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EPISODIC MIGRAINE (S PARIKH, SECTION EDITOR)

Cognitive Behavioral Therapy for the Management of Episodic Migraine

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Abstract

Purpose of Review This article provides an overview of the application of CBT in the management of episodic migraine while also providing context and insight into the underlying neurophysiological mechanisms of therapeutic change. It discusses the theoretical foundations of CBT and highlights key components including education, cognitive restructuring, behavioral interventions, relaxation techniques, and lifestyle changes.

Recent Findings Cognitive behavioral therapy (CBT) is an empirically based treatment that is well suited for the management of episodic migraine. Although first-line treatments of migraine are typically pharmacological, a review of empirical literature suggests growing evidence for the use of CBT as a standard non-pharmacological treatment of headache conditions.

Summary In summary, this article explores evidence supporting the efficacy of CBT in reducing the frequency, intensity, and duration of migraine attacks as well as improving the quality of life and psychological well-being of those with episodic migraine.

Keywords Migraine · Education · Cognitive · Neurophysiology · Relaxation · Lifestyle

Introduction

Migraine is a headache disorder that impacts an estimated 36 million Americans and is one of the most common causes of disability [1•, 2]. While diagnostic benchmarks that distinguish episodic and chronic migraine continue to develop; it is well established that a state of chronic migraine is associated with substantial personal and societal burden, increased comorbidities, and a greater likelihood of degenerative brain abnormalities [3]. Previous literature has demonstrated that over the course of a year, about 2.5% of episodic migraine sufferers will progress to chronic migraine status [4]. While the primary goal of treatment for some may be alleviating pain and reestablishing function, an additional goal geared toward preventing the progression from episodic to chronic migraine is reasonable [1].

Cognitive behavioral therapy (CBT) is an empirically based treatment that is well suited for the management of episodic migraine. A review of empirical literature suggests that CBT should be considered a standard non-pharmacological treatment of headache conditions rather than an alternative treatment approach [5]. Furthermore, there is growing evidence that CBT can aid in the prevention of headaches in migraine patients [6]. Cognitive behavioral therapy is not a single intervention, but instead a multidimensional approach that aims to modify unhelpful and maladaptive thoughts, beliefs, and behaviors. Cognitive behavioral interventions targeting migraine can increase self-efficacy, decrease pain catastrophizing, lead to better clinical outcomes, and improve maladaptive emotional regulation, which is a known risk factor for the development and maintenance of chronic pain [7–9].

Given that the first-line treatment of migraine is often pharmacological, patients tend to lack alternative or complementary approaches to treating their symptoms. Additionally, individuals from under-represented backgrounds or those with socioeconomic challenges face disparities in healthcare that may preclude them from well-rounded treatment and impact their ability to participate in non-pharmacological therapies [10]. Although medications can be helpful in managing migraines, they often come with potential side effects and do not address the underlying psychological or behavioral factors that contribute to the condition. On the other hand, non-pharmacological mind–body therapies such as CBT have very few side effects and can be used concurrently with medication [11, 12]. The purpose of this review is to provide a rationale, background, and

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overview of CBT for the management of episodic migraine. Specifically, this article will cover 5 treatment components including migraine education through a biopsychosocial lens, cognitive restructuring, relaxation (self-regulation strategies), behavioral activation (breaking through fear and avoidance), and lifestyle changes.

Education

Practitioners who are unfamiliar with CBT may erroneously believe that treatment is reserved for those with mental illness and that pain is generated psychologically [13•]. Through psychoeducation, a well-trained cognitive behavioral clinician intentionally cultivates an understanding that the patient's symptoms are not merely a reflection of psychological processes, but rather an intricate amalgamation of biological, psychological, and sociological factors. Although the bi-directional relationship between the mind and body has been well established, patients often lack an in-depth understanding of the biopsychosocial model of episodic migraine and the neurophysiological underpinnings of pain. Clinicians practicing CBT strive to help the patient become a "headache expert" by imparting foundational principles involved in migraine development and treatment. The biopsychosocial approach emphasized in CBT allows individuals to view their symptoms through a multidimensional lens, instead of the dominant and often unilateral biomedical viewpoint.

Patient education can improve knowledge of treatment options, train patients in self-management skills, and change maladaptive behaviors and thoughts that may impact pain regulation) [14]. The nature of migraine is complex and spans far beyond biology [15]). A biopsychosocial viewpoint attempts to overcome a solely biological perspective by taking a bottom-up approach, in which biology considers the impact of psychological and sociological factors on pain [16]. Thus, a biopsychosocial model of care such as CBT is well equipped to meet the complex needs of migraine sufferers. Poor awareness of subtle psychological factors often influences maladaptive behaviors that maintain the migraine cycle [17]. For example, patients may commonly mistake prodromal symptoms of migraine, such as mood changes or increased appetite for triggers, which may directly or indirectly impact how they perceive and treat their symptoms [18]. Through education on the biopsychosocial model, individuals are taught to recontextualize their symptoms and consider other relevant psychological and behavioral nuances that instigate, perpetuate, and maintain their migraine.

In a landmark study by Russell Packard, 50 physicians were asked to identify what they believed migraine patients wanted from a consultation. Sensibly, about 66% chose pain relief as the primary goal with another 22% nominating an explanation of the pain [19]. When the same survey was provided to patients, the priorities were reversed. For patients, the most notable top goal was an explanation of pain (46%) as compared to seeking pain relief (31%) [19]. Fast-forward 20 years, and similar research demonstrated that patients rated "willingness to answer questions," as a more important physician attribute than "medical expertise in diagnosis and treatment" [20]. Given that patients are often the ones tasked with treating and tending to their migraine acutely, it is important for them to have an understanding about the etiology, pathology, and course of their condition. Specifically, individuals with episodic migraine or less frequent headaches can benefit from education and insight building through a CBT lens as it can help them identify factors, patterns, and dynamics associated with their migraine, and provide gain a sense of control over their symptoms [21].

Furthermore, compelling evidence that education addressing the neurophysiology of pain has a positive effect on pain, disability, catastrophic thinking, and physical performance has been established [22, 23]. Yet, recent research demonstrated that patients with migraine have a low-level knowledge about pain neurophysiology [24]. Lack of knowledge can influence a person's perception of pain and impact their ability to generate healthy solutions to manage episodic migraines. Fortunately, providers can use non-technical, jargon-free examples to educate patients on the intricate neurobiological process of pain. For example, in migraine, patients are often taught about the gate control theory, which posits that pain perception is a combination and integration of physical, cognitive, and emotional stimuli and not the result of a singular biological cause [25]. The theory strongly aligns with the biopsychosocial nature of CBT and is frequently introduced as a core component of episodic migraine management education. Patients are taught to identify factors that can open and close their "pain gate," often giving them a sense of control over their symptoms. Overall, cognitive behavioral therapy imparts components of education and insight building, which lead to a better understanding of pain biology, improve behavioral outcomes, decrease catastrophic thinking related to pain, and lead to reductions in pain and activity-related fear [26].

Cognitive Restructuring

In migraine treatment, cognitive restructuring is a collaborative tool that focuses on teaching people to identify and replace maladaptive thought patterns related to pain with healthier forms of thinking. Cognitive restructuring is a shift in perspective that is achieved through the analyzation and reconstruction of negative pain-related thoughts and the adaptation and adoption of thinking that is balanced, rational, and realistic. It improves self-efficacy and agency, promotes pain acceptance, and diminishes catastrophic thinking [27]. For individuals with migraine, automatic and unwanted thoughts can increase catastrophic thinking, perpetuate

anxiety, and lead to a greater level of impairment [28•]. Fortunately, techniques such as cognitive restructuring can reduce pain catastrophizing and migraine symptoms, while improving quality of life and migraine-related disability [29].

Negative automatic thoughts and beliefs can wreak havoc on migraine pain and erode confidence while promoting fear that one is unequipped to manage their symptoms effectively, which translates to poor self-efficacy. Locus of control is an individual's belief framework regarding their own agency. Both self-efficacy and locus of control are manifestations of cognitive processes and key predictors and sustainers of behavior change [30]. Research has demonstrated that both poor self-efficacy and an external locus of control are associated with poorer headache outcomes, while a higher internal locus of control is associated with lower headache disability [31, 32].

Higher catastrophizing is associated with more severe migraine symptoms, increased disability, and reduced quality of life. Catastrophic thinking styles can lead to excessive pain-related thoughts and avoidance of pain, in which a person might attempt to control, avoid, or limit unpleasurable experiences [33]. Cognitive restructuring in this area can increase levels of acceptance and decrease pain catastrophizing, and lead to significant enough change to show up on brain scans [27, 34•]. Patients undergoing CBT treatment demonstrate greater brain activation in frontal regions involved in the cognitive regulation of pain leading to improved top-down pain control. More specifically, CBT is associated with changes in gray matter in the dorsolateral prefrontal cortex, an area in the brain believed to be involved in pain modulation, in part due to techniques such as cognitive restructuring [34•].

While there are many ways to restructure unhealthy pain-related cognitions, a thought record is a common tool that is used in the treatment of episodic migraine and can have a positive impact on beliefs, anxiety, and behaviors [35]. The thought record examines pain-related cognitive distortions in detail and provides a platform for transforming them. In migraine, common examples of negative thoughts may include "I can't handle this pain," "This migraine will never go away," or "I feel useless when I have a migraine." Once such specific negative thoughts are identified, the thought record can immediately be utilized. The thought record embraces a systematic and logical procedure that modifies self-defeating thoughts by implementing thinking styles that are flexible, compassionate, and healthy. For example, "I can't handle this pain" can be reframed as "Although my pain is bad today, I have coped with pain like this before, and I can do it again." Taking a flexible and compassionate approach to pain can help migraine patients improve emotional control and reduce pain severity [36]. Replacing negative thoughts with healthier alternative thoughts validates the client's migraine experience while shifting the focus and attention away from pain and onto a more positive and balanced perspective. Cognitive restructuring strategies help patients to reassess their thoughts, beliefs, and patterns of behavior related to their pain while instilling confidence, improving pain regulation, and embracing a perspective that is flexible and open. Furthermore, gains resulting from CBT tend to persist well after treatment cessation, suggesting that cognitive restructuring for episodic migraine can lead to sustained benefits beyond the initial treatment phase [37].

Relaxation (Self-regulation Strategies)

CBT practitioners can use a variety of relaxation and self-regulation skills to teach patients mind and body calming strategies in efforts to reduce the response to stress, improve autonomic nervous system (ANS) dysregulation, and increase self-efficacy and locus of control. The ANS is thought to play a significant role in migraine [38] and altered ANS tone can be found from the premonitory through the postdrome phases [39]. More specifically, ANS dysfunction appears related to increased sympathetic and decreased parasympathetic response [40]. Similarly, heart rate variability (HRV) is an indicator of parasympathetic activity and vagal tone, and higher HRV is found in people who are more emotionally and physically resilient [41]. HRV has been shown to be lower in migraine patients compared to controls [42], in patients with disabling migraine [43], and in those with episodic migraine [44]. Under the umbrella of CBT, there is a myriad of empirically based relaxation strategies that can be used to improve ANS regulation and stabilize HRV, which in turn can aid in the management of episodic migraine. For example, patients can use biobehavioral self-regulation strategies to lower their blood pressure, reduce stress, and induce a sense of relaxation [45]. Strategies of self-regulation are essential components of comprehensive CBT treatment for episodic migraine.

Relaxation training as well as thermal biofeedback combined with relaxation training and EMG biofeedback has demonstrated Grade A evidence for their effectiveness in the prevention of migraine [46]. For an excellent overview of the possible mechanisms of biofeedback, see McKee [47]. In CBT, relaxation training typically involves learning about the relaxation response and strategies for inducing relaxation including progressive muscle relaxation (PMR), mental imagery, cue-controlled relaxation, autogenic phrases, and muscle scanning [48] as well as meditation or passive relaxation [46]. Both mindfulness-based stress reduction (MBSR), a standardized mind/body intervention that teaches mindfulness meditation and yoga [11], and mindfulness-based cognitive therapy for migraine (MBCT-m), an approach that integrates the key elements of CBT and MBSR [49], have demonstrated emerging evidence as a treatment for migraine. Furthermore, treatments like yoga have also been found to

reduce migraine symptoms and improve vagal tone [50]. In CBT, practitioners can choose from a multitude of empirically based relaxation strategies to help patients become more tolerant of their migraine and associated distress, and ultimately improve their quality of life.

Behavioral Activation (Breaking Through Fear Avoidance)

Alongside cognitive and relaxation techniques, behavioral strategies are also critical to the successful implementation of CBT treatment for episodic migraine. Specifically, behavioral activation and fear exposure help to discontinue the cycle of fear avoidance through inducing feared activity. Often, this cycle of avoidance decreases a person's ability to pursue value-driven activities in daily living and may ultimately worsen their migraine experience and quality of life [33, 36]. Furthermore, there is solidified evidence that physical and social avoidance can negatively impact pain [51]. The cycle of fear and avoidance is often instigated by thoughts, beliefs, and behaviors that become highly associated with pain. For example, a person may have catastrophic thinking related to an episode of migraine that includes hyper fixation and hypervigilance of symptoms. This pattern of thinking frequently prompts avoidance that tends to maintain the migraine. Additionally, many people are taught to identify and avoid certain headache triggers which can reinforce avoidance and often generalize to additional feared stimuli. As this cycle of avoidance continues, physical deconditioning takes place which has been shown to worsen pain-related cognitions and migraine disability [52].

CBT practitioners can systematically help people disengage from patterns of avoidance, often leading to a quicker return to baseline functioning. To facilitate a more adaptive response, individuals are educated on the etiology of fear avoidance, graded exposure, and pacing. As discussed, strategies such as cognitive restructuring are used alongside graded exposure to challenge faulty cognitions connected with the avoidance of feared activity. Graded exposure uses behavioral experiments to disprove these often faulty or exaggerated fears. First, the person identifies feared activities in a hierarchal manner. After which, the person attempts the feared or avoided activity in a stepwise manner, starting with the least feared situation. Pacing is used to provide a consistent and measurable means to self-manage migraine. The use of pacing has been shown to lead to a decrease in migraine pain and prevention of migraine and an overall increase in activity for the patient [53]. Using graded exposure with pacing, the person will move from the least threatening situation to the most feared objective. Through graded exposure, desensitization, and an increase in psychological flexibility, maladaptive beliefs and behaviors are ultimately disconfirmed. It is often the case that as patients increase their exposure to events and activities that were once feared, the individual can tolerate more activity than previously believed.

Lifestyle Changes

CBT can help individuals commit to lifestyle changes that are important for their health and migraine treatment. Migraine symptoms create significant disruptions in daily living and can stifle a person's ability to adequately care for themselves. For example, it is common that migraine sufferers may skip meals, become sedentary, and experience sleep disruption leading to an increase in migraine disability. The CBT clinician evaluates which of these factors are impacting the patient's quality of life and headache threshold in a collaborative fashion. Often, stigma is created when a patient feels that they have in some way created or caused the migraine, and this pattern of thinking is modified and challenged within the context of lifestyle changes. Therefore, the patient is introduced to lifestyle changes as part of the overall treatment plan, and the clinician maintains an emphasis on the headache threshold rather than one specific trigger to pain. This approach supports the patient in taking increased ownership of migraine control.

Lifestyle changes can encompass a wide range of components although some factors appear more often in the migraine research. A review of literature illuminates sleep, exercise, diet, and stress management as frequent areas of focus in non-pharmacological approaches to pain [54]. It is well established that there is a bi-directional relationship between migraine and sleep disturbances [55, 56]. More recent research has shown that individuals with circadian delays or circadian misalignments are more likely to experience higher migraine frequency and intensity [57]. Cognitive behavioral therapy for insomnia (CBT-I) is a first-line, non-pharmacological treatment that utilizes cognitive and behavioral approaches to improve sleep quality. There is a bevy of CBT skills that can be used to treat sleep disorders including sleep restriction therapy, relaxation training, and cognitive skills building. Cognitive behavioral practitioners are competently trained to shift between modes and mediums of cognitive therapies to attend to the patient's needs with immediacy.

Exercise is another key component in migraine management and healthy lifestyle. Exercise and physical activity are often erroneously emphasized as triggers to pain especially as the fear avoidance cycle is enacted [58]. Evidence shows a moderate activity level may reduce the number of migraine days, prevent the onset of the attack, and lessen migraine disability [59]. As with most lifestyle components of migraine, evidence supports consistency to be the most valuable variable in lifestyle management with the recommendation being

aerobic activity two to three times weekly over anaerobic activity [60]. The CBT practitioner examines unhealthy or distorted thoughts regarding activity level, and activity is increased based on obtainable and reachable goals. For example, someone with a sedentary lifestyle with chronic migraine may attempt chair yoga or tai chi as an initial movement goal. Lastly, patients are educated as benefits are seen after consistently maintaining these behaviors [60].

A healthy balanced diet is a basic health recommendation in the general population, and this applies to those with migraine as well. The healthy plate diet, for example, has been shown to reduce the number of migraine days for patients [61]. Lack of food or water is often listed as a trigger that adds to the headache threshold and the patient is encouraged to eat and drink water in a consistent manner. Many patients describe the role of certain food as triggers to attacks. It is important to educate the patient that research for food triggers to migraine is limited, and that the evidence supports an overall healthy approach to food rather than eating according to rigid thinking. There is no universal diet specific to migraine; however, some diets have been shown to play a role in the management of migraine symptoms. Elimination diets may help a patient determine which foods are a trigger or a food allergy [39]. The overall recommendation is to promote flexible thinking and a healthy lifestyle in hopes to decrease the likelihood of a migraine attack.

Discussion and Future Directions

This paper provides a comprehensive overview of empirically based CBT techniques and strategies for the management of episodic migraine. Although styles, techniques, and applications of CBT may vary among clinicians and change based on patient needs, this paper lays a foundation and structure for the successful treatment of a migraine patient. Furthermore, these strategies specifically target the multifaceted biological, psychological, and sociological nature of migraine. Given that CBT is a validated approach that reduces the intensity and frequency of migraine, there are several opportunities for potential future directions of research including:

1. Tailored CBT: given that everyone's migraine experience is unique, future research can focus on treatment that is customized to each patient's triggers, symptoms, and personal factors.
2. Online and virtual reality: due to the rise of telemedicine, future research can focus on the efficacy of online-based treatments and virtual reality-type devices that can introduce migraine triggers such as light or noise in a safe and virtual environment which can lead to desensitization and reduced frequency of migraines.
3. Combined CBT: future research should focus on blended approaches to migraine management. CBT can be used in conjunction with other empirically based approaches to correspond to specific and diverse patient needs.
4. Group CBT: patients with migraine may feel alone and misunderstood, and others around them might not understand the depth of their disability or pain. Group CBT can offer a safe setting for patients to gain critical social support. Group therapy may also be a cost-effective solution for patients and clinics.
5. Preventive: future research can focus on testing the preventive measures of CBT for groups that are vulnerable to developing migraine or progressing from episodic to a chronic migraine phase.

Compliance with Ethical Standards

Conflict of Interest The authors have no conflicts of interests to declare. There is no financial interest to report. We certified that the submission is original work and is not under review at any other publication.

Human and Animal Rights and Informed Consent This article does not contain any studies with human or animal subjects performed by any of the authors.

References

Papers of particular interest, published recently, have been highlighted as:
• Of importance

1.• Lipton RB, Silberstein SD. Episodic and chronic migraine headache: breaking down barriers to optimal treatment and prevention. Headache J Head Face Pain. 2015;55:103–22. **This article highlights important barriers and factors that can significantly impact the course and outcome of headache treatment. This article also strives to emphasize the importance of chronic migraine prevention.**
2. Stovner LJ, Nichols E, Steiner TJ, Abd-Allah F, Abdelalim A, Al-Raddadi RM, et al. Global, regional, and national burden of migraine and tension-type headache, 1990–2016: a systematic analysis for the Global Burden of Disease Study 2016. The Lancet Neurology. 2018;17(11):954–76. https://doi.org/10.1016/s1474-4422(18)30322-3.
3. Aurora SK, Kulthia A, Barrodale PM. Mechanism of chronic migraine. Curr Pain Headache Rep. 2011;15(1):57–63.
4. Bigal ME, Serrano D, Buse D, Scher A, Stewart WF, Lipton RB. Acute migraine medications and evolution from episodic to chronic migraine: a longitudinal population-based study. Headache J Head Face Pain. 2008;48(8):1157–68.
5. Rains JC, Penzien DB, McCrory DC, Gray RN. Behavioral headache treatment: history, review of the empirical literature, and methodological critique. Headache J Head Face Pain. 2005;45:S92–109.
6. Nahman-Averbuch H, Schneider VJ, Chamberlin LA, Kroon Van Diest AM, Peugh JL, Lee GR, Powers SW. Alterations in

brain function after cognitive behavioral therapy for migraine in children and adolescents. Headache J Head Face Pain. 2020;60(6):1165–82.
7. Shpaner M, Kelly C, Lieberman G, Perelman H, Davis M, Keefe FJ, Naylor MR. Unlearning chronic pain: a randomized controlled trial to investigate changes in intrinsic brain connectivity following cognitive behavioral therapy. NeuroImage Clin. 2014;5:365–76.
8. Singer AB, Buse DC, Seng EK. Behavioral treatments for migraine management: useful at each step of migraine care. Curr Neurol Neurosci Rep. 2015;15:1–8.
9. Koechlin H, Coakley R, Schechter N, Werner C, Kossowsky J. The role of emotion regulation in chronic pain: a systematic literature review. J Psychosom Res. 2018;107:38–45.
10. Befus DR, Irby MB, Coeytaux RR, Penzien DB. A critical exploration of migraine as a health disparity: the imperative of an equity-oriented, intersectional approach. 2018.
11. Wells RE, Burch R, Paulsen RH, Wayne PM, Houle TT, Loder E. Meditation for migraines: a pilot randomized controlled trial. Headache J Head Face Pain. 2014;54(9):1484–95.
12. Jacobs GD. Clinical applications of the relaxation response and mind–body interventions. The Journal of Alternative & Complementary Medicine. 2001;7(1):93–101.
13.• Thorn BE. Putting the brain to work in cognitive-behavioral therapy for chronic pain. Pain. 2020;161(Suppl 1):S27. **This article highlights the fact that biopsychosocial treatments canlead to biological outcomes. This article provides an excellent template fortreatment and discusses effective ways to work with patients who have chronicpain.**
14. World Health Organization. Regional Office for Europe. Therapeutic patient education: continuing education programmes for health care providers in the field of prevention of chronic diseases: report of a WHO working group. Copenhagen: WHO Regional Office for Europe. 1998.
15. Buse DC, Greisman JD, Baigi K, Lipton RB. Migraine progression: a systematic review. Headache J Head Face Pain. 2019;59(3):306–38.
16. Rosignoli C, Ornello R, Onofri A, Caponnetto V, Grazzi L, Raggi A, Sacco S. Applying a biopsychosocial model to migraine: rationale and clinical implications. J Headache Pain. 2022;23(1):100.
17. Pistoia F, Salfi F, Saporito G, Ornello R, Frattale I, D'Aurizio G, Sacco S. Behavioral and psychological factors in individuals with migraine without psychiatric comorbidities. J Headache Pain. 2022;23(1):1–9.
18. Pavlovic JM, Buse DC, Sollars CM, Haut S, Lipton RB. Trigger factors and premonitory features of migraine attacks: summary of studies. Headache J Head Face Pain. 2014;54(10):1670–9.
19. Packard RC. What does the headache patient want? Headache J Head Face Pain. 1979;19(7):370–4.
20. Lipton RB, Stewart WF. Acute migraine therapy: do doctors understand what patients with migraine want from therapy? Headache J Head Face Pain. 1999;39:S20–6.
21. Seng EK, Buse DC, Klepper JE, Mayson JS, Grinberg AS, Grosberg BM, Lipton RB. Psychological factors associated with chronic migraine and severe migraine-related disability: an observational study in a tertiary headache center. Headache J Head Face Pain. 2017;57(4):593–604.
22. Butler DS, Moseley GL. Explain Pain 2nd Edn. Noigroup publications. 2013.
23. Louw A, Diener I, Butler DS, Puentedura EJ. The effect of neuroscience education on pain, disability, anxiety, and stress in chronic musculoskeletal pain. Arch Phys Med Rahabil. 2011;92:2041–56.
24. Dantas MIO, Pereira TAB, DeSantana JM. Chronic migraine patients have low level of knowledge about pain neurophysiology. BrJP. 2021;4:339–43.
25. Melzack R, Wall PD. Pain mechanisms: a new theory: a gate control system modulates sensory input from the skin before it evokes pain perception and response. Science. 1965;150(3699):971–9.
26. Moseley GL, Butler DS. Fifteen years of explaining pain: the past, present, and future. J Pain. 2015;16(9):807–13.
27. Fish RA, Hogan MJ, Morrison TG, Stewart I, McGuire BE. Willing and able: a closer look at pain willingness and activity engagement on the Chronic Pain Acceptance Questionnaire (CPAQ-8). J Pain. 2013;14(3):233–45.
28.• Kimpara K, Arizono S, Tanaka T, Kimpara T, Terada K, Ohgi S. Brain activation of unpleasant emotions increases catastrophizing in patients with chronic pain. Pain Manag Nurs. 2023. **This article is important as it highlights the role that emotionalstates can have on brain function, thinking, and management of chronic pain.This article provides a unique perspective on the mind, body, and brainconnection.**
29. Thorn BE, Pence LB, Ward LC, Kilgo G, Clements KL, Cross TH, Tsui PW. A randomized clinical trial of targeted cognitive behavioral treatment to reduce catastrophizing in chronic headache sufferers. J Pain. 2007;8(12):938–49.
30. Dolce JJ, Crocker MF, Moletteire C, Doleys DM. Exercise quotas, anticipatory concern and self-efficacy expectancies in chronic pain: a preliminary report. Pain. 1986;24(3):365–72.
31. French DJ, Holroyd KA, Pinell C, Malinoski PT, O'donnell F, Hill KR. Perceived self-efficacy and headache-related disability. Headache J Head Face Pain. 2000;40(8):647–56.
32. Scharff L, Turk DC, Marcus DA. The relationship of locus of control and psychosociaI-behavioral response in chronic headache. Headache J Head Face Pain. 1995;35(9):527–33.
33. Almarzooqi S, Chilcot J, McCracken LM. The role of psychological flexibility in migraine headache impact and depression. J Context Behav Sci. 2017;6:239–43.
34.• Seminowicz DA, Shpaner M, Keaser ML, Krauthamer GM, Mantegna J, Dumas JA, Naylor MR. Cognitive-behavioral therapy increases prefrontal cortex gray matter in patients with chronic pain. J Pain. 2013;14(12):1573–84. **This study is of great importance as it provides insight into thebiological and physical changes that can occur in the brain through cognitiveand behavioral therapy. This research has major implications as it pertains tounderstanding the human brain and the use of nonpharmacological approaches to improvebiological outcomes.**
35. McManus F, Van Doorn K, Yiend J. Examining the effects of thought records and behavioral experiments in instigating belief change. J Behav Ther Exp Psychiatry. 2012;43(1):540–7.
36. Martin PR, MacLeod C. Behavioral management of headache triggers: avoidance of triggers is an inadequate strategy. Clin Psychol Rev. 2009;29:483–95.
37. Adler AD, Strunk DR, Fazio RH. What changes in cognitive therapy for depression? An examination of cognitive therapy skills and maladaptive beliefs. Behav Ther. 2015;46(1):96–109. https://doi.org/10.1016/j.beth.2014.09.001.
38. Peroutka SJ. Migraine: a chronic sympathetic nervous system disorder. Headache. 2004. https://doi.org/10.1111/j.1526-4610.2004.04011.x.
39. Gazerani P. Migraine and diet. Nutrients. 2020;12(6):1658. https://doi.org/10.3390/nu12061658.PMID:32503158;PMCID:PMC7352457.
40. Gass JJ, Glaros AG. Autonomic dysregulation in headache patients. Appl Psychophysiol Biofeedback. 2013;38:257–63. https://doi.org/10.1007/s10484-013-9231-8.

41. Minen Mia T, Corner Sarah, Berk Thomas, Levitan Valeriya, Friedman Steven, Adhikari Samrachana, Seng Elizabeth B. Heartrate variability biofeedback for migraine using a smartphone application and sensor: a randomized controlled trial. Gen Hosp Psychiatry. 69.
42. Koenig J, Williams DP, Kemp AH, Thayer JF. Vagally mediated heart rate variability in headache patients—a systematic review and meta-analysis. Cephalalgia. 2016;36(3):265–78. https://doi.org/10.1177/0333102415583989.
43. Aaron Shechter, Stewart Walter F, Silberstein Stephen D, Lipton Richard B. Migraine and autonomic nervous system function: a population-based, case-control study. Neurology. 2002;58(3):422–7. https://doi.org/10.1212/WNL.58.3.422.
44. Lvming Zhang, Shi Qiu, Chunxia Zhao, Wang Peifu Yu, Shengyuan,. Heart rate variability analysis in episodic migraine: a cross-sectional study. Front Neurol. 2021;12. https://www.frontiersin.org/articles/10.3389/fneur.2021.647092.
45. Nakao M, Yano E, Nomura S, Kuboki T. Blood pressure-lowering effects of biofeedback treatment in hypertension: a meta-analysis of randomized controlled trials. Hypertens Res. 2003;26(1):37–46.
46. Campbell J, Penzien, D. Evidenced-based guidelines for migraine headache: behavioral and physical treatments. 2000.
47. Michael G. McKee. Biofeedback: an overview in the context of heart-brain medicine. Clevel Clin J Med. 2008;75(2). https://doi.org/10.3949/ccjm.75.suppl_2.s31
48. Seng Elizabeth K, Holroyd Kenneth A. Dynamics of changes in self-efficacy and locus of control expectancies in the behavioral and drug treatment of severe migraine. Ann Behav Med. 2010;40(3):235–47. https://doi.org/10.1007/s12160-010-9223-3.
49. Seng EK, Singer AB, Metts C, Grinberg AS, Patel ZS, Marzouk M, Rosenberg L, Day M, Minen MT, Lipton RB. Does mindfulness-based cognitive therapy for migraine reduce migraine-related disability in people with episodic and chronic migraine? A phase 2b pilot randomized clinical trial. Headache J Head Face Pain. 2019;59:1448–67.
50. Kisan R, Sujan MU, Adoor M, Rao R, Nalini A, Kutty BM, et al. Effect of Yoga on migraine: a comprehensive study using clinical profile and cardiac autonomic functions. Int J Yoga. 2014. https://doi.org/10.4103/0973-6131.133891.
51. Hasenbring MI, Hallner D, Rusu AC. Fear-avoidance-and endurance-related responses to pain: development and validation of the Avoidance-Endurance Questionnaire (AEQ). Eur J Pain. 2009;13(6):620–8.
52. Vlaeyen JWS, Crombez G, Linton SJ. The fear-avoidance model of pain. Pain. 2016;157(8):1588–9. https://doi.org/10.1097/j.pain.0000000000000574. (PMID: 27428892).
53. McLean A, Coutts K, Becker WJ. Pacing as a treatment modality in migraine and tension-type headache. Disabil Rehabil. 2012;34(7):611–8. https://doi.org/10.3109/09638288.2011.610496. Epub 2011 Oct 8 PMID: 21980991.
54. Roditi D, Robinson ME. The role of psychological interventions in the management of patients with chronic pain. Psychol Res Behav Manag. 2011;4:41–9. https://doi.org/10.2147/PRBM.S15375. Epub 2011 May 11. PMID: 22114534; PMCID: PMC3218789.
55. Kim J, Cho SJ, Kim WJ, Yang KI, Yun CH, Chu MK. Insufficient sleep is prevalent among migraineurs: a population-based study. J Headache Pain. 2017;18:50.
56. Lin YK, Lin GY, Lee JT, et al. Associations between sleep quality and migraine frequency: a cross-sectional case-control study. Medicine (Baltimore). 2016;95: e3554.
57. Ong JC, Taylor HL, Park M, Burgess HJ, Fox RS, Snyder S, Wyatt JK. Can circadian dysregulation exacerbate migraines? Headache J Head Face Pain. 2018;58(7):1040–51.
58. Amin FM, Aristeidou S, Baraldi C, Czapinska-Ciepiela EK, Ariadni DD, Di Lenola D, European Headache Federation School of Advanced Studies (EHF-SAS). The association between migraine and physical exercise. The journal of headache and pain. 2018;19:1–9.
59. Lemmens J, De Pauw J, Van Soom T, et al. The effect of aerobic exercise on the number of migraine days, duration and pain intensity in migraine: a systematic literature review and meta-analysis. J Headache Pain. 2019;20:16.
60. Song TJ, Chu MK. Exercise in treatment of migraine including chronic migraine. Curr Pain Headache Rep. 2021;25:14.
61. Altamura C, et al. The healthy eating plate advice for migraine prevention: an interventional study. Nutrients. 2020;12(6):1579.