness. Kappa tests revealed inter-rater reliability of .581, indicating moderate agreement between raters.

Theme One: Discomfort Practicing Mindfulness (Table 18 and 28)

> "I like very vividly recall getting like upset about having like an active physical discomfort of having to experience the sensations."
>
> Interview 1, EM

Most commonly, participants described frustration or annoyance with mindfulness practice, and physical discomfort while practicing. Terms used to describe discomfort practicing mindfulness also included emotional overload, emotional discomfort, flooding, a changed relationship toward the discomfort, allodynia, and a discomfort the very first time practicing mindfulness. All participants that described discomfort while practicing mindfulness had EM, while no participants with CM reported discomfort practicing mindfulness.

Theme Two: Routine Mindfulness Practice is Difficult (Table 19 and 29)

> "And I remember telling myself, like, you can think about that other thing later. Try to stay. Try to stay here and now. And, you know, during the study, it got easier. But it was hard."
>
> Interview 11, CM

Participants with both EM and CM reported routine mindfulness practice is difficult, with most common barriers to practicing mindfulness including: busyness, takes gradual skill development, and mind wandering during practice. More participants with CM (3/4 subtheme responses) described thoughts/emotions are distracting during mindfulness practice, than participants with EM (1/4 subtheme responses), and more participants with CM (3/4 subtheme responses) reported mindfulness practice was cognitively difficulty during a severe migraine attack compared to participants with EM (1/4 subtheme responses). More participants with EM (3/4 subtheme responses) described difficulty balancing mindfulness practice with social, family, or work obligations, compared to participants with CM (1/4 subtheme responses). Participants also described barriers including forgetting to practice, length of practice, e.g. longer meditations were more difficult, certain mindfulness exercises resonated more, finding enjoyable meditations, and one participant described mindfulness as "cheesy."

Theme Three: Mindfulness Practice Provides Control/Is Empowering (Table 20 and 30)

> "It's also helped me realize that in some ways I have some semblance of control over my migraine, because I think that's something that I really didn't feel like I had early on. I felt like I was at the mercy of my migraines and had to do whatever I could to try to feel better and before I felt like I had no control over it. But now realizing that oh yeah I can at least predict better when I'm getting a headache and be able to take the medicine earlier and help improve how I'm going to feel, I think that was a really nice sense of control that I gained which I kept."
>
> Interview 7, CM

The most common subtheme was mindfulness practice increased control over migraine and migraine management. All participants with CM (6/6), described increased control over migraine. Participants also described an increased control over their thoughts, mood, and actions, and a changed mindset or different perspective on life. For 1 participant with EM, mindfulness also provided a sense of empowerment.

Theme Four: Mindfulness Improved Acceptance/Appreciation (Table 21 and 31)

> "One time I remember being on the train standing and it's hot and there is weird smells, all these things that can cause a migraine, I felt one coming on and I, the mindfulness was fresh in my mind, and I was able to just focus on what I was feeling and accepting all the smells and the sounds and the heat. And it didn't necessarily get rid of the headache, but just accepting that it was happening was a whole new thing for me."
>
> Interview 4, CM

Participants with both EM and CM described a changed relationship to migraine after mindfulness practice, e.g. feeling less stressed about migraine onset. Only participants with CM (5/6 total participants with CM), described acceptance of migraine, and being kinder to themselves and taking time to prioritize self-care, whereas no participants with EM reported acceptance of migraine or being kinder to themselves for practicing mindfulness and self-care. Participants also described enjoyment of life, appreciation without judgment, appreciation of the present moment, and appreciation of their surrounding environment.

Theme Five: Mindfulness as Acute Treatment (Table 22 and 32)

> "So if I'm getting a migraine around 3:00, and at 4:00 I would have had a really really bad migraine, but at 3:00 I'm mindful, it's almost like I lower the threshold of how bad the migraine can be."
>
> Interview 4, CM

For participants with both EM and CM, the most common subthemes were using mindful awareness to manage acute migraine attacks, and having a committed action/plan to manage acute attacks. Participants also described using meditation only during migraine attacks, rather than medications, and described using meditation while waiting for medication to work for migraine treatment.

Theme Six: Mindfulness as Preventive Treatment (Table 23 and 33)

> "I mostly did it in the morning or in the evening before work and I followed whatever that week's task or activity was… I tried to have a routine. Like I did it the same time every day. It wasn't like, oh I have a migraine I need to do this, it was like 9:00 in the morning, that was the time to do it. So it was more about getting into a routine than about identifying a specific time it was needed and doing it then."
>
> Interview 1, EM

Participants identified using mindfulness practice as preventive treatment, e.g. something they practiced regularly to improve migraine and quality of life outcomes, by reporting they followed the instructions of the program regularly. More participants with CM (5/6 subtheme responses) identified using mindfulness as a preventive anxiety management tool, compared to participants with EM (1/6 subtheme responses). Participants also identified

practicing mindfulness through yoga and using mindfulness practice for a broad value for improving quality of life.

Theme Seven: Increased Awareness of Emotions/Thoughts/Bodily Sensations (Table 24 and 34)

> "Yeah even my posture too. I completely ignored that before since I was so focused on something else and on work and didn't pay attention to what my body was telling me."
>
> Interview 5, EM

For participants with both EM and CM, the most common subthemes were increased awareness of: the present moment, physical sensations, senses, and the breath (interoception). Participants (4/12 total participants) with both EM (2/4 subtheme responses) and CM (2/4 subtheme responses) also expressed awareness of anticipatory anxiety about migraine.

Theme Eight: Feelings of Guilt (Table 25 and 35)

> "So I used to get a migraine and think, I just have to take my medication but I have too much other stuff to do, and if I actually just do the mindfulness it lowers my stress. By doing mindfulness, and seeing the benefit of it, has made me more able to relax and take time that I need mentally without feeling guilty about it."
>
> Interview 4, CM

Half of participants with CM (3/6), described guilt taking the time for mindfulness practice and pressure to practice mindfulness correctly. Other subthemes associated with feelings of guilt identified were a need to justify migraine treatment to others (reported by 1

participant with EM), and that mindfulness changed feelings of guilt towards migraine (reported by 1 participant with CM).

Theme Nine: Mindfulness Helped Migraine Management/Problem Solving During Migraine (Table 26 and 36)

> "I don't know I wouldn't even think about it [the pain 3 years ago] and now I can feel the pain and it really helps. Sometimes I can't prevent it but it helps me take the medication earlier which is a tremendous thing because then the abortive medication just works and then I don't have the migraine at all or I have it very mild, or I can take medications that aren't as strong and still be able to get rid of the migraine."
>
> Interview 5, EM

Participants described that mindfulness helped with migraine management and problem solving during a migraine attack, with most common subthemes of mindfulness helped with treating migraine early, was a migraine management tool/made migraine feel more manageable., and aided medication decision making. More participants with CM (5/7 subtheme responses) described mindfulness helped with treating migraine early, and described mindfulness was a migraine management tool/made migraine feel more manageable (4/5 subtheme responses), compared to participants with EM (2/7 subtheme responses and 1/5 subtheme responses, respectively).

Theme Ten: Participation in MBCT-M Study Increased Accountability for Mindfulness Practice (Table 27 and 37)

> “And so I liked the experience of having that encouragement because I think when you're starting, it is a little foreign. And it was nice to have that extra coaching.”
>
> Interview 9, CM

Participants described increased accountability for mindfulness practice during the MBCT-M study, with most common subthemes being: documentation of practice held me accountable, liked hearing therapist’s voice in meditation recordings, and coaching of therapist was helpful. Voices in the mindful meditation recordings were matched to who did 1:1 therapy with each participant. Only participants with CM (4/4 subtheme responses) described documentation of practice held them accountable.

CHAPTER IV

Discussion

This mixed-method study is a secondary analysis of a phase 2b randomized clinical trial of MBCT for Migraine that found certain aspects of mindfulness, e.g. Total mindfulness, Observing, and Nonreactivity to Inner Experience, significantly increased in participants with migraine who completed an 8-week individual protocol of MBCT-M compared to WL/TAU. Additionally, specific facets of mindfulness, e.g. Acting with Awareness and Nonjudging of Inner Experience, significantly decreased in participants with migraine who completed MBCT-M compared to WL/TAU from baseline to Month 2, half-way through the MBCT-M protocol, and then increased from Month 2 to Month 4 (one month following MBCT-M treatment) in the MBCT-M group, although not to a clinically significant degree. These initial decreases could be due to difficulties beginning to practice mindfulness and incorporating mindfulness techniques in acting with awareness or nonjudging of inner experience early on in treatment. Total mindfulness scores significantly mediated changes in headache-related disability (HDI) over time, whereas no specific components of mindfulness were found to impact the relationship between migraine-related disability and time. Qualitative analyses supported quantitative findings suggesting that mindfulness is useful for migraine treatment, mindfulness aides in decision making for people with migraine, and aspects of mindfulness may be difficult, change, and improve over time.

Notably, the present study found certain aspects of mindfulness specifically increase over time over the course of MBCT-M treatment, while other areas of mindfulness did not improve when compared to WL/TAU. Over the course of treatment, MBCT-M mostly targeted overall mindfulness concepts (FFMQ Total), increased awareness of the environment and senses (Observing), and a developed sense of awareness and acceptance without reactions to emotions (Nonreactivity to Inner Experience). This corroborates with qualitative findings where two major themes emerged in which participants who received MBCT-M reported increased awareness of emotions/thoughts/bodily sensations and improved acceptance and appreciation. There were no changes in participant's abilities to explain or put their feelings into words (Describing) in the MBCT-M group compared to WL/TAU.

No other study has examined in detail mindfulness as a change mechanism of MBCT treatment over time in populations with migraine. One previous study examining brief-MBCT for chronic tension-type headache also found significant changes in only FFMQ Observing pre- and post-treatment in the treatment group compared to the control group (Cathcart et al., 2014). It is possible that people with migraine are already aware of their surrounding triggers to migraine, thus leading to possible improvements in Observing over the course of treatment. It is also possible that a lack of power given small sample size or theoretical commonality between facets of mindfulness on the FFMQ resulted in certain areas of mindfulness changing over time, while other areas did not improve.

For both FFMQ Acting with Awareness and FFMQ Nonjudging of Inner Experience, mean scores significantly decreased from baseline to Month 2, and then scores increased from Month 2 to Month 4 (although not a statistically significant increase) in the MBCT-M

group compared to WL/TAU. Decreases in scores early on in treatment could be indicative of the difficulties of learning a new skill as evidenced by qualitative findings. Further, participants may have experienced an initial increase in stress awareness, since they may not have fully understood questions focused on awareness at the start of MBCT-M, compared to after beginning the program. Qualitative data in the present study showed mindfulness practice is difficult, mindfulness practice was easier over time throughout the study, and feelings of guilt emerged. Being in the present moment, acceptance, and feeling less guilty of emotions (FFMQ Acting with Awareness and FFMQ Nonjudging of Inner Experience) may have increased from Month 2 to Month 4 based on the MBCT-M treatment protocol. The last 4 weeks of treatment following Month 2 focused on concepts such as allowing/letting be, learning how to experience stressors without judging them, choosing how to respond to situations, thoughts are not facts, and letting thoughts pass without judgment. These are all skills that are most closely related to the FFMQ subscales of Acting with Awareness and Nonjudging of Inner Experience, so it is evident that these facets did improve after participants learned these specific areas of mindfulness. Initial decreases in scores from baseline to Month 2, and then increases in scores from Month 2 to Month 4 may suggest that participants could benefit from mindfulness-based treatment longer than 8 weeks to develop greater trait mindfulness as measured by the FFMQ (Baer et al., 2006). Future studies should examine any benefits from longer mindfulness protocols. Future studies should also investigate whether additive treatment modalities like Acceptance and Commitment Therapy may facilitate increased acceptance, nonjudging, and awareness of migraine in the present moment, since pain acceptance may help to improve pain and disability in patients with migraine (Foote et al., 2016).

The present study further examined the relationship between mindfulness and migraine-related disability, finding correlations between increased levels of mindfulness and deceased migraine-related disability at baseline, prior to receiving MBCT-M treatment. Mindfulness-based interventions focus on observation, awareness, and nonjudgment of migraine experiences, which was thought to impact migraine-related disability rather than headache days and thus chosen as the main outcome variable in the parent study (Day et al., 2013; Seng et al., 2019). Consistent with this hypothesis, the present study found no relationships between mindfulness and headache days or severity. Higher FFMQ Total, Acting with Awareness, Nonjudging of Inner Experience, and Nonreactivity to Inner Experience scores were all associated with lower scores on the HDI, a measure of emotional and functional migraine-related disability, whereas FFMQ Observing and Describing scores were not correlated to migraine-related disability scores. This is supported by previous literature where Observing and Describing facets were not correlated to psychological distress (Baer et al., 2006; Medvedev et al., 2018). Further, one prior study found the FFMQ Observing subscale did not assess for emotional awareness, which may provide reason for a non-significant relationship between this subscale and a measure of emotional migraine-related disability (Rudkin et al., 2018). Future studies assessing for the relationship between mindfulness and emotional disability, defined as affective distress, in patients with migraine may consider removing the Observing subscale if using the FFMQ to measure mindfulness.

Mindfulness may mediate change in migraine-related disability as measured by the HDI over time for the MBCT-M group compared to the WL/TAU group. In the present study, FFMQ Total scores mediated the relationship between change in HDI and time over baseline to Month 4 in the MBCT-M treatment group, and not in the WL/TAU group.

However, when examining facets of mindfulness more closely, no FFMQ subscales elucidated significant mediations between migraine-related disability and time. This finding may suggest that a combination of all five facets of mindfulness, Observing, Describing, Acting with Awareness, Nonjudging of Inner Experience, and Nonreactivity to Inner Experience, are needed to serve as a change mechanism for migraine-related disability over the course of MBCT-M treatment, rather than a certain component of mindfulness alone.

Additionally, researchers may not be measuring changes in mindfulness as accurately as possible by just using the FFMQ to determine change mechanisms in mindfulness-based interventions for migraine. One recent study showed MRI changes in the brain and greater cognitive efficiency during a cognitive challenge in participants with EM who received enhanced mindfulness based stress reduction compared to stress management for headache (Seminowicz et al., 2019). This study found differences at week 20 in brain activation, specifically reduced activation in the bilateral cuneus and right parietal operculum, and changed visual cortex connectivity in MBSR compared to stress management for headache (Seminowicz et al., 2019). Future studies should move towards measuring mindfulness with brain biomarkers in addition to measures like the FFMQ to further examine change mechanisms within mindfulness-based interventions to inform treatment.

This study was one of the first to address findings from qualitative data to determine how people with EM and CM are using mindfulness in their daily lives. Results indicated differences between participants with EM and CM who completed MBCT-M treatment. Strikingly, only participants with EM reported discomfort while practicing mindfulness. Discomfort was often described as a frustration or annoyance with practice, physical discomfort, or emotional discomfort. It is important to note that meditation comes with

potential side effects of discomfort and may trigger past traumatic events (Lindahl et al., 2019). It is possible that participants with EM experience greater discomfort than participants with CM since they spend less time focused on pain than participants with CM. People with CM experience greater pain severity, emotional burden, and disability levels than people with EM (Katsarava et al., 2012). Thus, participants with CM may have been more conditioned to experiencing negative emotions and physical pain than participants with EM, making mindful meditation less discomforting than for participants with EM. Alternatively, participants with CM could have "numbed out" their pain, which may signal that it could take more work for participants with CM to be tuned into mindfulness skills. While mindfulness practice may be discomforting for participants with EM, mindfulness-based treatment for migraine has been effective at lowering disability and headache days for people with EM (Seminowicz et al., 2019; Seng et al., 2019). Future research should further examine possible reasons for discomfort in people with EM by having participants record discomfort on a daily diary, and through further qualitative interviews. A few people with EM experienced a changed relationship toward discomfort over the course of MBCT treatment, so it is possible participants with EM may need a greater amount of time partaking in mindful activities or meditation to become comfortable with the practice.

The present study also found at-home mindfulness practice and MBCT-M treatment are certainly not easy tasks. More than half of participants reported mindfulness practice was difficult, specifically that it is hard to practice when leading a busy life, takes gradual skill development, mind is often wandering, and that thoughts and emotions are distracting. Mindfulness is a difficult skill to learn and practice, which again may provide further support for longer protocols for MBCT treatment, and future studies should continue to compare

standard 8-week MBCT protocols, to shorter or longer protocols (Carmody & Baer, 2009). Additionally, more participants with CM than EM reported mindfulness was cognitively difficult to practice during a severe migraine attack. This result is not surprising given people with CM generally have higher migraine pain intensity than people with EM (Blumenfeld et al., 2011). This finding indicates people with CM may want to use other relaxation techniques, such as deep breathing or progressive muscle relaxation, during a migraine attack rather than mindfulness practice. Clinicians should validate and normalize to patients with migraine throughout mindfulness-based treatment that mindfulness is difficult to practice.

According to qualitative results, mindfulness practice also improved acceptance in people with migraine who received MBCT-M treatment. In particular, 5 out of 6 participants with CM reported greater acceptance of migraine. A previous study found increased acceptance was associated with lower levels of migraine-related disability, depression, and anxiety in people with migraine from a tertiary care headache center (Seng et al., 2018). This finding may indicate mindfulness is particularly valuable in treatment for patients with CM who already have higher levels of disability to fuel acceptance to improve outcomes. Acceptance should be further explored in future studies as a potential change mechanism in MBCT-M treatment to impact changes in migraine-related disability over time. Additionally, behavioral treatments that focus on acceptance, such as Acceptance and Commitment Therapy, should be evaluated for effectiveness in changes in migraine-related outcomes for patients with both CM and EM (Grazzi et al., 2019). One previous study found a one-day Acceptance and Commitment Therapy plus Migraine Education workshop was effective at improving depressive symptoms, anxiety symptoms, migraine-related disability, and pain acceptance in a sample of 25 veterans with comorbid migraine and depression and/or anxiety

(Huddleston et al., 2018). Practitioners may consider adding one-day booster workshops focusing on acceptance and migraine over time following MBCT treatment to improve outcomes.

Qualitative findings of the present study show mindfulness helped to improve migraine management and problem solving during migraine attack. Decision making in the moment and at the attack level is crucial for patients with migraine given the episodic nature of migraine versus chronic pain (Peters et al., 2003). Further, a previous study found patients with chronic migraine with medication-overuse headache had weakened decision making skills as evidenced by neurological circuits similar to people with substance-use disorders (Biagianti et al., 2012). Most people with migraine report delaying their medication intake, yet taking medication early on while headache pain is mild has been found to be most effective for treating migraine attacks (Foley et al., 2005; Goadsby et al., 2008). More than half of all participants with migraine were using mindfulness as an acute treatment by using mindful awareness to manage acute attacks. When participants were present in the moment, they were aware of their pain earlier, which then helped with treating migraine earlier. Notably, more participants with CM than EM reported mindfulness helped with treating migraine early, made migraine feel more manageable, and aided medication decision making. All 6 participants with CM also reported increased control over migraine and migraine management. Mindfulness can be used at the attack level, especially for patients with CM, to aide in decision making for migraine, to improve migraine-related outcomes and quality of life.

Qualitative findings also supported the notion that nonspecific treatment techniques across behavioral interventions may lead to improved outcomes (Kazdin, 1979). Participants

reported partaking in MBCT-M therapy increased their accountability to practice mindfulness, specifically noting documenting practice held them accountable, and the coaching and voice of their therapist was helpful. Similar qualitative findings were reported in a previous study comparing MBCT treatment responders and non-responders in people with headache pain where participants commented on therapist characteristics such as being caring and facilitative (Day et al., 2014). Therapists working with patients with migraine should focus on creating and maintaining a strong therapeutic alliance by establishing common goals for therapy and providing an open, safe place for patients to speak about migraine.

Clinical Implications

For Patients with Migraine: Patients with migraine would benefit from learning and engaging in mindfulness-based cognitive therapy, and the practice of mindful awareness in daily life to improve functioning. Learning mindfulness tools may help to inform treatment decisions for migraine, increase awareness to migraine onset, and may be empowering. Based on qualitative results, patients with migraine should consider using mindful meditation recordings from people that they know to increase accountability to practice, rather than using mindfulness-based applications on their phone.

For Providers: Providers engaging with patients with migraine should learn mindfulness, provide mindfulness-based cognitive therapy or mindful awareness exercises to patients with migraine**,** or refer patients with migraine to other clinicians who practice mindfulness for migraine. Providers should be aware of challenges associated with mindfulness practice as identified in the current study, such as mindfulness is difficult to practice, can provide discomfort, and is easier to learn over time. Providers should therefore

validate to patients with migraine that mindfulness is difficult to incorporate into daily life, and may be easier to learn over time following increased practice. Providers may want to provide patients with migraine a handout on mindfulness techniques to practice following appointments. Additionally, providers should ask patients with migraine how they are using mindfulness in their daily life during appointments, rather than relying on scale measurements to assess for mindfulness practice. This will give providers a greater understanding of patient's personal experience with mindfulness and migraine, which will help guide treatment planning.

Limitations

The present study included a sample of majority White, highly educated, female participants. Thus, results can only be generalized to patients with migraine from this group. This is consistent with prevalence of migraine, as historically less males and less people of color have migraine compared to White, female populations (R. B. Lipton et al., 2011). More recent data suggests that migraine or severe headache is most prevalent in American Indian or Alaska Natives (Burch, Rizzoli, & Loder, 2018). However, previous research has found migraine is more prevalent in people of lower income compared to people of higher income households (R. B. Lipton et al., 2011). Future research should prioritize recruitment of a diverse sample, including people of lower socioeconomic status, to determine the effects of mindfulness on migraine-related treatment outcomes.

Additionally, this study did not include people with daily headache or with infrequent migraine, so results may not be generalizable to these patients. Participants were also recruited between the ages of 18 to 65 years old, with the average age of participants around

40 years old in the present study. Future studies should assess the use of MBCT for older adult populations with migraine and other comorbid medical or psychiatric conditions.

The recruitment goal of the parent study was originally 80 participants, but recruitment was stopped at 60 participants. Additionally, it was planned to recruit a larger qualitative sample, but only 12 participants responded. Larger sample sizes are needed to provide greater power for analyses and a greater range of levels of baseline mindfulness. Additionally, qualitative recruitment and interviews could have been impacted by contacting participants during the COVID-19 pandemic and during quarantine. Qualitatively, this study also examined differences between responses from participants with EM and CM with a sample size of 12 participants. These differences are worthy of exploring in larger sample sizes to better determine differences in responses about mindfulness from participants with EM and CM. Since this was one of the first qualitative studies to examine the use of mindfulness in participants with EM and CM, more qualitative studies are needed to continue to learn more about how people with migraine are using mindfulness in their daily lives.

This study also included people who were highly interested in mindfulness and participating in MBCT treatment. As evidenced by both qualitative and quantitative baseline data findings, participants had a high understanding of mindfulness, and some were practicing either mindfulness or meditation prior to participation in the MBCT-M study. Therefore, changes in mindfulness may not have been as apparent over time since participants were already starting off the study with fairly high levels of mindfulness. Researchers should attempt to recruit participants who have never practiced mindfulness before to better determine changes in outcomes over time.

In regards to treatment groups in the parent study, a waitlist/treatment-as-usual group was utilized versus the MBCT-M treatment group. A treatment-as-usual group is usually the alternative in real-life situations, so it provides meaningful data that can be compared to life circumstances. However, the present study was unable to compare mechanisms of change between MBCT and other behavioral interventions for migraine, such as Cognitive Behavioral Therapy, relaxation, or biofeedback techniques. Future studies should consider adding other behavioral interventions to be able to determine change mechanisms that may be specific to MBCT for migraine.

The present study also provided individual 8-week MBCT-M sessions, while MBCT is often provided in a group format. Qualitative data was thus lacking responses from participants about the influence of being surrounded and supported by other people with migraine. Replications of the current study should be conducted using MBCT-M in a group format. Future studies may also include groups who are randomized to receive individual MBCT-M treatment or group MBCT-M treatment to determine outcomes of group versus individual therapy to further inform treatment delivery for migraine.

This study sought out to examine changes in specific components of mindfulness throughout MBCT-M treatment, as measured by the FFMQ. The FFMQ comes with its limitations, as there may be theoretical overlap between facets. As previously mentioned, studies have found the Observing subscale lacks assessment for emotional awareness (Rudkin et al., 2018). One study found in a sample of meditators, the factor structure of the FFMQ changes over time from pre- to post-MBCT treatment where meditation influences the correlation between the Observing subscale to the four other facets of mindfulness over time (Williams et al., 2014). Researchers in this study suggest possibly eliminating the Observing

subscale when conducting pre- and post-MBCT treatment comparisons (Williams et al., 2014). Further, in a previous study with people with chronic migraine, only the Nonjudging of Inner Experience and Nonreactivity to Inner Experience subscales were chosen to assess for mindfulness as they most closely related to one's relationship with pain (Ciere et al., 2019).

The present study also examined each facet of the FFMQ, increasing the number of analyses run and Type I error. Future studies should consider only using Total mindfulness scores, or limiting the number of facets examined to decrease Type I error. The FFMQ is also a measure of trait mindfulness instead of state mindfulness, so changes in trait mindfulness over time may be more difficult to assess. Future analyses should include mindfulness practice time, to determine the impact of practice time outside of MBCT-M sessions and changes in mindfulness over time, and the impact of practice time on changes in migraine-related disability over time. Future studies should move to use brain biomarkers to measure mindfulness treatment outcomes to eliminate self-report biases in people with migraine (Seminowicz et al., 2019). The present study utilized a mixed-method design to evaluate how people with migraine are using mindfulness to also address limitations of the FFMQ.

Conclusions

The present study found certain aspects of mindfulness changed over time during the course of MBCT-M treatment. A combination of all five facets of mindfulness was needed to mediate the relationship between migraine-related disability over time, suggesting learning and practicing all areas of mindfulness may be most beneficial to improve outcomes in people with migraine. People with migraine are using mindfulness to help aide in decision making and as an acute treatment during a migraine attack. Participants also reported

mindfulness is difficult, uncomfortable at times, is easier to learn over time, increases awareness in the present moment, can be empowering, and improves acceptance, which all inform treatment for people with both EM and CM. Mindfulness can be used to improve awareness in the moment to bodily sensations and migraine onset, leading patients to treat migraine earlier, which may result in improved quality of life outcomes and improved response to treatment. Mindful awareness is a tool that both providers and people with migraine can be taught to benefit migraine management and used at the attack level in combination with other preventive medication or behavioral treatment options.

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TABLES

Table 1

MBCT-M sessions (Seng et al., 2019).

Theme	Teach a Concept	Practice a Skill	Homework
1: Automatic Pilot	Automatic pilot involves lacking awareness and habitual responding to one's environment. Mindfulness can improve living with migraine through intentional awareness.	▪ Body scan ▪ Mindful eating	▪ Body scan
2: Awareness of Appraisals and Stress	Mindfulness allows you to observe how you feel and think. How we appraise a situation is more important than the objective situation itself. How you appraise migraine and other life stressors can impact the stress response, which in turn influences your likelihood of having a migraine attack.	▪ Body scan ▪ Awareness of appraisals ▪ Awareness of thoughts arising during breathing meditation	▪ Body scan ▪ Mindfulness of breath ▪ Awareness of thoughts ▪ Stressful events calendar
3: Mindfulness of the Breath	Practicing mindfulness throughout the day can break automatic pilot patterns and disrupt the stress response. The breath is always with you and can anchors you to the present moment.	▪ Breathing space ▪ Labeling automatic thoughts	▪ Sitting meditation and body scan ▪ Breathing space

4: Recognizing Aversion	Aversion is an automatic response to avoid unpleasant experiences. Mindfulness helps us to inquire about the multiple responses we can have to stressors, such as migraine.	▪ Mindful movement (walking and stretching)	▪ Sitting meditation and mindful movement ▪ Breathing space
5: Allowing/ Letting Be	Mindfulness, as opposed to aversion, can help us experience stressors without judging them (acceptance) and thoughtfully choose how to react to any given situation.	▪ Identifying automatic thoughts ▪ Sitting meditation with acceptance	▪ Sitting meditation ▪ Breathing space
6: Thoughts are Not Facts	Thoughts are not facts. Mindfulness teaches us how to observe our thoughts and consider the context in which our thoughts are occurring.	▪ Sitting meditation ▪ Mindful observation of cognitions and considering alternatives ▪ Awareness of pleasant events	▪ Choose your own meditation ▪ Breathing space for coping ▪ Pleasant events calendar
7: How Can I Best Take Care of Myself?	When you notice your life becoming unbalanced, stressors emerging, or begin to feel migraine symptoms, you can use "warning signs" to mindfully consider the best course of action.	▪ Sitting meditation ▪ Linking activity and mood/stress/migraine ▪ Identifying warning signs for stress and migraine ▪ Making a plan for nourishing activities	▪ Develop routine to practice mindfulness ▪ Dealing with stress and migraine
8: Using Mindfulness to Cope with Migraine	Maintaining and extending the gains you have made during MBCT-M requires planning and intentional action.	▪ Body scan ▪ Relapse prevention ▪ Focused meditation	

Table 2

Demographic Characteristics

Demographics	**Total (N = 60) M(SD) or N(%)**	**MBCT-M (N = 31) M(SD) or N(%)**	**WL/TAU (N = 29) M(SD) or N(%)**	**Significance**
Age	40.1 (11.7)	36.2 (10.6)	44.2 (11.5)	.007
Gender				
Female	55 (91.7%)	29 (93.5%)	26 (89.7%)	.938
Male	5 (8.3%)	2 (6.5%)	3 (10.3%)	
Ethnicity				
Hispanic	10 (16.7%)	5 (16.1%)	5 (17.2%)	.908
Non-Hispanic	50 (83.3%)	26 (83.9%)	24 (82.8%)	
Race				
White	49 (81.7%)	26 (83.9%)	23 (79.3%)	.903
Black/African American, Asian, Other	11 (18.3%)	5 (16.1%)	6 (20.7%)	
Employment				
Full-time	38 (63.3%)	21 (67.7%)	17 (58.6%)	.642
Part-time or unemployed	22 (36.7%)	10 (32.3%)	12 (41.4%)	
Education				
Some college or less	6 (10.0%)	3 (9.7%)	3 (10.3%)	.775
College graduate	21 (35.0%)	12 (38.7%)	9 (31.0%)	
Graduate degree	33 (55.0%)	16 (51.6%)	17 (58.6%)	
Marital Status				
Single	28 (46.7%)	17 (54.8%)	11 (37.9%)	.821
Separated/Divorced	6 (10.0%)	1 (3.2%)	5 (17.2%)	
Married/Living with Domestic Partner	26 (43.3%)	13 (41.9%)	13 (44.8%)	

Note. MBCT-M = Mindfulness-Based Cognitive Therapy for Migraine; WL/TAU = Waitlist/Treatment as Usual; Education was collapsed into college graduate or some college or less vs graduate degree; Marital Status was collapsed into single and separated/divorced vs married/living with a domestic partner.

Table 3

Participant Baseline Migraine Variables

Variable	**Total (N = 60) M(SD) or N(%)**	**MBCT-M (N = 31) M(SD) or N(%)**	**WL/TAU (N = 29) M(SD) or N(%)**	**Significance**
Headache days/30 days	16.0 (5.9)	16.5 (6.0)	15.5 (5.9)	.490
Average headache severity/30 days	1.7 (0.3)	1.8 (0.3)	1.7 (0.3)	.241
MIDAS				.355
Severe (≥21)	50 (83.3%)	24 (77.4%)	26 (89.7%)	
Not severe (<21)	10 (16.7%)	7 (22.6%)	3 (10.3%)	
HDI	51.4 (19.0)	52.5 (21.2)	50.2 (16.2)	.644
Average MIDI/30 days	3.1 (1.8)	2.8 (1.6)	3.4 (2.0)	.198
Preventive Medication				.070
Yes	29 (48.3%)	11 (35.5%)	18 (62.1%)	
No	31 (51.7%)	20 (64.5%)	11 (37.9%)	
Acute Medication				
Yes	58 (96.7%)	29 (93.5%)	29 (100%)	.492

Note. MBCT-M = Mindfulness-Based Cognitive Therapy for Migraine; WL/TAU = Waitlist/Treatment as Usual; MIDAS = Migraine Disability Assessment; HDI = Henry Ford Hospital Headache Disability Inventory; MIDI = Migraine Disability Index (0-10).

Table 4

Participant Baseline Mindfulness Characteristics

FFMQ	Total (N = 60) M(SD)	MBCT-M (N = 31) M(SD)	WL/TAU (N = 29) M(SD)	Significance
Total	129.4 (17.7)	126.8 (17.6)	132.1 (17.7)	.250
Observing	26.6 (5.3)	24.7 (5.2)	28.5 (4.8)	.005
Describing	29.3 (5.0)	29.4 (4.1)	29.2 (5.8)	.892
Acting with Awareness	26.3 (5.2)	26.8 (5.5)	25.8 (5.0)	.438
Nonjudging of Inner Experience	27.4 (6.4)	27.1 (7.4)	27.6 (5.3)	.751
Nonreactivity to Inner Experience	19.9 (4.4)	18.8 (4.3)	21.0 (4.4)	.052

Note. MBCT-M = Mindfulness-Based Cognitive Therapy for Migraine; WL/TAU = Waitlist/Treatment as Usual; FFMQ = Five Facet Mindfulness Questionnaire. Total Scores: 39 – 195; Observing Scores: 8 – 40; Describing Scores: 8 – 40; Acting with Awareness Scores: 8 – 40; Nonjudging of Inner Experience Scores: 8 – 40; Nonreactivity to Inner Experience Scores: 7 – 35. Higher scores indicate more agreement to mindfulness questionnaire items.

Table 5

Relationship Between FFMQ Total Scores and Migraine-Related Disability, Headache days/30 days, and Average Headache Severity/30 days at Baseline

Variables	1	2	3	4
1. FFMQ Total				
2. HDI	-.46**			
3. Average MIDI/30 days	-.11	.37**		
4. Headache days/30 days	.01	.28*	-.09	
5. Average Headache Severity/30 days	.03	-.03	.44**	.07

Note. ** = $p < .01$; * = $p < .05$; FFMQ = Five Facet Mindfulness Questionnaire; HDI = Henry Ford Hospital Headache Disability Inventory; MIDI = Migraine Disability Index.

Table 6

Relationship Between FFMQ Observing Subscale Scores and Migraine-Related Disability, Headache days/30 days, and Average Headache Severity/30 days at Baseline

Variables	1	2	3	4
1. FFMQ Observing				
2. HDI	-.16			
3. Average MIDI/30 days	-.08	.37**		
4. Headache days/30 days	.17	.28*	-.09	
5. Average Headache Severity/30 days	.02	-.03	.44**	.07

Note. ** = $p < .01$; * = $p < .05$; FFMQ = Five Facet Mindfulness Questionnaire; HDI = Henry Ford Hospital Headache Disability Inventory; MIDI = Migraine Disability Index.

Table 7

Relationship Between FFMQ Describing Subscale Scores and Migraine-Related Disability, Headache days/30 days, and Average Headache Severity/30 days at Baseline

Variables	1	2	3	4
1. FFMQ Describing				
2. HDI	-.21			
3. Average MIDI/30 days	.06	.37**		
4. Headache days/30 days	.08	.28*	-.09	
5. Average Headache Severity/30 days	.07	-.03	.44**	.07

Note. ** = $p < .01$; * = $p < .05$; FFMQ = Five Facet Mindfulness Questionnaire; HDI = Henry Ford Hospital Headache Disability Inventory; MIDI = Migraine Disability Index.

Table 8

Relationship Between FFMQ Acting with Awareness Subscale Scores and Migraine-Related Disability, Headache days/30 days, and Average Headache Severity/30 days at Baseline

Variables	1	2	3	4
1. FFMQ Acting with Awareness				
2. HDI	-.38**			
3. Average MIDI/30 days	-.24	.37**		
4. Headache days/30 days	-.10	.28*	-.09	
5. Average Headache Severity/30 days	-.05	-.03	.44**	.07

Note. ** = $p < .01$; * = $p < .05$; FFMQ = Five Facet Mindfulness Questionnaire; HDI = Henry Ford Hospital Headache Disability Inventory; MIDI = Migraine Disability Index.

Table 9

Relationship Between FFMQ Nonjudging of Inner Experience Subscale Scores and Migraine-Related Disability, Headache days/30 days, and Average Headache Severity/30 days at Baseline

Variables	1	2	3	4
1. FFMQ Nonjudging of Inner Experience				
2. HDI	-.42**			
3. Average MIDI/30 days	-.19	.37**		
4. Headache days/30 days	-.05	.28*	-.09	
5. Average Headache Severity/30 days	-.04	-.03	.44**	.07

Note. ** = $p < .01$; * = $p < .05$; FFMQ = Five Facet Mindfulness Questionnaire; HDI = Henry Ford Hospital Headache Disability Inventory; MIDI = Migraine Disability Index.

Table 10

Relationship Between FFMQ Nonreactivity to Inner Experience Subscale Scores and Migraine-Related Disability, Headache days/30 days, and Average Headache Severity/30 days at Baseline

Variables	1	2	3	4
1. FFMQ Nonreactivity to Inner Experience				
2. HDI	-.33*			
3. Average MIDI/30 days	.14	.37**		
4. Headache days/30 days	-.06	.28*	-.09	
5. Average Headache Severity/30 days	.11	-.03	.44**	.07

Note. ** = $p < .01$; * = $p < .05$; FFMQ = Five Facet Mindfulness Questionnaire; HDI = Henry Ford Hospital Headache Disability Inventory; MIDI = Migraine Disability Index.

Table 11

Relationship Between FFMQ Total and Subscale Scores and MIDAS scores at Baseline

	MIDAS Severe (≥21)		MIDAS Not severe (<21)		
	M	SD	M	SD	*p*-value
FFMQ Total	130.3	18.3	131.7	17.0	.655
FFMQ Observing	26.7	5.6	26.4	4.1	.920
FFMQ Describing	29.5	5.0	28.5	4.7	.565
FFMQ Acting with Awareness	25.9	5.4	29.2	3.3	.054
FFMQ Nonjudging of Inner Experience	26.9	6.2	28.4	7.4	.574
FFMQ Nonreactivity to Inner Experience	20.0	4.5	19.2	4.3	.617

Note. FFMQ = Five Facet Mindfulness Questionnaire; MIDAS = Migraine Disability Assessment.

Table 12

Linear Mixed Effects Models for Changes in Mindfulness Over Time

	FFMQ Total			**Observing**			**Describing**			**Acting with Awareness**			**Nonjudging of Inner Experience**			**Nonreactivity t Inner Experien**		
Fixed Effects	Estimate	SE	*p*	Estimate	SE	*p*	Estimate	SE	*p*	Estimate	SE	*p*	Estimate	SE	*p*	Estimate	SE	
Intercept	132.37	3.52	**<.001**	28.31	1.02	**<.001**	29.84	1.01	**<.001**	24.97	1.00	**<.001**	28.37	1.23	**<.001**	20.95	.84	**<.**
Group	2.27	4.94	.648	.19	1.43	.894	.46	1.41	.743	1.53	1.41	.281	-.63	1.74	.719	.95	1.19	.4
Month																		
1 vs. baseline	-1.16	1.57	.463	-.16	.63	.802	.18	.51	.721	-1.37	.57	**.017**	.60	.74	.419	-.39	.54	.4
2 vs. baseline	3.98	2.14	.065	.37	.72	.609	.25	.65	.704	-.04	.73	.961	3.45	1.00	**.001**	-.02	.65	.9
4 vs. baseline	.21	2.40	.930	-.20	.69	.772	.59	.67	.379	-.78	.77	.314	.75	1.12	.508	-.05	.65	.9
Month*Group																		
1 vs. baseline	1.12	2.18	.606	.33	.87	.701	.53	.71	.460	.45	.78	.566	-.76	1.02	.458	.55	.74	.4
2 vs. baseline	-2.15	2.94	.467	2.38	.98	**.016**	.78	.89	.378	-2.39	1.00	**.018**	-3.83	1.38	**.006**	.99	.89	.2
4 vs. baseline	7.57	3.40	**.030**	3.98	.99	**<.001**	.29	.95	.764	.47	1.09	.665	-.10	1.58	.948	3.17	.93	**.0**

Note. SE = Standard Error; *p* = Significance; Bolded values = p < .05.

Table 13

Linear Mixed Effects Models for Changes in Mindfulness Over Time Controlling for Age

	FFMQ Total			Observing			Describing			Acting with Awareness			Nonjudging of Inner Experience			Nonreactivity t Inner Experien		
Fixed Effects	Estimate	SE	*p*	Estimate	SE	*p*	Estimate	SE	*p*	Estimate	SE	*p*	Estimate	SE	*p*	Estimate	SE	
Intercept	115.58	9.95	**<.001**	25.15	2.83	**<.001**	27.12	2.88	**<.001**	21.46	2.80	**<.001**	25.78	3.38	**<.001**	16.93	2.29	**<.**
Group	5.15	5.22	.987	.72	1.51	.635	.85	1.52	.577	2.16	1.51	.155	-.19	1.86	.919	1.69	1.25	.1
Month																		
1 vs. baseline	-1.18	1.53	.443	-.16	.66	.810	.18	.51	.718	-1.33	.61	**.031**	.62	.80	.437	-.39	.54	.4
2 vs. baseline	3.89	2.28	.091	.41	.68	.550	.24	.65	.714	-.18	.72	.805	3.37	1.03	**.002**	-.03	.65	.9
4 vs. baseline	.26	1.91	.894	-.16	.67	.812	.60	.68	.383	-.71	.63	.260	.86	.87	.328	-.05	.66	.9
Month*Group																		
1 vs. baseline	1.14	2.12	.593	.24	.92	.796	.55	.71	.441	.41	.85	.627	-.79	1.11	.479	.62	.75	.4
2 vs. baseline	-2.06	3.15	.514	2.28	.93	**.016**	.90	.90	.319	-2.31	.99	**.021**	-3.69	1.42	**.011**	1.07	.90	.2
4 vs. baseline	7.40	2.73	**.008**	3.66	.96	**<.001**	.16	.71	.869	.28	.91	.761	-.24	1.25	.848	3.13	.94	**.0**

Note. SE = Standard Error; *p* = Significance; Bolded values = p < .05.

Table 14

Linear Mixed Effects Models for Changes in Mindfulness Over Time in Completers

	FFMQ Total			**Observing**			**Describing**			**Acting with Awareness**			**Nonjudging of Inner Experience**			**Nonreactivity t Inner Experien**		
Fixed Effects	Estimate	SE	*p*	Estimate	SE	*p*	Estimate	SE	*p*	Estimate	SE	*p*	Estimate	SE	*p*	Estimate	SE	
Intercept	131.92	3.72	**<.001**	28.22	1.06	**<.001**	29.48	1.04	**<.001**	25.10	1.07	**<.001**	28.11	1.25	**<.001**	21.00	.89	**<.**
Group	5.30	5.36	.327	.14	1.53	.090	1.36	1.49	.366	1.90	1.55	.223	.63	1.80	.729	1.28	1.29	.3
Month																		
1 vs. baseline	-1.89	1.60	.239	-.41	.69	.554	.06	.60	.927	-1.40	.63	**.029**	.59	.82	.477	-.63	.54	.2
2 vs. baseline	4.41	2.34	.063	.54	.71	.454	.05	.58	.931	.10	.75	.892	3.59	1.05	**.001**	.13	.72	.8
4 vs. baseline	.60	1.91	.755	-.22	.68	.748	.44	.60	.465	-.63	.64	.322	1.00	.86	.249	.01	.59	.9
Month*Group																		
1 vs. baseline	3.40	2.29	.140	1.13	.98	.253	1.06	.86	.218	.30	.91	.741	.01	1.17	.991	.79	.78	.3
2 vs. baseline	-1.08	3.29	.745	2.74	.99	**.007**	.1.83	.81	**.026**	-2.79	1.04	**.009**	-3.33	1.46	**.025**	.76	1.00	.4
4 vs. baseline	8.42	2.76	**.003**	4.38	.98	**<.001**	.96	.87	.277	.03	.92	.975	.02	1.25	.989	3.04	.84	**<.**

Note. SE = Standard Error; *p* = Significance; Bolded values = p < .05

Table 15

Linear Mixed Effects Models for Changes in Mindfulness Over Time Controlling for FFMQ Observing Scores at Baseline

	FFMQ Total			**Observing**			**Describing**			**Acting with Awareness**			**Nonjudging of Inner Experience**			**Nonreactivity t Inner Experien**		
Fixed Effects	Estimate	SE	*p*	Estimate	SE	*p*	Estimate	SE	*p*	Estimate	SE	*p*	Estimate	SE	*p*	Estimate	SE	
Intercept	174.29	14.28	**<.001**	36.03	2.03	**<.001**	38.85	4.55	**<.001**	36.14	4.67	**<.001**	31.62	5.99	**<.001**	31.47	3.36	**<.**
Group	11.84	5.59	.277	4.08	.97	**.030**	2.03	1.76	.207	2.45	1.83	.346	-.75	2.37	.889	2.91	1.36	.4
Month																		
1 vs. baseline	-1.20	1.54	.438	.01	.70	.990	.18	.58	.751	-1.34	.60	**.026**	.60	.79	.448	-.41	.52	.4
2 vs. baseline	3.84	2.28	.095	.53	.68	.439	.32	.59	.595	-.16	.72	.821	3.38	1.03	**.001**	-.11	.68	.8
4 vs. baseline	.28	1.91	.882	.18	.71	.800	.55	.59	.355	-.71	.62	.258	.87	.87	.318	-.05	.57	.9
Month*Group																		
1 vs. baseline	1.17	2.12	.584	.34	.96	.723	.53	.80	.514	.43	.89	.605	-.76	1.09	.486	.57	.72	.4
2 vs. baseline	-1.95	3.12	.534	2.30	.90	.012	.77	.81	.343	-2.29	.98	**.022**	-3.70	1.41	**.010**	1.11	.92	.2
4 vs. baseline	8.05	2.71	**.004**	4.10	1.02	**<.001**	.48	.84	.566	.29	.89	.747	-.10	1.24	.937	3.17	.81	**<.**

Note. SE = Standard Error; *p* = Significance; Bolded values = p < .05.

Table 16

Demographic Characteristics for Qualitative Sample

Demographics	**Total (N = 12) M(SD) or N(%)**	**EM (n = 6) M(SD) or N(%)**	**CM (n = 6) M(SD) or N(%)**
Age	36.8 (9.4)	39.0 (12.6)	34.7 (4.9)
Gender			
Female	11 (91.7%)	5 (83.3%)	6 (100.0%)
Male	1 (8.3%)	1 (16.7%)	
Ethnicity			
Hispanic	3 (25.0%)	1 (16.7%)	2 (33.3%)
Non-Hispanic	9 (75.0%)	5 (83.3%)	4 (66.7%)
Race			
White	10 (83.3%)	5 (83.3%)	5 (83.3%)
Black/African American, Asian, Other	2 (16.7%)	1 (16.7%)	1 (16.7%)
Employment			
Full-time	9 (75.0%)	4 (66.7%)	5 (83.3%)
Part-time or unemployed	3 (25.0%)	2 (33.3%)	1 (16.7%)
Education			
Some college or less	1 (8.3%)	1 (16.7%)	
College graduate	3 (25.0%)	1 (16.7%)	2 (33.3%)
Graduate degree	8 (66.7%)	4 (66.7%)	4 (66.7%)
Marital Status			
Single	4 (33.3%)	2 (33.3%)	2 (33.3%)
Separated/Divorced	1 (8.3%)	1 (16.7%)	
Married/Living with Domestic Partner	7 (58.4%)	3 (50.0%)	4 (66.7%)

Note. EM = Episodic Migraine; CM = Chronic Migraine.

Table 17

Participant Baseline Migraine Variables for Qualitative Sample

Variable	**Total (N = 12) M(SD) or N(%)**	**EM (n = 6) M(SD) or N(%)**	**CM (n = 6) M(SD) or N(%)**
Headache days/30 days	15.8 (6.1)	11.5 (5.8)	20.0 (2.5)
Average headache severity/30 days	1.7 (0.4)	1.8 (0.4)	1.7 (0.3)
MIDAS			
Severe (≥21)	9 (75.0%)	4 (66.7%)	5 (83.3%)
Not severe (<21)	3 (25.0%)	2 (33.3%)	1 (16.7%)
HDI	47.3 (19.5)	35.7 (18.9)	59.0 (12.2)
Average MIDI/30 days	2.4 (1.5)	2.0 (1.6)	2.7 (1.4)
Preventive Medication			
Yes	5 (41.7%)	2 (33.3%)	3 (50.0%)
No	7 (58.3%)	4 (66.7%)	3 (50.0%)
Acute Medication			
Yes	12 (100%)	6 (100%)	6 (100%)

Note. EM = Episodic Migraine; CM = Chronic Migraine; MIDAS = Migraine Disability Assessment; HDI = Henry Ford Hospital Headache Disability Inventory; MIDI = Migraine Disability Index (0-10).

Table 18

Participant Baseline Mindfulness Characteristics for Qualitative Sample

FFMQ	**Total (N = 12) M(SD)**	**EM (n = 6) M(SD)**	**CM (n = 6) M(SD)**
Total	134.4 (16.7)	138.0 (19.7)	130.9 (14.0)
Observing	25.7 (4.3)	24.2 (2.9)	27.2 (5.2)
Describing	30.7 (3.8)	31.8 (3.0)	29.5 (4.3)
Acting with Awareness	29.2 (4.6)	32.8 (3.3)	25.5 (2.1)
Nonjudging of Inner Experience	29.3 (7.7)	30.3 (9.2)	28.2 (6.6)
Nonreactivity to Inner Experience	19.7 (4.9)	18.8 (5.9)	20.5 (4.1)

Note. EM = Episodic Migraine; CM = Chronic Migraine; FFMQ = Five Facet Mindfulness Questionnaire; Total Scores: 39 – 195; Observing Scores: 8 – 40; Describing Scores: 8 – 40; Acting with Awareness Scores: 8 – 40; Nonjudging of Inner Experience Scores: 8 – 40; Nonreactivity to Inner Experience Scores: 7 – 35. Higher scores indicate more agreement to mindfulness questionnaire items.

Table 19

Theme One: Discomfort Practicing Mindfulness

Subthemes	Total	EM	CM
Frustration/Annoyance	5	5	0
Physical discomfort	4	4	0
Emotional overload	2	2	0
Frustration of not getting maximal benefit	2	2	0
Flooding	2	2	0
Changed sensory awareness toward pain	2	2	0
Body Attention increased Allodynia	1	1	0
Challenge of first time practicing	1	1	0

Note. EM = Episodic Migraine; CM = Chronic Migraine; N = 12; EM = 6 participants; CM = 6 participants.

Table 20

Theme One: Discomfort Practicing Mindfulness, Illustrative Quotes

Subthemes	Illustrative Quotes
Frustration/Annoyance	"I hated the breathing. I just I don't know. Somehow the deep breathing, I didn't find it relaxing. I just found it annoying." Interview 10, EM
Physical discomfort	"I like very vividly recall getting like upset about having like an active physical discomfort of having to experience the sensations." Interview 1, EM
Emotional overload	"It was hard. Your body basically bombards you with a lot of thoughts and emotions." Interview 3, EM
Frustration of not getting maximal benefit	"And later to the process there were other methods for practicing mindfulness that resonated more with me than the body scan so I felt like it gave me more anxiety and I felt angry that I wasn't like getting out of it what I should have been getting out of it." Interview 1, EM
Flooding	"I just thought I was more overwhelmed with feeling anxious and not liking it [the body scan] than paying attention to it." Interview 1, EM
Changed sensory awareness toward pain	"Even if I was feeling pain I wouldn't pay attention to it. I don't know I wouldn't even think about it and now I can feel the pain and it really helps." Interview 5, EM
Body Attention increased Allodynia	"When people touch me or my skin you know I just don't like it, if I have uncomfortable clothing that is already very stressful for me and so to actively pay attention to that was very hard and it made me so annoyed." Interview 1, EM
Challenge of first time practicing	"The first time I practiced it was terrible. I really struggled paying attention to the sensations that my body was experiencing." Interview 1, EM

Table 21

Theme Two: Routine Mindfulness Practice is Difficult

Subthemes	Total	EM	CM
Busyness	7	3	4
Takes gradual skill development	7	4	3
Mind wandering	5	3	2
Thoughts/emotions are distracting	4	1	3
Cognitively difficult during severe migraine attack	4	1	3
Social/family/work balance	4	3	1
Forget to practice	3	1	2
Length of practice	2	2	0
Certain exercises resonate more	2	1	1
Finding enjoyable meditations	1	0	1
Cheesy	1	1	0

Note. EM = Episodic Migraine; CM = Chronic Migraine; N = 12; EM = 6 participants; CM = 6 participants.

Table 22

Theme Two: Routine Mindfulness Practice is Difficult, Illustrative Quotes

Subthemes	Illustrative Quotes
Busyness	"I would always get busy and just let work take over at the time I wanted to practice mindfulness." Interview 1, EM
Takes gradual skill development	"And I remember telling myself, like, you can think about that other thing later. Try to stay. Try to stay here and now. And, you know, during the study, it got easier. But it was hard." Interview 11, CM
Mind wandering	[What was difficult at first was:] "Not letting my mind wander." Interview 2, EM
Thoughts/emotions are distracting	"It was hard. Your body basically bombards you with a lot of thoughts and emotions. And obviously, you want to experience these emotions." Interview 3, EM
Cognitively difficult during severe migraine attack	"Moments when the pain is that severe it's hard to focus." Interview 3, EM
Social/family/work balance	"So it's been really crazy, between work and home, and I kind of have no routine of any kind right now." Interview 5, EM
Forget to practice	"It's a thing that the further away from the study I get, it's not that I don't want to do it, but I forget that it is an option." Interview 4, CM
Length of practice	"I definitely found the longer recordings less than pleasurable I guess. I never turn them off. I was really trying to give it a fair thought, you know, trying to not be grouchy about it." Interview 10, EM
Certain exercises resonate more	"And later to the process there were other methods for practicing mindfulness that resonated more with me than the body scan." Interview 1, EM
Finding enjoyable meditations	"One of the things I found that was really hard was that I couldn't find guided meditation that I liked. I tried the popular apps like Headspace and one of the other apps that was really popular. And I didn't like the voices of the people that were being used." Interview 11, CM
Cheesy	"I think I also personally maybe I found it all a little bit cheesy. I don't know. It just, you know, like breathing and I don't know some of the messages for me, I just I think this is my personality

somehow it doesn't always work. It just wasn't always my style that much.”
Interview 10, EM

Table 23

Theme Three: Mindfulness Practice Provides Control/Is Empowering

Subthemes	Total	EM	CM
Increased control over migraine and migraine management	7	1	6
Increased control over thoughts/mood/actions	4	3	1
Allowed a changed mindset/different perspective on life	3	2	1
Feeling capable	2	1	1
Sense of empowerment	1	1	0

Note. EM = Episodic Migraine; CM = Chronic Migraine; N = 12; EM = 6 participants; CM = 6 participants.

Table 24

Theme Three: Mindfulness Provides Control/Is Empowering, Illustrative Quotes

Subthemes	Illustrative Quotes
Increased control over migraine and migraine management	"It's also helped me realize that in some ways I have some semblance of control over my migraine, because I think that's something that I really didn't feel like I had early on. I felt like I was at the mercy of my migraines and had to do whatever I could to try to feel better and before I felt like I had no control over it. But now realizing that oh yeah I can at least predict better when I'm getting a headache and be able to take the medicine earlier and help improve how I'm going to feel, I think that was a really nice sense of control that I gained which I kept." Interview 7, CM
Increased control over thoughts/mood/actions	"And I think feeling, not that I can control them [migraine], but that I can control myself and my emotions around them has been tremendously helpful." Interview 12, CM
Allowed a changed mindset/different perspective on life	"I think it's just like a change in mindset a little bit, because I am just very constant going going all the time. So I think it was just like a different way of approaching my day." Interview 8, EM
Feeling capable	"I feel like it's something that you try to do in practice when you feel like you need to be brought back to a moment to feel like a little bit healthier and more capable." Interview 9, CM
Sense of empowerment	"It kind of feels empowering for a second." Interview 3, EM

Table 25

Theme Four: Mindfulness Improved Acceptance/Appreciation

Subthemes	Total	EM	CM
Less stressed	8	5	3
Acceptance of experiences during migraine attack	5	0	5
Kinder to self/prioritizing self-care	5	0	5
Enjoyment of life	5	3	2
Appreciation without judgment	2	2	0
Appreciation of present moment	2	1	1
Appreciation of surrounding environment	2	1	1
Changed relationship to negative states	2	1	1
Acceptance of pain	1	0	1
Gratitude	1	1	0
No right or wrong way to practice mindfulness	1	0	1

Note. EM = Episodic Migraine; CM = Chronic Migraine; N = 12; EM = 6 participants; CM = 6 participants.

Table 26

Theme Four: Mindfulness Improved Acceptance/Appreciation, Illustrative Quotes

Subthemes	Illustrative Quotes
Less stressed	"It was more like being generally less stressed and less stressed about the fact that I do have migraines and I think that had an effect on the amount of headache attacks that I had." Interview 3, EM
Acceptance of experiences during migraine attack	"One time I remember being on the train standing and it's hot and there is weird smells, all these things that can cause a migraine, I felt one coming on and I, the mindfulness was fresh in my mind, and I was able to just focus on what I was feeling and accepting all the smells and the sounds and the heat. And it didn't necessarily get rid of the headache, but just accepting that it was happening was a whole new thing for me." Interview 4, CM
Kinder to self/prioritizing self-care	"I think realizing that it was okay to take some time to relax my body and take some time for myself instead of just trying to work through the migraine or plow through it and that also helped." Interview 7, CM
Enjoyment of life	"It helps in so many ways because it's the same as the migraine outcome, that in general life I'm just more comfortable because I am aware of the fact that I'm sitting in an incorrect posture or doing something that was probably detrimental to my health and I wasn't noticing it for some reason. Now that I do I can take action and improve things or make adjustments." Interview 5, EM
Appreciation without judgment	"I would say it [mindfulness] like just how you go about looking at the world like appreciate like without judgment and without just automatically attaching emotions to things." Interview 8, EM
Appreciation of present moment	"Appreciating also what you're experiencing at the time and taking it outside of meditation. Like if you're eating, enjoy the flavors, the textures, if you're looking at something enjoy the colors, the lights, the sounds, the smells. Just appreciating everything and being tuned in." Interview 2, EM
Appreciation of surrounding environment	"So like if I'm waiting for someone outside and I'm on my phone with my shoulders hunched over, I remind myself, put your phone away and look around outside. And then I sort of feel my whole body becomes calm when your shoulders go down and you're just paying attention to what is around you. Even if it's not a beautiful day outside, it can be a rainy day but there's always something to pay attention to that is happening

	right now, and so I feel like that aspect I have really incorporated into my daily life. I think about it like all the time." Interview 1, EM
Changed relationship to negative states	"Normally, like when I get super, super anxious and I'm feeling a lot of anxiety, I might take a walk and try to focus on the things that I see on the walk and really be mindful of the sounds and the sights." Interview 11, CM
Acceptance of pain	"Paying attention to the pain in the moment. And accepting was a key part for me since it sounds so counterintuitive to accept that I was in pain to get out of pain." Interview 4, CM
Gratitude	"I am just appreciating very small things and just practicing gratitude and just being happy with where I am." Interview 2, EM
No right or wrong way to practice mindfulness	"I think it just before I did the study. I think I thought the goal was to like, learn how to meditate, get good at it, and then then you could start the practice of doing it every day or, you know, regularly. And I think. Being told like there's no right or wrong way to do this helped me figure out that, like I was already practicing meditation and mindfulness and that there wasn't some goal of learning how to do it right." Interview 11, CM

Table 27

Theme Five: Mindfulness as Acute Treatment

Subthemes	Total	EM	CM
Using mindful awareness to manage acute attack	7	3	4
Committed action/plan to manage acute attack	6	3	3
Meditation only during migraine attack	3	1	2
Meditation while waiting for medication to work	3	2	1

Note. EM = Episodic Migraine; CM = Chronic Migraine; N = 12; EM = 6 participants; CM = 6 participants.

Table 28

Theme Five: Mindfulness as Acute Treatment, Illustrative Quotes

Subthemes	Illustrative Quotes
Using mindful awareness to manage acute attack	"So if I'm getting a migraine around 3:00, and at 4:00 I would have had a really really bad migraine, but at 3:00 I'm mindful, it's almost like I lower the threshold of how bad the migraine can be." Interview 4, CM
Committed action/plan to manage acute attack	"It was more like okay let's eliminate the chatter in my head when I have a migraine and let's just see what's here and what I can do right now." Interview 1, EM
Meditation only during migraine attack	"Luckily, I haven't had too many [migraines] in a while, but like listening to something [meditation] is something I can do. I can't really read, I can't really like watch anything, not that I would want to but like listening to something quiet is doable … For sure it was helpful. And everything like that, that has been something that stayed with me." Interview 12, CM
Meditation while waiting for medication to work	"One of the things that I would do also during the study while waiting for a medication to work was focused on breathing. That actually helps." Interview 11, CM

Table 29

Theme Six: Mindfulness as Preventive Treatment

Subthemes	Total	EM	CM
Preventive Anxiety management tool	6	1	5
Increased mindfulness practice during regular yoga practice	6	2	4
Broad value for improving quality of life	4	2	2
Relaxation	4	1	3
Part of daily routine	3	1	2
Practiced any time of day	3	0	3
Emotion regulation tool	2	1	1
State of mind you can go in and out of	2	2	0

Note. EM = Episodic Migraine; CM = Chronic Migraine; N = 12; EM = 6 participants; CM = 6 participants.

Table 30

Theme Six: Mindfulness as Preventive Treatment, Illustrative Quotes

Subthemes	Illustrative Quotes
Preventive Anxiety management tool	"And I don't really, in terms of mindfulness, I was always under the impression that the point was, which is maybe wrong, that it was to get into a routine and do it so that you can have that tool in your belt for when you have a migraine and it also is pretty good for my anxiety. So, it's just a good tool to have in general." Interview 1, EM
Increased mindfulness practice during regular yoga practice	"I did yoga at a yoga class a few times a week so I would make more of an effort to just be in my space and focus on me in the moment." Interview 2, EM
Broad value for improving quality of life	"And I felt like I was excited to keep doing it because I was seeing things that at least helped, if not with my migraine directly around things that are peripherally, you know, like sleep, and stress and some of those things. And so I felt like it was pretty it was pretty immediate." Interview 9, CM
Relaxation	"I feel that it's like a comfort or a soothing exercise and that's the feeling I get. It was relaxing before bed." Interview 6, CM
Part of daily routine	"I mostly did it in the morning or in the evening before work and I followed whatever that week's task or activity was… I tried to have a routine. Like I did it the same time every day. It wasn't like, oh I have a migraine I need to do this, it was like 9:00 in the morning, that was the time to do it. So it was more about getting into a routine than about identifying a specific time it was needed and doing it then." Interview 1, EM
Practiced any time of day	"And so it really was variable for me because. You know, I just I wasn't always, like, super structured about having to do it, like always at the same time of day." Interview 9, CM
Emotion regulation tool	"So it really compounded this feeling and it's like I don't really do the body scan much anymore but I can do it without feeling those feelings [anxiety] and I can be more present and not get overwhelmed with those feelings now." Interview 1, EM
State of mind you can go in and out of	"So I wish I could be more aware of more things in the moment for longer periods of time in my daily life, but it's more that I have these moments where I tell myself that remember there is a different state of mind that you can be in and I may go there for a minute or two and then something else distracts me."

Interview 3, EM

Table 31

Theme Seven: Increased Awareness of Emotions/Thoughts/Bodily Sensations

Subthemes	Total	EM	CM
Present moment instead of past or future	9	5	4
Physical sensations	6	3	3
Eating	5	4	1
Breath	5	3	2
Anticipatory anxiety about migraine	4	2	2
Thoughts	3	1	2
Emotions	3	3	0
Life experiences	1	0	1

Note. EM = Episodic Migraine; CM = Chronic Migraine; N = 12; EM = 6 participants; CM = 6 participants.

Table 32

Theme Seven: Increased Awareness of Emotions/Thoughts/Bodily Sensations, Illustrative Quotes

Subthemes	Illustrative Quotes
Present moment instead of past or future	"I mean, I think of mindfulness, the sort of being in the present moment. And, I guess like not fixating on the past or on the future. But just like feeling what's happening in the present." Interview 10, EM
Physical sensations	"Yeah even my posture too. I completely ignored that before since I was so focused on something else and on work and didn't pay attention to what my body was telling me." Interview 5, EM
Eating	"It was not a struggle for me because I love eating and I have a very careful diet and I have always appreciated foods so to focus more on it was just interesting and more pleasurable for me, so it wasn't a struggle or a task, it just brought more awareness." Interview 2, EM
Breath	"And then also just in terms of kind of like training your mind, just, you know, anchoring back to the breath, like we talked about before, is definitely something that I never thought about it and definitely used in my daily life for sure." Interview 8, EM
Anticipatory anxiety	"The way I saw it was more that mindfulness is not necessary only there to help me like with the pain but also how I react to the pain. I think it helped with anxiety of feeling like the attack coming. So it maybe didn't help with having less pain, but it more so helped with how I reacted to knowing I had a migraine in general in my life and when I feel an attack coming." Interview 3, EM
Thoughts	"Like noticing the thoughts that you're having and sort of like you notice them and then you just sort of send them on their way." Interview 10, EM
Emotions	"But I would say that I definitely use the concept of mindfulness and being aware of your emotions and not constantly attaching them directly to certain actions." Interview 8, EM
Life experiences	"It was just more about the meditation and how you can bring attention to experiences." Interview 6, CM

Table 33

Theme Eight: Feelings of Guilt

Subthemes	Total	EM	CM
Guilty taking time for mindfulness practice	4	1	3
Pressure to do mindfulness right	3	0	3
Need to justify migraine treatment to others	1	1	0
Mindfulness changed feelings of guilt towards migraine	1	0	1

Note. EM = Episodic Migraine; CM = Chronic Migraine; N = 12; EM = 6 participants; CM = 6 participants.

Table 34

Theme Eight: Feelings of Guilt, Illustrative Quotes

Subthemes	Illustrative Quotes
Guilty taking time for mindfulness practice	"So if I took time for self-care or mindfulness, I used to think I was wasting time or that I could be getting something else done." Interview 4, CM
Pressure to do mindfulness right	"I mean, I think that, like, I'm a perfectionist, so I remember wanting to do it right. And I know that, like, when you're told that there is no right way, it's just kind of hard. You know, there has to be a right way." Interview 12, CM
Need to justify migraine treatment to others	"But just the thought of me having regular migraines is stressful for me because I have to feel like I have to justify my behavior to my family or my medication intake to my family and that is something that maybe I wasn't that aware of that will basically put a certain amount of stress on me." Interview 3, EM
Mindfulness changed feelings of guilt	"So I used to get a migraine and think, I just have to take my medication but I have too much other stuff to do, and if I actually just do the mindfulness it lowers my stress. By doing mindfulness, and seeing the benefit of it, has made me more able to relax and take time that I need mentally without feeling guilty about it." Interview 4, CM

Table 35

Theme Nine: Mindfulness Helped Migraine Management/Problem Solving During Migraine

Subthemes	Total	EM	CM
Helped with treating migraine early	7	2	5
Migraine management tool/made migraine feel more manageable	5	1	4
Aided medication decision making	4	1	3
Time to think about reactions	2	0	2

Note. EM = Episodic Migraine; CM = Chronic Migraine; N = 12; EM = 6 participants; CM = 6 participants.

Table 36

Theme Nine: Mindfulness Helped Migraine Management/Problem Solving During Migraine, Illustrative Quotes

Subthemes	Illustrative Quotes
Helped with treating migraine early	"I don't know I wouldn't even think about it [the pain 3 years ago] and now I can feel the pain and it really helps. Sometimes I can't prevent it but it helps me take the medication earlier which is a tremendous thing because then the abortive medication just works and then I don't have the migraine at all or I have it very mild, or I can take medications that aren't as strong and still be able to get rid of the migraine." Interview 5, EM
Migraine management tool/made migraine feel more manageable	"When I get a migraine, I can practice mindfulness from my desk at work because I'm focusing on pain rather than stress and in turn it relieves my stress which in turn relieves my pain. It's kind of a cool circle." Interview 4, CM
Aided medication decision making	"I think also I think it helped me sort of like be aware of what was going on in my body and like whether I needed to take my medicine. Like I would stop and evaluate whether I needed to take one and make that decision rather than just like have an absolute freak out." Interview 12, CM
Time to think about reactions	"I think like just being, you know, obviously in XX and like a high stress job and I work in XX. So it just I think I'm always constantly like, go, go, go, and just never take a moment to step back and actually think about how I react to things, I guess. So I think that helped." Interview 7, CM

Table 37

Theme Ten: Participation in MBCT-M Study Increased Accountability for Mindfulness Practice

Subthemes	Total	EM	CM
Documentation of practice held me accountable	4	0	4
Liked hearing therapist's voice in meditation recordings	4	1	3
Coaching of therapist was helpful	4	2	2
Therapist provided comfort	2	1	1

Note. EM = Episodic Migraine; CM = Chronic Migraine; N = 12; EM = 6 participants; CM = 6 participants.

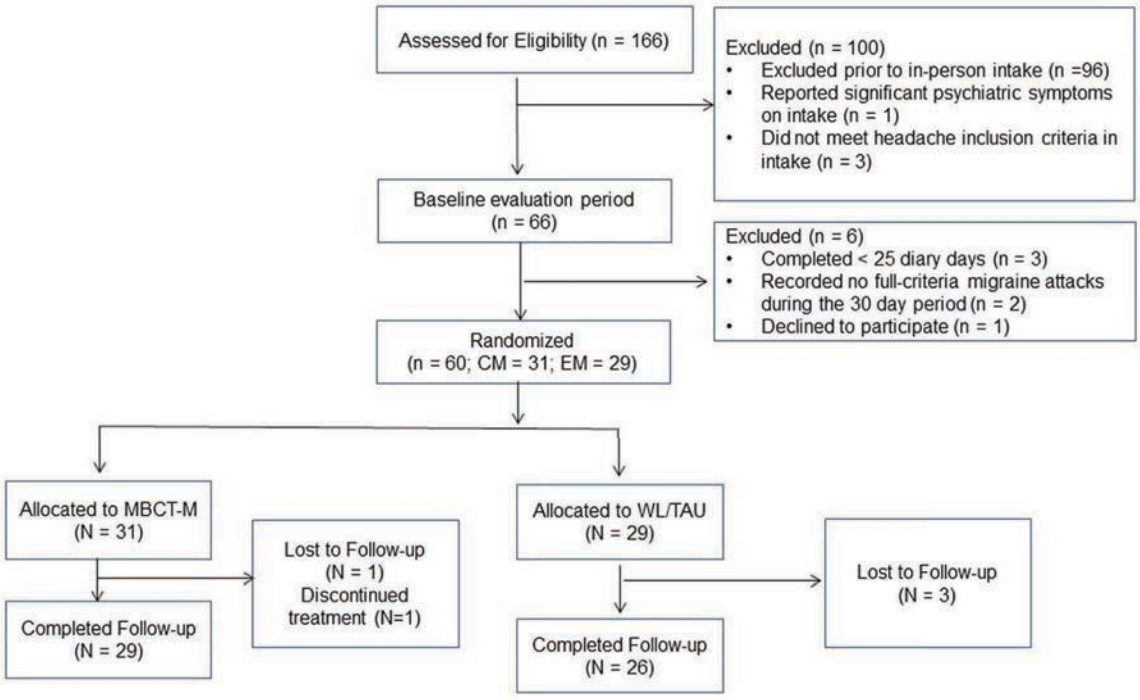
Table 38

Theme Ten: Participation in MBCT-M Study Increased Accountability for Mindfulness Practice, Illustrative Quotes

Subthemes	Illustrative Quotes
Documentation of practice held me accountable	"I think I did practice it basically after the first meeting and as soon as I had to document things, since I am a little bit type A so as soon as I had to document something I thought this is something I need to do and document daily. So I was pretty good about as soon as I was documenting things I tried to keep myself on schedule." Interview 7, CM
Like hearing therapist's voice in meditation recordings	"And I think sometimes, you know, like during the migraine I found having [my therapist's] voice, very calming, but also instructional, and I enjoyed listening to her to the point where I was like, I don't need to memorize all of this." Interview 9, CM
Coaching of therapist was helpful	"And so I liked the experience of having that encouragement because I think when you're starting, it is a little foreign. And it was nice to have that extra coaching." Interview 9, CM
Therapist provided comfort	"I thought it was good like ultimately having it with another person and doing it in person with my therapist. I think it got me more comfortable with then doing it by myself." Interview 12, CM

FIGURES

Figure 1. Study flow diagram for quantitative study (Seng et al., 2019).



Note. MBCT-M = Mindfulness-Based Cognitive Therapy-Migraine; WL/TAU = Waitlist/Treatment-as-Usual; CM = Chronic Migraine; EM = Episodic Migraine.

Figure 2. MBCT for Migraine study outline (Seng et al., 2019).

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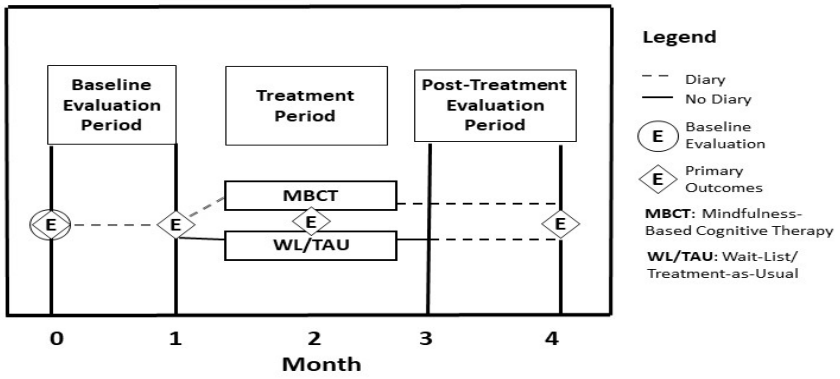
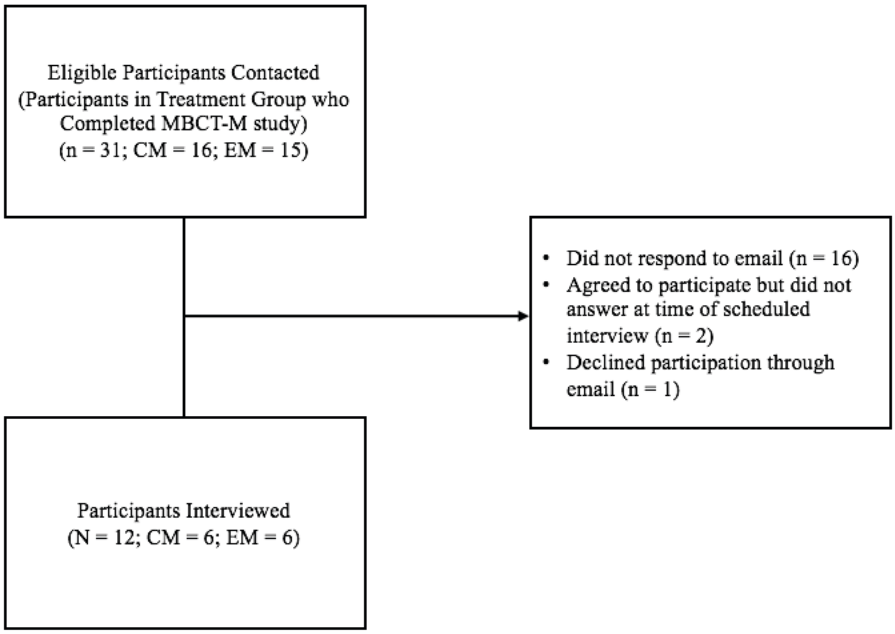


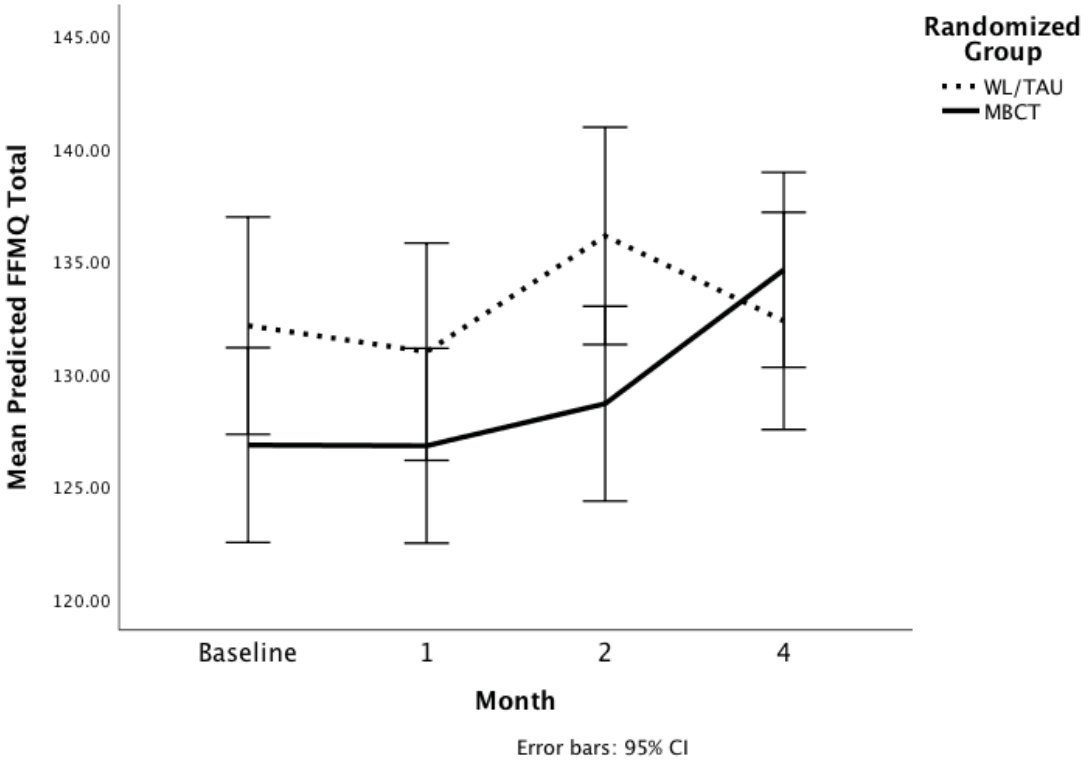
Note. MBCT = Mindfulness-Based Cognitive Therapy; WL/TAU = Waitlist/Treatment-as-Usual.

Figure 3. Study flow diagram for qualitative study.



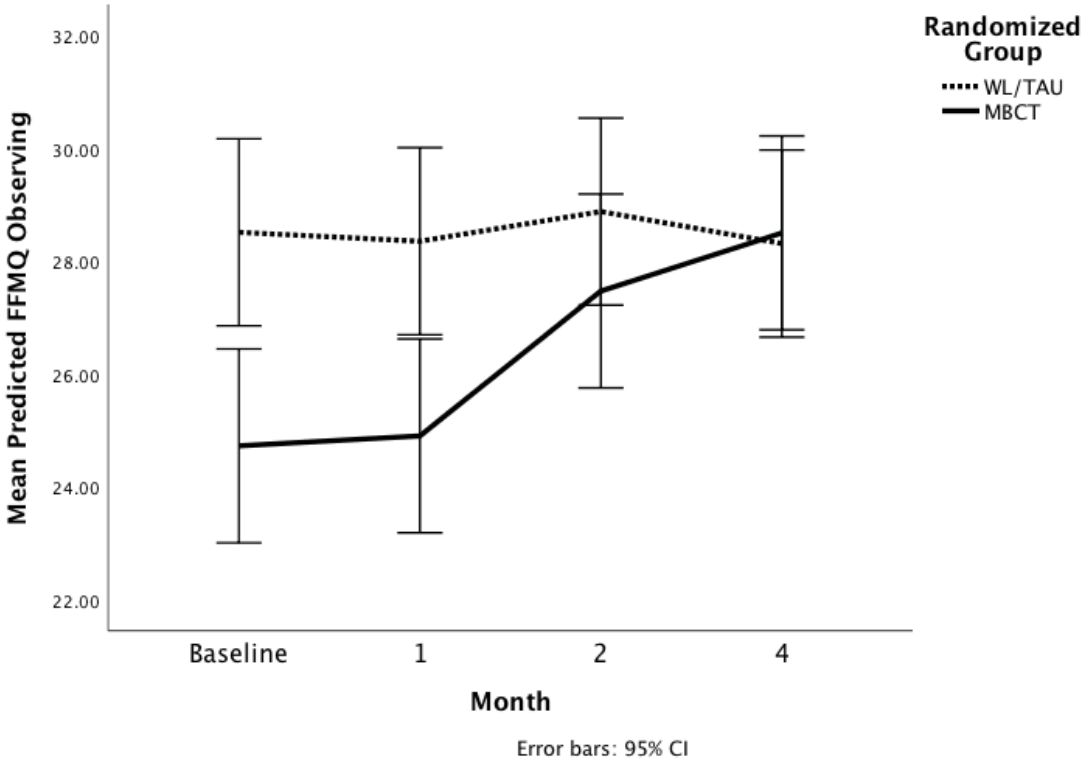
Note. MBCT-M = Mindfulness-Based Cognitive Therapy-Migraine; CM = Chronic Migraine; EM = Episodic Migraine.

Figure 4. Change from Baseline to Month 4 in FFMQ Total scores per treatment group.



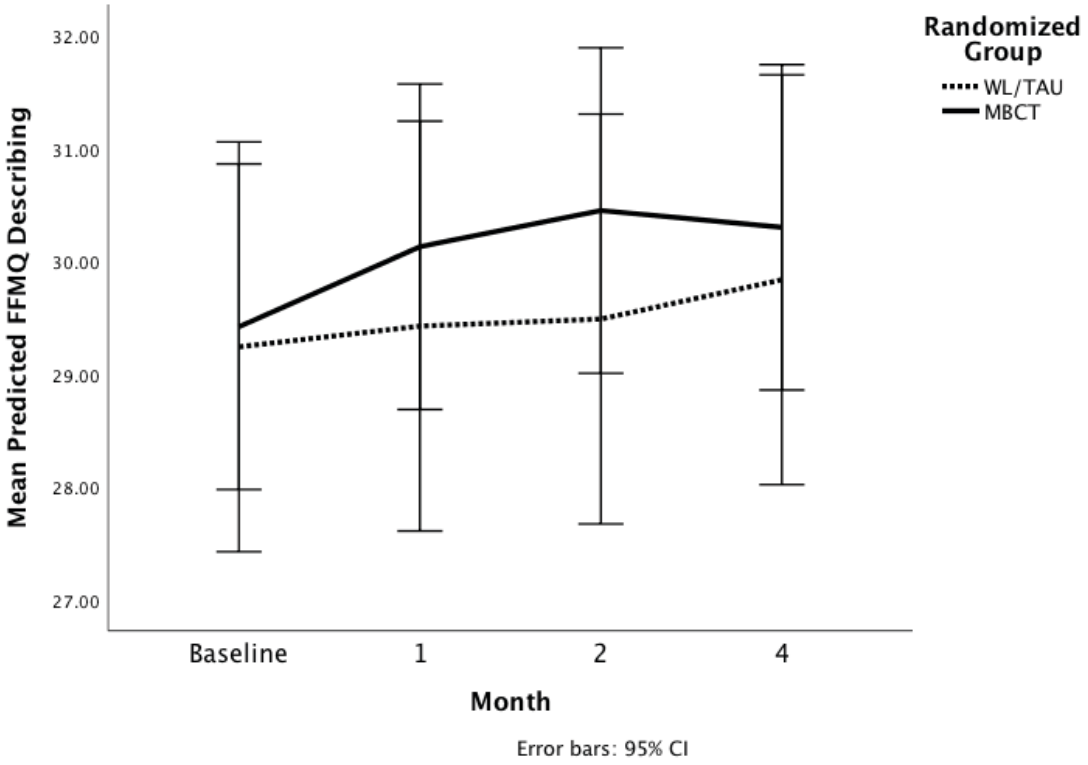
Note. FFMQ = Five Facet Mindfulness Questionnaire; MBCT = Mindfulness-Based Cognitive Therapy; WL/TAU = Waitlist/Treatment-as-Usual.

Figure 5. Change from Baseline to Month 4 in FFMQ Observing scores per treatment group.



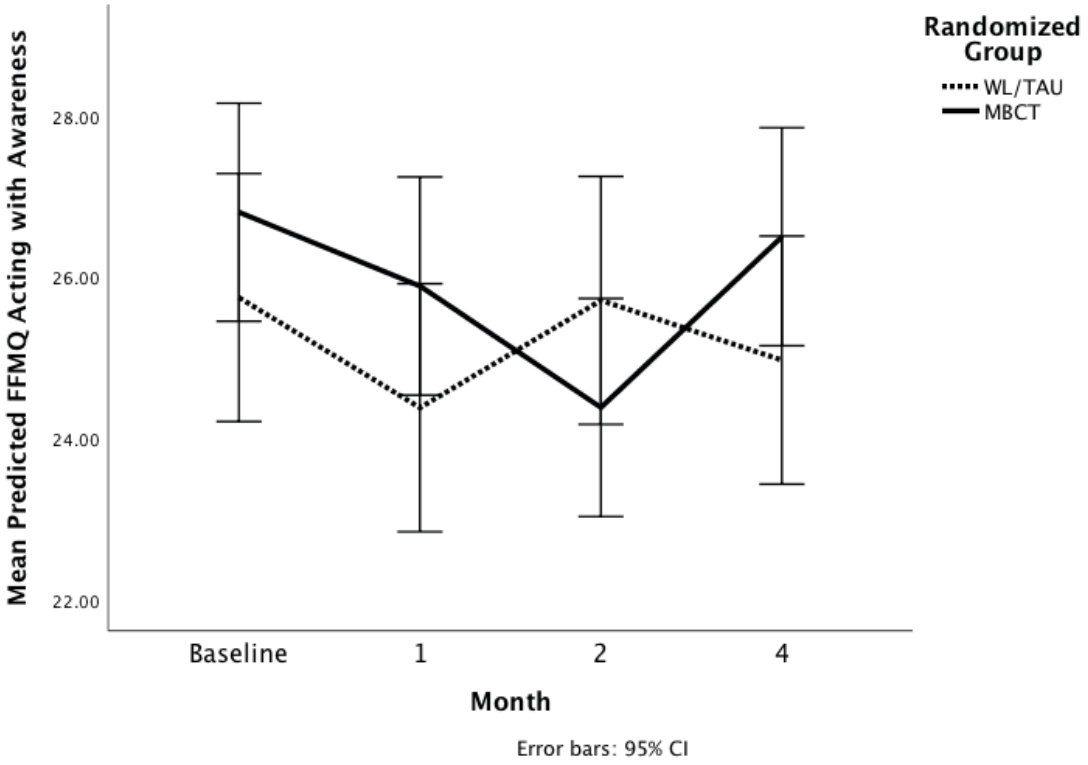
Note. FFMQ = Five Facet Mindfulness Questionnaire; MBCT = Mindfulness-Based Cognitive Therapy; WL/TAU = Waitlist/Treatment-as-Usual.

Figure 6. Change from Baseline to Month 4 in FFMQ Describing scores per treatment group.



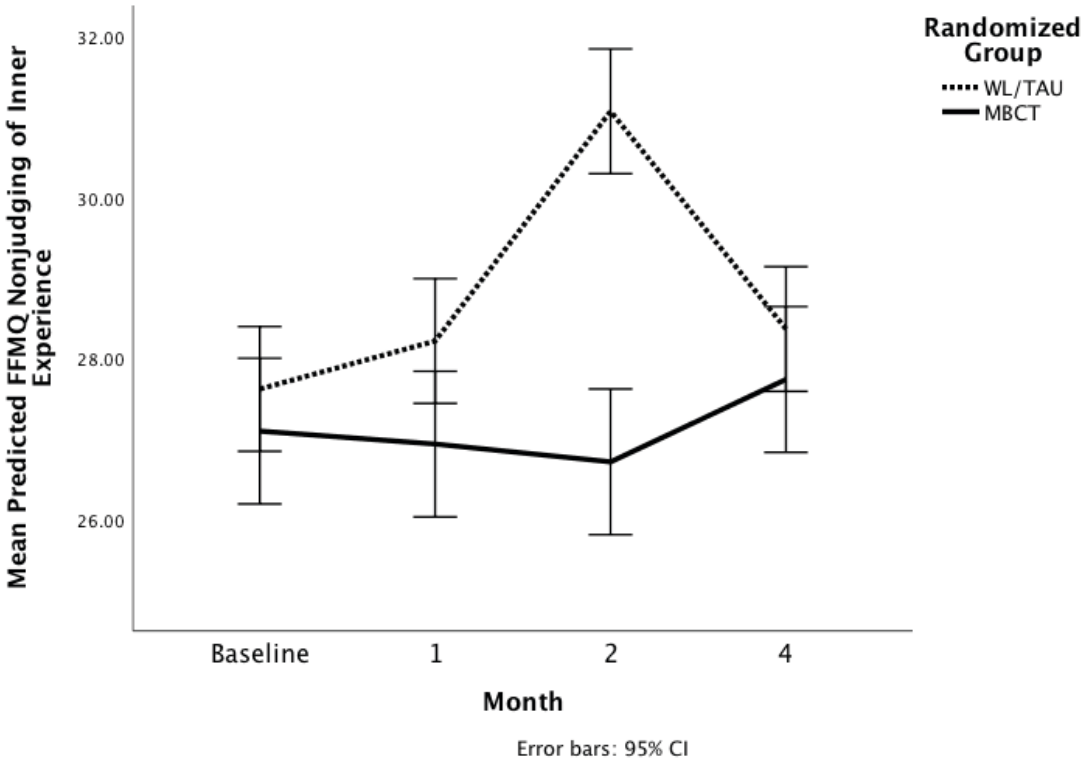
Note. FFMQ = Five Facet Mindfulness Questionnaire; MBCT = Mindfulness-Based Cognitive Therapy; WL/TAU = Waitlist/Treatment-as-Usual.

Figure 7. Change from Baseline to Month 4 in FFMQ Acting with Awareness scores per treatment group.



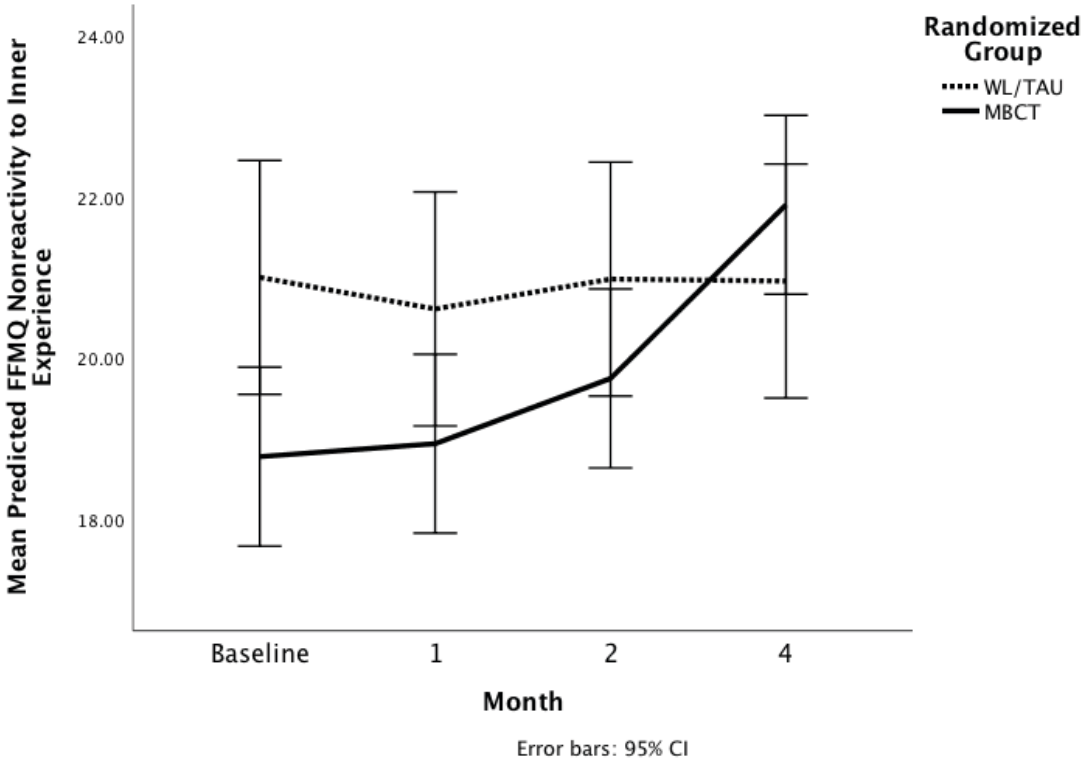
Note. FFMQ = Five Facet Mindfulness Questionnaire; MBCT = Mindfulness-Based Cognitive Therapy; WL/TAU = Waitlist/Treatment-as-Usual.

Figure 8. Change from Baseline to Month 4 in FFMQ Nonjudging of Inner Experience scores per treatment group.



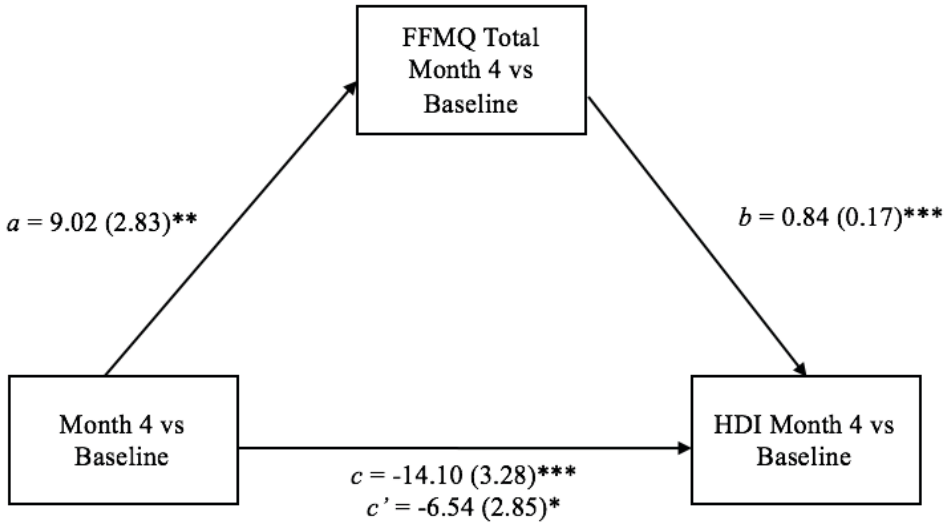
Note. FFMQ = Five Facet Mindfulness Questionnaire; MBCT = Mindfulness-Based Cognitive Therapy; WL/TAU = Waitlist/Treatment-as-Usual.

Figure 9. Change from Baseline to Month 4 in FFMQ Nonreactivity to Inner Experience scores per treatment group.



Note. FFMQ = Five Facet Mindfulness Questionnaire; MBCT = Mindfulness-Based Cognitive Therapy; WL/TAU = Waitlist/Treatment-as-Usual.

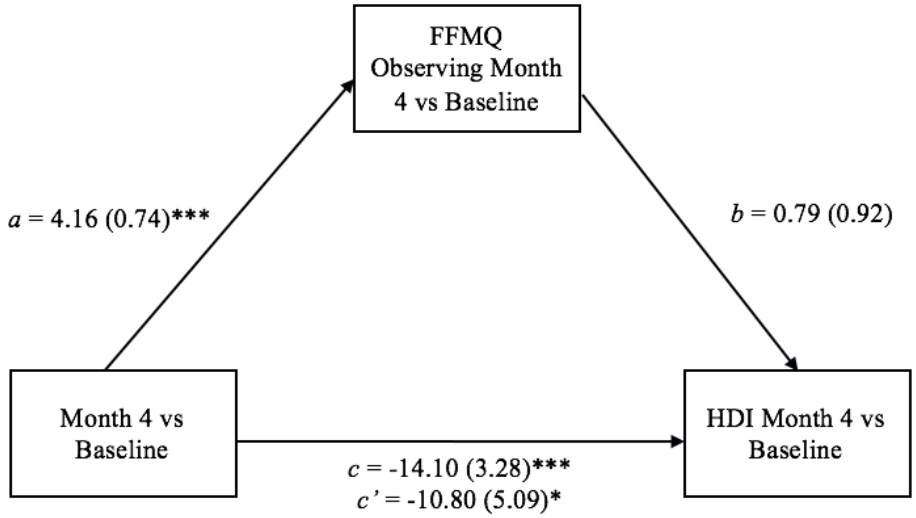
Figure 10. Simple mediation model for the association between X = Month 4 vs Baseline and Y = HDI Month 4 vs Baseline as mediated by M = FFMQ Total Scores Month 4 vs Baseline in the MBCT treatment group.



Note. n = 25; X = Month 4 vs Baseline, Y = HDI Month 4 vs Baseline, M = FFMQ Total Month 4 vs Baseline; * = p < .05; ** = p < .01; *** = p < .001.

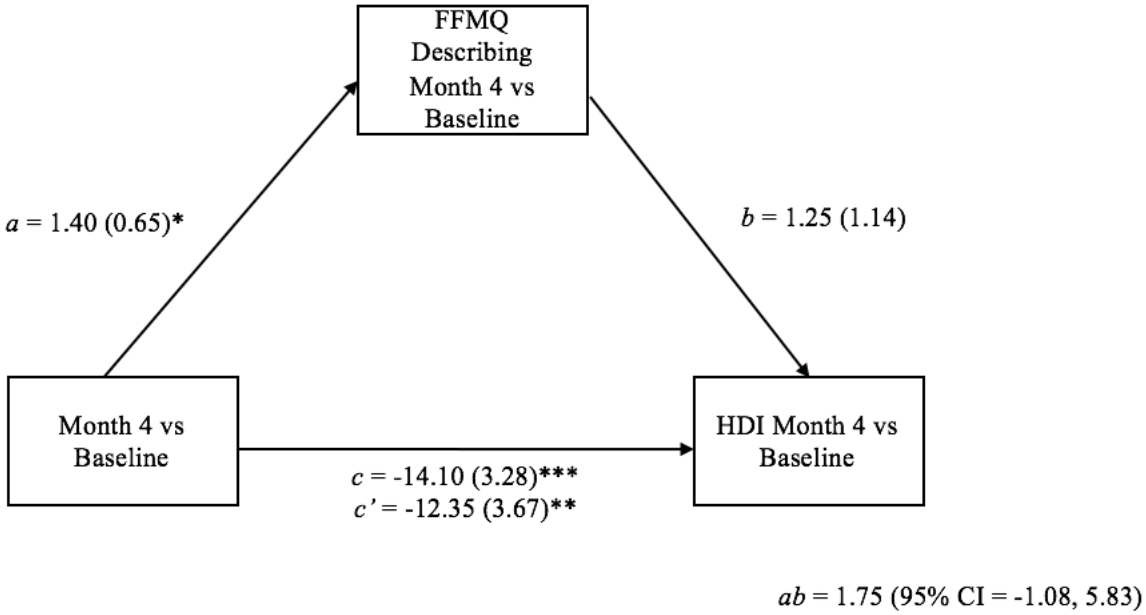
APPENDICES

Appendix 1. Simple mediation model for the association between X = Month 4 vs Baseline and Y = HDI Month 4 vs Baseline as mediated by M = FFMQ Observing Scores Month 4 vs Baseline in the MBCT treatment group.



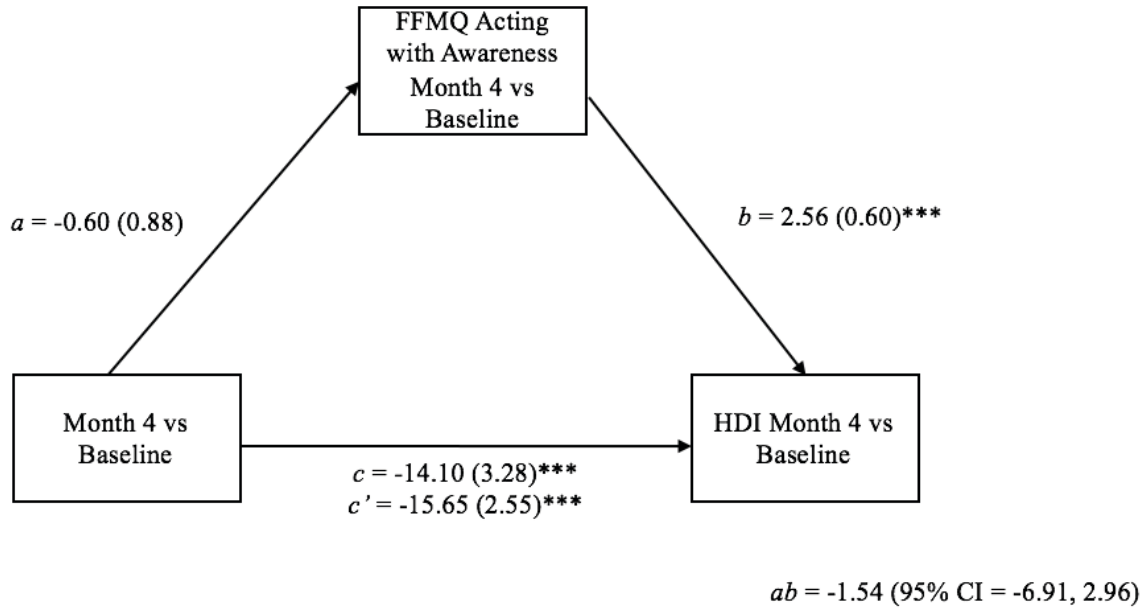
Note. n = 25; X = Month 4 vs Baseline, Y = HDI Month 4 vs Baseline, M = FFMQ Observing Month 4 vs Baseline; * = p < .05; ** = p < .01; *** = p < .001.

Appendix 2. Simple mediation model for the association between X = Month 4 vs Baseline and Y = HDI Month 4 vs Baseline as mediated by M = FFMQ Describing Scores Month 4 vs Baseline in the MBCT treatment group.



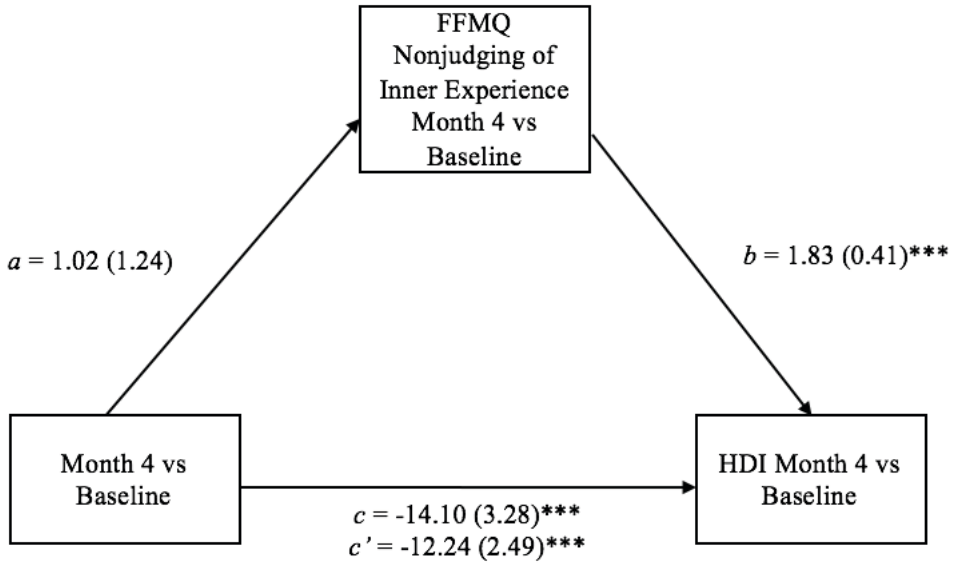
Note. n = 25; X = Month 4 vs Baseline, Y = HDI Month 4 vs Baseline, M = FFMQ Describing Month 4 vs Baseline; * = p < .05; ** = p < .01; *** = p < .001.

Appendix 3. Simple mediation model for the association between X = Month 4 vs Baseline and Y = HDI Month 4 vs Baseline as mediated by M = FFMQ Acting with Awareness Scores Month 4 vs Baseline in the MBCT treatment group.



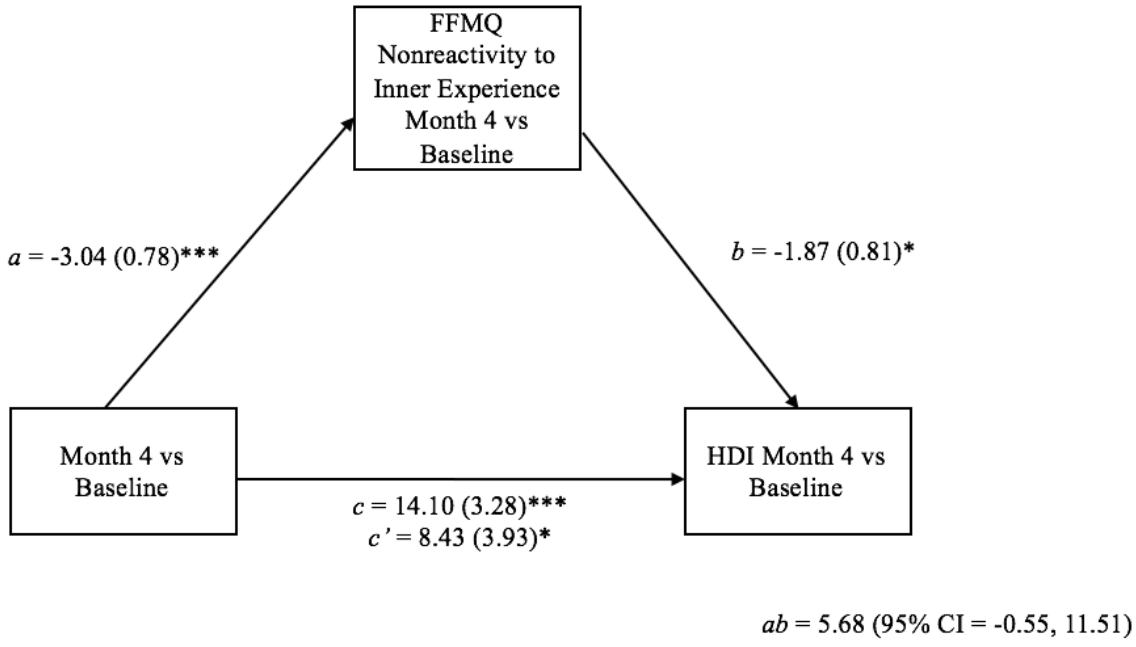
Note. n = 25; X = Month 4 vs Baseline, Y = HDI Month 4 vs Baseline, M = FFMQ Acting with Awareness Month 4 vs Baseline; * = $p < .05$; ** = $p < .01$; *** = $p < .001$.

Appendix 4. Simple mediation model for the association between X = Month 4 vs Baseline and Y = HDI Month 4 vs Baseline as mediated by M = FFMQ Nonjudging of Inner Experience Scores Month 4 vs Baseline in the MBCT treatment group.



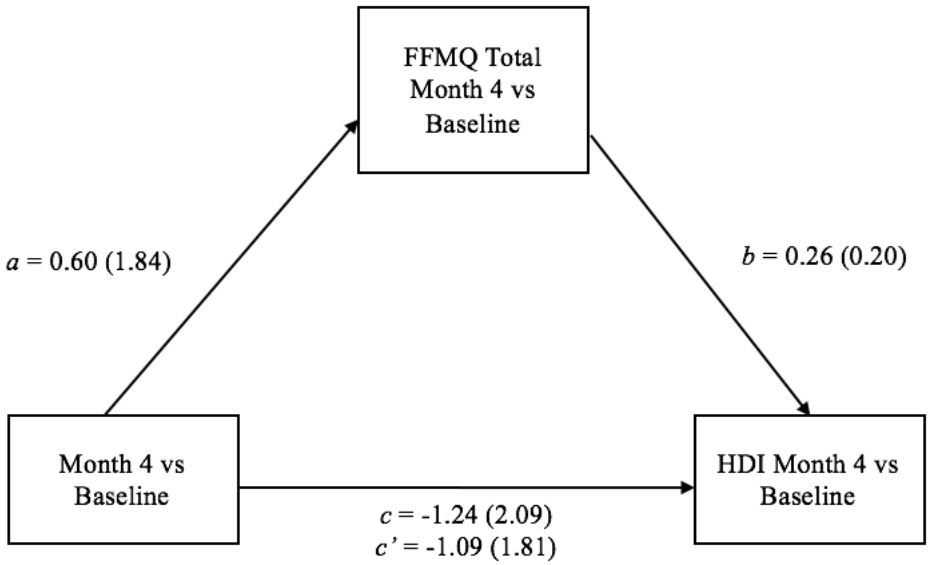
Note. n = 25; X = Month 4 vs Baseline, Y = HDI Month 4 vs Baseline, M = FFMQ Nonjudging of Inner Experience Month 4 vs Baseline; * = p < .05; ** = p < .01; *** = p < .001.

Appendix 5. Simple mediation model for the association between X = Month 4 vs Baseline and Y = HDI Month 4 vs Baseline as mediated by M = FFMQ Nonreactivity to Inner Experience Scores Month 4 vs Baseline in the MBCT treatment group.



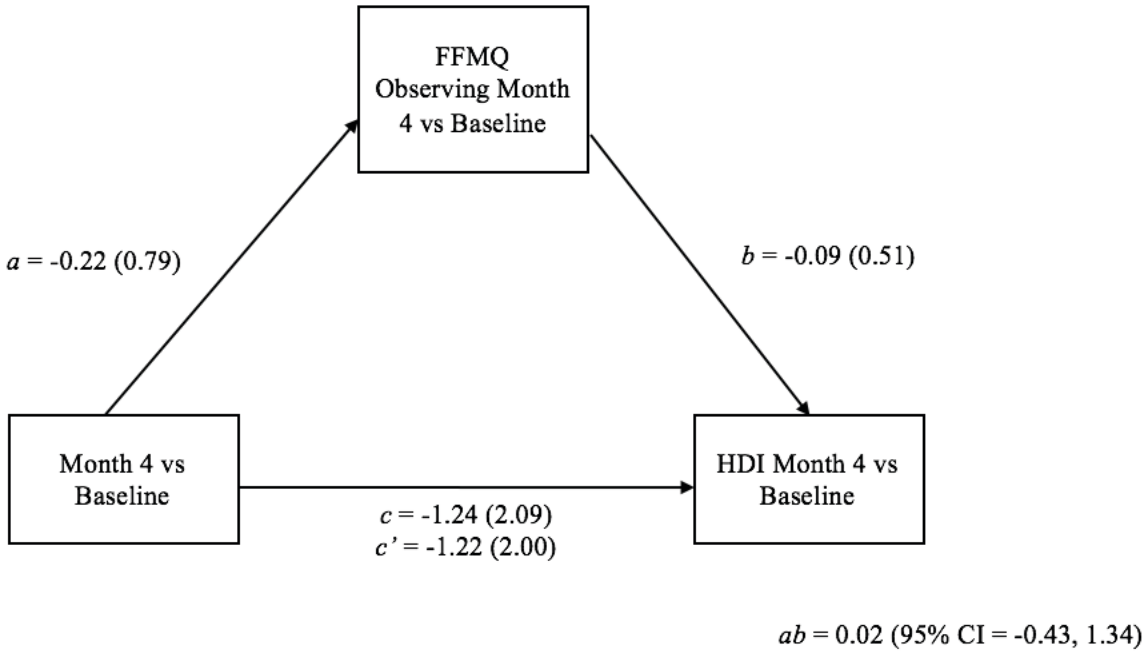
Note. n = 25; X = Month 4 vs Baseline, Y = HDI Month 4 vs Baseline, M = FFMQ Nonreactivity to Inner Experience Month 4 vs Baseline; * = p < .05; ** = p < .01; *** = p < .001.

Appendix 6. Simple mediation model for the association between X = Month 4 vs Baseline and Y = HDI Month 4 vs Baseline as mediated by M = FFMQ Total Scores Month 4 vs Baseline in the Waitlist/Treatment as Usual group.



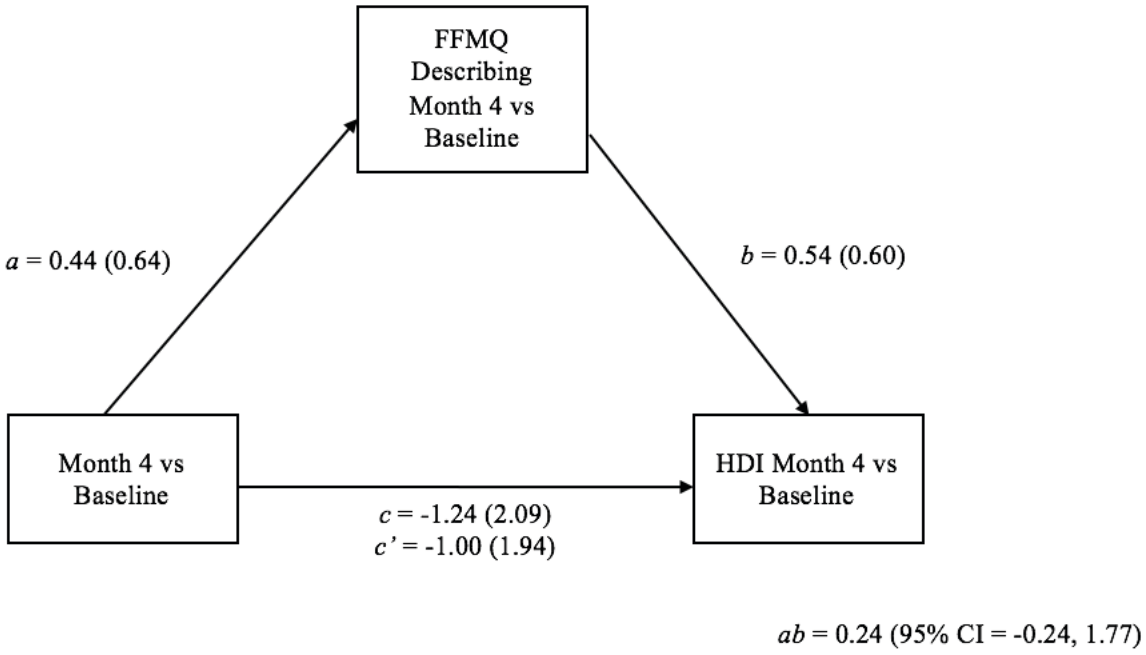
Note. n = 27; X = Month 4 vs Baseline, Y = HDI Month 4 vs Baseline, M = FFMQ Total Month 4 vs Baseline; * = p < .05; ** = p < .01; *** = p < .001.

Appendix 7. Simple mediation model for the association between X = Month 4 vs Baseline and Y = HDI Month 4 vs Baseline as mediated by M = FFMQ Observing Scores Month 4 vs Baseline in the Waitlist/Treatment as Usual group.



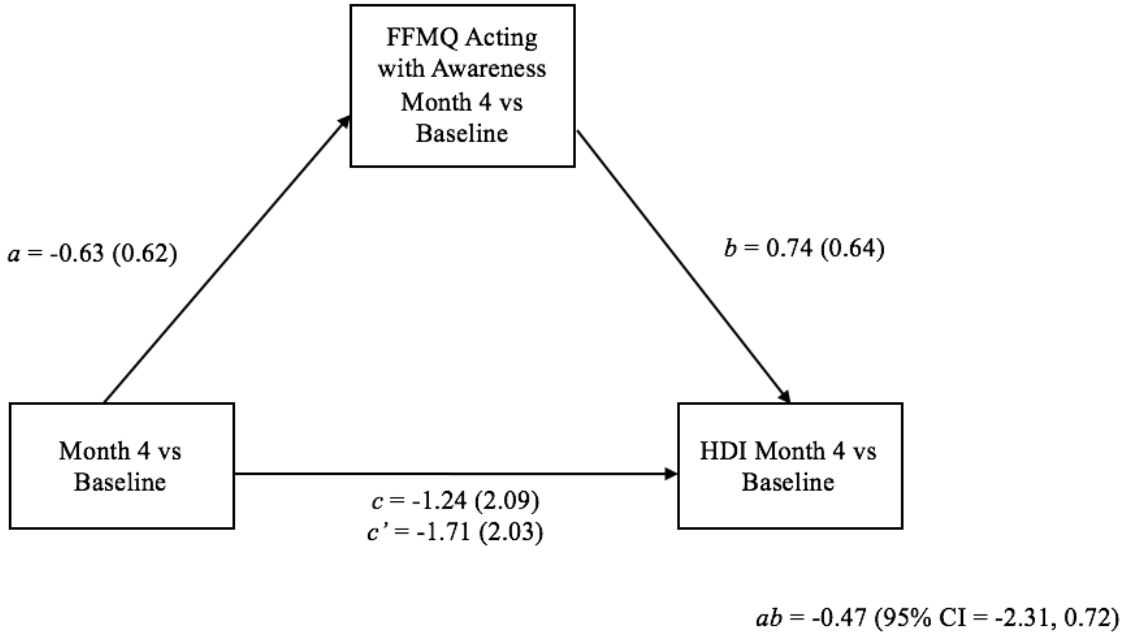
Note. n = 27; X = Month 4 vs Baseline, Y = HDI Month 4 vs Baseline, M = FFMQ Observing Month 4 vs Baseline; * = p < .05; ** = p < .01; *** = p < .001.

Appendix 8. Simple mediation model for the association between X = Month 4 vs Baseline and Y = HDI Month 4 vs Baseline as mediated by M = FFMQ Describing Scores Month 4 vs Baseline in the Waitlist/Treatment as Usual group.



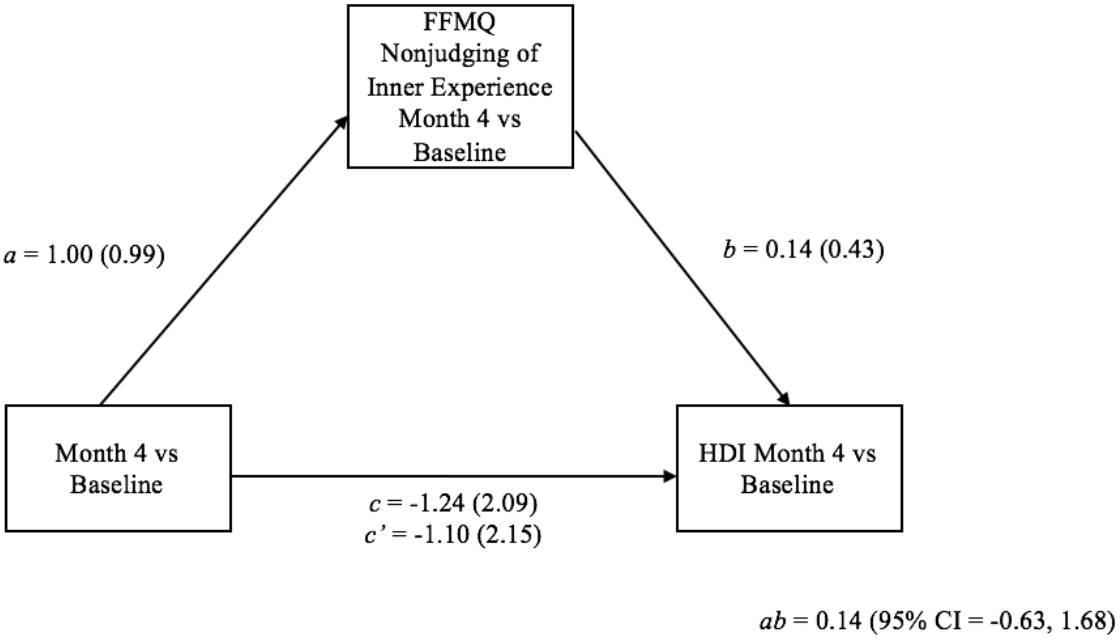
Note. n = 27; X = Month 4 vs Baseline, Y = HDI Month 4 vs Baseline, M = FFMQ Describing Month 4 vs Baseline; * = p < .05; ** = p < .01; *** = p < .001.

Appendix 9. Simple mediation model for the association between X = Month 4 vs Baseline and Y = HDI Month 4 vs Baseline as mediated by M = FFMQ Acting with Awareness Scores Month 4 vs Baseline in the Waitlist/Treatment as Usual group.



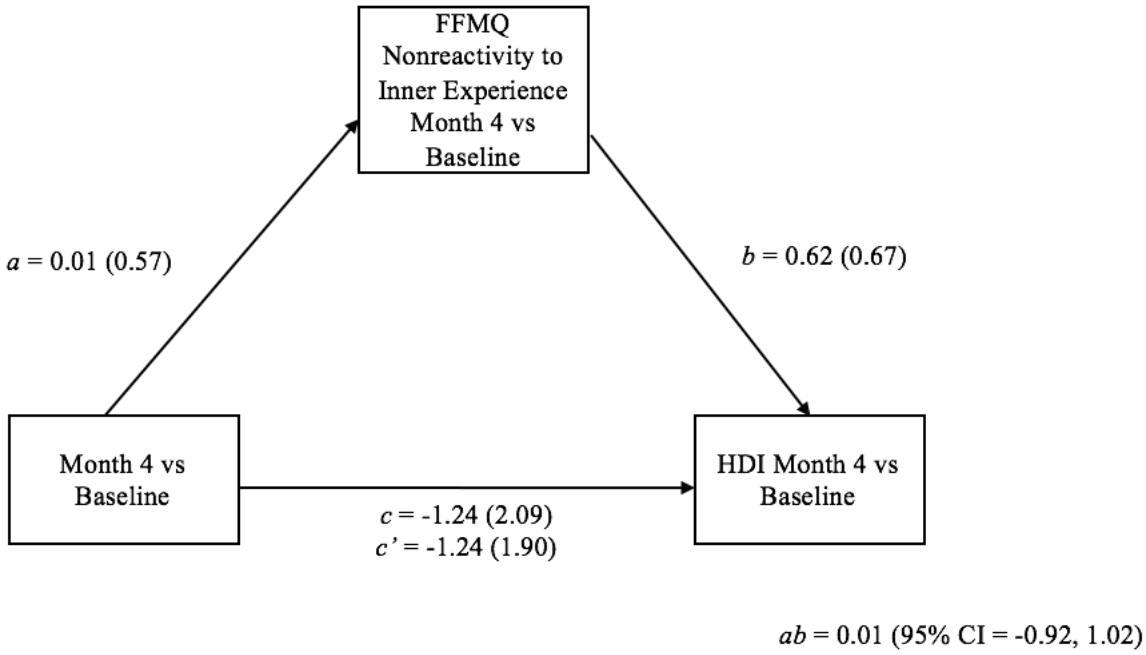
Note. n = 27; X = Month 4 vs Baseline, Y = HDI Month 4 vs Baseline, M = FFMQ Acting with Awareness Month 4 vs Baseline; * = p < .05; ** = p < .01; *** = p < .001.

Appendix 10. Simple mediation model for the association between X = Month 4 vs Baseline and Y = HDI Month 4 vs Baseline as mediated by M = FFMQ Nonjudging of Inner Experience Scores Month 4 vs Baseline in the Waitlist/Treatment as Usual group.



Note. n = 27; X = Month 4 vs Baseline, Y = HDI Month 4 vs Baseline, M = FFMQ Nonjudging of Inner Experience Month 4 vs Baseline; * = p < .05; ** = p < .01; *** = p < .001.

Appendix 11. Simple mediation model for the association between X = Month 4 vs Baseline and Y = HDI Month 4 vs Baseline as mediated by M = FFMQ Nonreactivity to Inner Experience Scores Month 4 vs Baseline in the Waitlist/Treatment as Usual group.



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