Complementary and Alternative Approaches to Chronic Daily Headache: Part I—Mind/Body

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Introduction to Parts I, II, and III: Complementary and Alternative Approaches for Chronic Daily Headache

The refractory nature of chronic daily headache makes it challenging to treat. Both patients and providers become frustrated with the often-poor treatment responses and persistent symptoms, and as a result many patients turn to complementary and alternative medicine (CAM) for relief. CAM therapies include diverse medical and healthcare systems, practices, and products not presently considered as part of conventional medicine [1]. These options can be used as alternatives or complements to traditional western medical options. Many CAM therapies address and target other factors (e.g., stress) that may be involved in development or persistence of medical symptoms. Typical pharmacologic options are often limited by side effects, poor tolerance, limited efficacy, patient noncompliance or non-adherence, medication contraindications, and comorbidities or coexisting conditions (e.g., pregnancy/nursing). Overuse of medications can become a critical problem, especially with chronic daily headache and the potential development of medication-overuse headache.

Some CAM therapies may be appealing because of their minimal cost, as well as patients' views that such products are more aligned with their personal health and wellness beliefs. Since they can be used concurrently with medications, many patients may use them without discussing them with their providers. However, these therapies may have side effects, and their costs may not be negligible. Understanding the benefits and risks of these therapies is critical for patients, who should seek appropriate provider counseling about CAM treatment options for headache [2].

Headache is among the most common neurological conditions associated with CAM use [3–5]. The prevalence of CAM use in patients with headaches ranges from 29 to 74% [3, 6–13]. This may even be an underestimate; one study ($n = 484$) determined prevalence based on initial admittance of use to be 17%, but follow-up questioning determined actual use to be 42% [3]. In an analysis of the 2007 National Health Interview Survey (NHIS, $n = 23,393$), 49.5% of adults with self-reported migraines/severe headache reported using CAM therapies versus 33.9% of those without migraines/severe headaches ($p < 0.001$) [6]. Therapies reported included mind/body therapies (30.2%), biologically based therapies such as herbs/supplements (23.7%), manipulation-based therapies such as chiropractic and massage (20.6%), and alternative systems such as acu-

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puncture and homeopathy (5.2%). This study was limited because patients did not report using the CAM therapy specifically for their headaches. An analysis of the 2012 NHIS data reports similar prevalence of CAM for adults with migraines/ severe headaches (44%) but with manipulation-based therapies most commonly used (23.7%), followed by biologically based therapies (22.2%), and then mind/body therapies (19.0%) [13]. Differences in rates from the 2007 to the 2012 analyses may be due to actual changes in use or different definitions of the CAM modalities in the analyses [6, 13]. A smaller survey from a Turkish headache clinic reported massage (51%) as most frequently used [7]. Since pediatric patients and their parents and providers often wish to avoid pharmacologic options due to risks of side effects and fear for long-term use, CAM is often used in children and adolescents [10]. In a survey of 124 pediatric headache patients from Italy, 76% reported using CAM, most often herbal preparations (64%). Eighty percent of respondents used CAM as a preventive treatment option [10].

If patients decide to use CAM, most report using three or more types of therapies [8, 14]. In addition, if used for headache, patients will often use CAM for other medical conditions. Headache patients most commonly use CAM based on provider recommendation, cost or ineffectiveness of conventional treatments [6], the wish of avoiding chronic use of drugs with their related side effects, the desire for an integrated approach, inefficacy of conventional medicine [10], the hope for a potential improvement of headache [9], or as a last resort after trying all conventional therapies [15]. The most common source of CAM referral is usually a friend or relative [8, 9]. For those who report using CAM, up to 42–62% do not discuss their use with their provider [6, 8, 9], although many say this is because the provider did not ask about their use, rather than fear of discouragement or lack of understanding [8]. In headache patients, predictors or correlates of CAM use include headache disability (e.g., headache impact test-6 [HIT-6] scores) [8], higher income, more frequent headaches [9], anxiety, joint or low back pain, alcohol use, higher education, and living in the western USA [6]. Using

CAM therapies does not exclude the use of conventional therapies, and some research suggests the contrary. For example, youth with headaches who used CAM, compared to nonusers, had higher expenditures while using most types of conventional care [11].

Many of the surveys assessing CAM use have also questioned perceived efficacy. A survey from a UK headache clinic ($n = 92$, with 32% reporting CAM use) demonstrated that 60% of CAM users perceived the therapy as beneficial in helping reduce headache frequency or intensity, 58% reported being satisfied or very satisfied with the treatment, and none felt the CAM therapy worsened their headaches [8]. However, several surveys report less than half of patients experiencing satisfaction from their CAM therapy. A Norwegian survey with 62% prevalence of CAM use in those with primary chronic headaches found a range of 0–43% perceived efficacy, without significant differences between gender, headache diagnoses, medication use, physician contact, and co-occurrence of migraine [12]. Another survey, based out of a Turkish headache clinic, found that out of all CAM modalities, only those using massage reported benefit and in only 33% of those patients [7]. Only 23% of 2477 chronic migraineurs reported satisfaction with their CAM treatment [14]. The type of headache treated may also affect perceived efficacy, as a survey of CAM use in cluster patients reported that only 8% perceived benefit and 28% had partial effectiveness [9].

Compared to those not using CAM, those who use CAM are more likely to have comorbid mental health issues, have more intense headaches, and experience more negative life impact from migraines [14]. Interestingly, CAM treatment satisfaction was inversely related to the number of psychiatric comorbidities, the frequency of migraines, and the number of migraine symptoms, although CAM treatment satisfaction was more strongly correlated with migraine outcomes than psychiatric comorbidities. Disability associated with chronic headaches may make it difficult to use extensive non-home-based CAM treatments, although for the same reasons chronic migraineurs may be more amenable to home

options such as meditation. The 2012 NHIS analysis of CAM use in adults with migraines found that women are more likely to use CAM than men and that CAM use was associated with decreased odds of moderate mental distress only in women [13]. The authors argue that women with migraines/severe headaches may have benefited from CAM for their mental distress.

Providers have also been surveyed to assess their opinion on CAM efficacy. A survey was administered to 223 different UK CAM organizations, and headaches/migraine was the second most commonly cited condition that would benefit by CAM (behind stress/anxiety) [16]. The recommended treatment options for headache/migraines included massage, yoga, reflexology, aromatherapy, and chiropractic treatments, along with other options not discussed in this chapter (Bowen technique, hypnotherapy, nutrition, Reiki). A survey completed by 1247 healthcare professionals in Switzerland reports that they would most likely refer patients for acupuncture for migraine (75%) or tension headaches (71%), although over half had never referred a patient to a CAM provider, and 84% felt they lacked the knowledge to inform their patients on CAM [17].

This review focuses on the evidence and outcomes to date for CAM therapies of mind/body therapies, Part I (e.g., meditation, yoga, tai chi, deep breathing); manipulation-based therapies, Part II (e.g., acupuncture, acupressure, dry needling, chiropractic manipulation, massage, craniosacral therapy, reflexology); and other CAM options (aromatherapy, homeopathy, hydrotherapy, daith piercing, and hyperbaric oxygen therapy) for headache. Part III summarizes this evidence for nutraceutical options for headache, specifically feverfew, riboflavin, magnesium, coenzyme Q10, melatonin, vitamin D, and ginkgo. Most of these therapies have very little research supporting their use, and the research that has been conducted is limited by critical methodologic concerns (e.g., small sample sizes, no active control groups, etc.). By the very nature of being "CAM," these therapies do not yet have the research evidence base to be accepted into mainstream medicine. Further, research on these therapies for headache, and specifically chronic

daily headache, is limited. The goal of this review is to describe the research on CAM therapies for headache and, when available, chronic daily headache. If not available, the research presented for headache can be extrapolated for consideration in the treatment of chronic daily headache.

Mind/Body and Chronic Daily Headache

Mind/body practices are based on the awareness of the mind and body connection, to enhance the mind's positive influence on the body's physical functioning and thus promote health. Mind/body therapies are often considered treatments that target stress. Since stress is the most cited trigger for migraine attacks [18] and has a complex relationship with headaches [19], headaches may be particularly amenable to mind/body therapies. Many mind/body therapies are also considered "behavioral treatments." Currently, "behavioral treatments" for headache include cognitive behavioral therapy, biofeedback, and relaxation training (Table 18.1) [20], with the goal of training patients in these "headache management skills." These therapies have been researched within the context of headache medicine for many years; the first study evaluating biofeedback for headaches appeared in 1969. Based on a large systematic review evaluating behavioral treatments for headache [21], the US Headache Consortium gave Grade A evidence for the use of relaxation train-

Table 18.1 Behavioral and mind/body treatment options

Behavioral	Mind/body
• Cognitive behavioral therapy	• Meditation
– Stress management	• Yoga
– Coping skills	• Guided imagery
• Biofeedback	• Biofeedback
• Relaxation training	• Hypnosis
	• Tai chi
	• Qi gong
	• Deep breathing exercises
	• Progressive muscular relaxation

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ing, thermal biofeedback with relaxation, electromyographic (EMG) biofeedback, and cognitive behavioral therapy [22]. Because of their increasing acceptance into mainstream headache medicine, these therapies may not be considered "CAM" anymore.

However, many typical "mind/body" approaches have been used in Eastern medicine for many years and are only now gaining attention in Western medicine, with limited research evidence for their use. Many mind/body therapies incorporate components of evidence-based behavioral treatments, such as relaxation, deep breathing, and guided imagery. Although clearly there is overlap between the two categories, Table 18.1 delineates the differences between behavioral treatments and mind/body treatments. For this chapter, the evidence and potential mechanisms for the mind/body approaches of meditation, yoga, tai chi, and deep breathing will be discussed. Few studies have been conducted evaluating these approaches in general and even fewer that are specific to chronic daily headache. Therefore, much of the evidence described will focus on these approaches to any type of headache, with the consideration of extrapolating the information to chronic daily headache.

Meditation

Meditation has long historical roots in religious and spiritual traditions, with goals of reaching heightened levels of spiritual awareness. In the last several decades, meditation has been researched for its physiological benefits. Benson published early investigations of meditation and its ability to elicit the "relaxation response" [23]. His research on the effects of the relaxation response through mantra-based transcendental meditation for cluster, migraine, and tension headaches demonstrated that twice-daily, 20-min sessions for 4–14 months resulted in significant clinical improvements for 6 of 17 headache patients [24, 25].

Kabat-Zinn's research further developed this line of inquiry through a program to teach "mindfulness meditation," defined as "paying attention in a particular way: on purpose, in the present moment, and non-judgmentally" [26]. Through the daily practice of mindfulness meditation, participants are encouraged to apply mindfulness in daily activities. The practice of mindfulness promotes an attitude of acceptance, curiosity, and openness. His original research focused on those with "chronic pain," including headache. Participants had improvements in pain symptoms, anxiety, depression, and drug utilization, with most effects maintained at 15 months follow-up [27, 28]. This program blossomed into the "mindfulness-based stress reduction (MBSR)" program, a standardized program of 8 weekly 2.5 h classes that has been taught to over 22,000 individuals, with referrals from over 6000 providers.

As a standardized intervention, MBSR has been helpful for a multitude of different medical conditions [29], with chronic pain being one of the most commonly studied conditions. A systematic review evaluated the benefits of MBSR or a variation of the program for chronic pain in 38 randomized clinical trials (RCTs) [30]. The authors reported that mindfulness meditation improves pain, depression, and quality of life, although they argued that larger, more well-designed and rigorous RCTs are needed to provide better estimates of efficacy [30]. Five of the RCTs included in this review evaluated mindfulness for headache; all are limited by lack of an active control [31–35].

We conducted the first RCT of MBSR in adults with episodic migraine ($n = 19$), one of the studies included in the systematic review. Both groups received usual care, and the active group also received MBSR. Most participants (89%) were taking migraine prophylactics daily and had an average of ten headaches/month. We observed statistically significant improvements in headache duration (captured with daily headache logs), disability (HIT-6 and Migraine Disability Assessment [MIDAS]), self-efficacy, and mindfulness. Adherence and study participation were excellent, with no adverse events. Although our small sample size limited the study's power to detect statistically significant differences in headache frequency or severity, a strength of this

study (standard for strong headache studies but unusual in the CAM literature) was use of daily headache logs for assessment of headache outcomes, with baseline data completed prior to randomization. The major limitation was the lack of an active control group.

Additional studies included in this review [30] evaluated MBSR or variations for different types of headaches. Two studies were conducted in Iran. One evaluated MBSR for "chronic headache" (primary chronic migraine or tension-type headache) versus usual care ($n = 40$), with pain and quality of life (SF-36) questionnaires at baseline and follow-up [35]. MBSR improved pain intensity and quality of life vs. the control group. However, the study was considered of "poor" quality in the systematic review because of weak statistical analyses, no active control group, and how headache outcomes were assessed. Rather than daily headache logs, headache outcomes were limited to a perceived pain intensity of headache at each time point, with a cumulative assessment and score for pain ratings, duration, and frequency of headaches in the prior month (not a typical headache outcome). Another RCT conducted in Iran of MBSR for tension headache (uncertain if episodic or chronic, $n = 60$) demonstrated improvements in headache severity (measured by daily headache logs) and mindfulness (mindfulness attention awareness scale) [34] and reported separately perceived stress and general mental health (Brief Symptom inventory) [36]. Although this study had a 3-month follow-up, it was also limited by lack of an active control group.

An RCT in Australia evaluated a briefer version of MBSR (classes twice weekly for 3 weeks) vs. wait-list control ($n = 58$) for ICHD-II defined chronic tension-type headache, with headache outcomes captured with 2-week headache diaries before/after the intervention and mindfulness assessed before/after with the Five-Factor Mindfulness Questionnaire. Headache frequency decreased in the intervention group compared to the control group; headache duration and intensity did not show improvements with MBSR. The intervention group had better scores on the observe scale from the Five-Factor Mindfulness Scale compared to the control group. The study was limited by significant dropouts (58 randomized but only 42 analyzed), no active control group, and a novel intervention with unknown reliability and validity. Another RCT evaluated a variant of MBSR, mindfulness-based cognitive therapy (that incorporates facets of both MBSR and CBT), for adults with "headache pain" (3+ days/month of any primary headache disorder) compared to delayed treatment control ($n = 36$) [33]. Compared to the control group, intervention participants reported better pain acceptance and self-efficacy, with additional improvements seen in pain interference and pain catastrophizing among those who completed the study ($n = 24$). Improvements in headache outcomes were not seen. Limitations included lack of an active control and limited headache log data (only 1-week baseline data, no posttreatment data); these weaknesses may have affected outcome assessments of headache. In a follow-up analysis to evaluate responders versus nonresponders, the authors reported pain acceptance and pain catastrophizing were key factors underlying treatment response [33].

After the systematic review [30] was conducted, a unique clinic-based "effectiveness" trial compared a mindfulness-based training group (6 weekly 45-min sessions, an MBSR variant) and prophylactic medication group in 44 adults with chronic migraine and medication-overuse headache [37]. Participants first completed a withdrawal program in a day hospital and then were given the option of which group to join; participants were not randomized. Both groups had statistically significant decreases in monthly headache days, monthly use of abortive medications intake, headache disability, and depression after the intervention compared to baseline, without differences between groups, with effects persisting to 12-month follow-up. Although limited by its non-randomized approach, this study provides evidence that a mindfulness program may be as effective as standard of care for patients with chronic migraine and medication-overuse headache.

A few other meditation studies for headache, not specifically of mindfulness meditation, were

not included in the mindfulness for chronic pain systematic review [30]. A study from India in chronic tension-type headaches compared two groups of 70 patients [38]. Both received twice-daily abortive medications; one group also received eight additional lessons in a form of spiritual meditation known as "Rajyoga meditation," which incorporates visualization of meaningful images with a focus on positive thoughts of a universal force. Within-group analyses showed that both groups had improvements in headache severity, frequency, and duration, although significant relief in headache severity, duration, and frequency was much higher in the meditation group (94/91/97% vs. 36/36/49%). This study was limited by within-group analyses and high participant dropout (only 50 participants completed).

Several studies have compared "spiritual meditation" (spiritually inspired mantras) to "secular meditation" (secular mantras) to "relaxation" (progressive muscular relaxation) [39–43]. The first study [39] in 68 healthy college students showed that "spiritual meditation" (20 min/day for 2 weeks) appeared to have the most benefits on anxiety, mood, spiritual health, and pain tolerance compared to "secular meditation" and "relaxation" [39]. Two follow-up studies in adults ($n = 83$ and $n = 92$) with two or more migraines per month also showed improvements with "spiritual meditation" compared to "secular meditation" and "relaxation" on measures of headache frequency, anxiety, negative affect, pain tolerance, headache related, and self-efficacy [40, 41]. A third study reported that a 20-minute meditation intervention improved immediate pain and emotional tension scores in 27 adults who had 2–10 migraines/month [42]. A more recent study ($n = 107$ randomized, 74 analyzed) showed that mindfulness meditation improved pain-related stress compared to simple relaxation and the mindfulness meditation intervention provided similar outcomes to spiritual mindfulness in pain-related outcomes [43]. Unfortunately, since participants in these studies were generally healthy, non-treatment seeking young adults, the results may not generalize to other populations. Further, many participants dropped out after

being randomized (from 84 to 68 in one study and from 107 to 74 in another study) [39, 43].

A small non-randomized study [44] of a mindfulness-based intervention in 20 adolescents with "recurrent headaches" (4 or more per month) showed safety (no adverse events), feasibility (median class attendance 7 out of 8), and improvements in depression, quality of life, and acceptance of pain; no changes in headache frequency or severity were seen. This was a pilot study and was not powered for headache outcomes but shows the possibility of using mindfulness interventions in adolescents with headaches.

In a study that tracked outcomes after an MBSR course in patients with a variety of chronic pain conditions, those with chronic headache/migraine experienced the smallest improvements in pain and quality of life compared to the other chronic pain conditions [45]. However, this study was limited by its observational nature and lacked a control group and direct measures of pain. The small sample sizes for each specific chronic pain condition limited statistical power and reliability of effect sizes (e.g., only 34 of 133 participants had headaches).

Potential Mechanisms of Meditation

Proposed mechanisms to explain the potential impact of meditation on pain (including headaches) include neurobiological changes in pain processing, stress reduction, changes in relevant psychological constructs, effects on other behaviors, and/or placebo [46]. The strongest evidence comes from the neuroscientific research that has demonstrated the specific neural pathways involved in meditation and pain relief. Mind/body therapies may be effective because they target the cognitive and affective control of pain [47]. Meditation may attenuate pain by improving its emotional and cognitive modulation at the cortical level [48]. In studies assessing the impact of meditation on experimentally induced heat pain in healthy controls, meditation-induced decreases in pain intensity were associated with increases in anterior insula and anterior cingulate activity detected on MRI—key regions for cognitive modulation of pain processing [49]. Meditation-

induced decreases in pain unpleasantness were associated with orbitofrontal activation (that could explain the cognitive reframing of sensory events with meditation) and thalamic deactivation (suggesting that meditation may downregulate the thalamus, the key relay station for pain transmission from sensory receptors to the brain). Additional research has shown that meditation-based pain relief does not require or use endogenous opioids [50] and has a distinct neurobiological signature from placebo analgesia [51].

Further research on the neuroscientific underpinnings of meditation has indicated that meditation may enhance frontal attentional control, increase cortical thickness, and activate areas of the brain important for pain modulation (hippocampus, insula, cingulate cortex, prefrontal cortex, and parietal cortex), thereby helping to decouple sensory-discriminative and cognitive-evaluative brain networks [52–54].

Meditation also fosters a calm state of focused attention that may better balance the parasympathetic and sympathetic systems. Meditation lowers stress levels [55], the most frequently cited trigger for migraine [18]. Further, the presence of migraine may impact stress-related dysregulation of the autonomic nervous system [56–58]. In a study that assessed heart rate variability in headache patients (randomized to either a mindfulness intervention or a control group) after a cognitive stress induction test [59], headache patients were more likely to have dysregulated stress recovery compared to controls. These data suggest that mindfulness practice may promote effective heart rate regulation, especially after a stressful event.

Other research has suggested the important role cognitive and psychological factors play in the relationship between meditation and migraines. In a cross-sectional study that compared stress-coping styles among migraineurs, meditators, and healthy controls, migraineurs used negative stress-coping strategies significantly more than the other groups, especially "rumination" [60]. In secondary analyses of the previously described RCT of MBCT for headache by Day and colleagues [33], pain acceptance was a significant mediator underlying improve-

ment in pain after MBCT [61]. Additional secondary analyses also demonstrated the importance of pretreatment expectations, patient motivation, and the development of strong rapport with the therapist as critical components to improving pain outcomes [62]. Day and colleagues developed a theoretical model to explain mindfulness-based pain relief, organized into the overarching factors of environment, brain state, cognitive content and coping/processes, behavior, and emotion and affect [54]. The cognitive factors not already discussed that they included in this model include increased self-efficacy, emotion regulation, positive affect, and decreased pain catastrophizing and negative affect.

In mindfulness meditation, participants are taught to notice sensations distinct from the thoughts related to the sensation; this detachment may alter pain perception. Participants may continue to have headaches but are able to better cope with the pain [28]. This flexible attentional capacity may help relieve the suffering of pain and improve quality of life.

Finally, mindfulness meditation, like all mind/body therapies, may work by helping to improve other behaviors that result in improvement of headaches. For example, meditation may improve sleep, and this effect could improve headaches. Meditation may also enhance a person's ability to engage in other healthy behaviors, such as improved diet and more exercise, which also could improve headaches.

Summary: Meditation and Chronic Daily Headache

The research on meditation for headaches is limited by the lack of active control groups, small sample sizes, and lack of long-term follow-up. However, the evidence suggests that meditation could benefit headache patients as a complement to standard of care. Meditative practices can be practiced anywhere, increasing adherence. Once the technique is learned, it requires little financial investment, so it may be applicable to a broader audience than typical psychological resources such as biofeedback. It does require active participation and self-responsibility, which may be critical ingredients for its success. Although such

active involvement may improve self-efficacy, it does require significant time, energy, and a commitment to regular practice. In a case report of a migraineur ultimately benefiting from mindfulness training, it took years of encouragement from a provider before the patient was ready to adopt a mind-body practice [63]. Another case report suggested that mindfulness meditation initially induced headaches in one patient but then became a powerful treatment option [64]. If helpful, research suggests that benefits may persist for up to 4 years [65]. Most research to date has focused on mindfulness meditation, although spiritual meditative techniques and transcendental meditation have also been explored. Future research needs to include active control groups and larger studies of appropriate design and longer follow-up periods.

Yoga

Yoga is a mind/body treatment that combines the physical exercise of postures ("asanas") with breathing ("pranayama") and deep relaxation ("shavasana") to create a meditative experience. Evidence suggests yoga may be beneficial for many health conditions and their associated symptoms (cancer, hypertension, diabetes mellitus type 2, multiple sclerosis, Parkinson's, depression, anxiety, pregnancy, pre−/postpartum depression, etc.) [66]. Although yoga has long been used to treat many different chronic pain conditions [67], a systematic review looking for RCTs of yoga specifically for headache [68] found only one publication from a headache clinic in India [69]. This study compared 12 weeks of yoga to a headache education group in 72 migraineurs without aura (uncertain if episodic or chronic). The yoga group practiced 5 days/week for 60 min, and participants were also instructed to practice as an abortive migraine treatment but only during the prodromal phase of a migraine. The intervention involved yoga postures, breathing practices, yoga breathing, relaxation practices, and meditation. Headache education group participants received headache education once/month for 3 months plus handouts on self-care.

Those in the yoga group had significant decreases in headache intensity, frequency, pain rating index, affective pain rating index, total pain rating index, anxiety, depression, and symptomatic medication use. Unfortunately, analyses did not compare baseline and end-of-study results; it only compared post-study results between groups. The study lacked matching on time and attention between the two groups, and the participants were not blinded. There was no long-term follow-up to assess treatment durability, and no adverse events were mentioned.

A few smaller studies provide additional insight on the impact and potential mechanisms of yoga on headache. As tension-type headache has long been viewed as a condition of muscular tension, many have felt yoga may be particularly applicable. A different study from India ($n = 16$) compared EMG biofeedback with yogic shavasana relaxation (both practiced twice per week in 30-min sessions for 10 weeks); the two groups had equally improved tension headaches (occurring at least twice per week for over a year) [70]. Interestingly, "complete remission" was achieved after only 13 sessions with the yoga group, compared to 16 sessions with the biofeedback group. Although small, this study suggests yoga may have similar benefits to EMG biofeedback. Another small study ($n = 15$ headache patients) compared NSAID treatment (undefined dosage/frequency), botulinum toxin (undefined frequency), and an intense yoga program (3 h/day for 2 weeks) for treatment of chronic tension-type headache [71] and found that subjective pain scores improved in all three groups. In another study, 32 women with migraines (uncertain if episodic or chronic) were randomized to either 12 weeks of medication treatment under a neurologist's supervision (undefined medication type, dosage, frequency) or medical treatment plus yoga [72]. Metabolites of nitric oxide, hypothesized as having a role in the mechanism of yoga on headache, were measured in both groups. Those in the yoga group (75-min guided sessions three times per week) had significant reductions in headache frequency and severity, but plasma nitric oxide levels were not different between groups before and after the study.

A more recent study assessed changes in endothelial function after yoga (three 75-min sessions per week for 12 weeks) compared to medication (undefined drug/dose/frequency) in 42 migraineurs (unclear if episodic or chronic) [73]. The study focused on plasma concentrations of intercellular adhesion molecule (ICAM) and vascular cell adhesion molecule (VCAM) as possible mechanisms for triggering vascular inflammatory responses; no headache measures were assessed. After treatment, plasma concentrations of ICAM decreased in the yoga group compared to the control group, with no differences detected in VCAM concentrations. Although the authors concluded that the intervention might improve vascular function in migraineurs, the methodologic concerns (only data from 32 participants were reported), lack of headache measures/outcomes, and inconsistent results between ICAM and VCAM limit such a conclusion.

In a recent pilot study of 8 weeks of 75-min yoga classes for pediatric patients with headache [74], 19 of 57 patients approached agreed to participate, but only 7 actually attended classes, with the weekly no-show rate ranging from 1 to 3 participants. This study demonstrates the challenges of adherence to interventions that involve significant time, although children may have more scheduling limitations than adults.

Summary: Yoga and Headache

Yoga may be a valuable treatment option for adults with headaches, but most studies are limited by serious methodologic concerns. In addition, the interventions studied to date have been intense programs, requiring significant time and motivation, limiting feasibility for many patients. Several studies have attempted to assess pathophysiologic mechanisms of yoga on migraine, with unclear results. Additional research is needed to assess other potential hypothesized mechanisms, such as the improvement in parasympathetic tone and calming of the stress response through active yoga postures, deep breathing, and deep relaxation states. However, yoga is now widely available, and among some settings, illiteracy and poverty make some behav-

ioral treatments (like biofeedback) more challenging; yoga could be a more easily accessible and inexpensive treatment option [70].

Tai Chi

Tai chi is a form of traditional Chinese medicine that incorporates physical, cognitive, social, and meditative components into this mind/body activity [75]. As a "moving meditation," the goal is to rebalance the body's own healing capacity. Evidence suggests it can prevent falls and improve balance and is helpful for many chronic musculoskeletal pain conditions [76]. Since tai chi overlaps with both mind/body interventions and other traditional Chinese medicine treatments like acupuncture, and both may help headaches, tai chi has been hypothesized to improve headaches. However, only one RCT has assessed tai chi for headache [77]. This study compared biweekly 60-min tai chi sessions for 15 weeks to a wait-list control group using the classical Yang style of tai chi with 24 standardized movements. Those in the intervention group demonstrated improvements in pain, energy/fatigue, social functioning, emotional well-being, and mental health summary scores on the HIT-6 and SF-36 instruments. Although 47 were randomized, only 30 completed the study; outcomes did not assess headache measures but rather only quality of life measures. Nonetheless, while this study suggests tai chi may be helpful for tension-type headaches, larger, more rigorous studies are needed for further recommendations.

Deep Breathing

In the National Health Interview Survey, "deep breathing" is assessed as a mind/body CAM medical treatment option. Of adults with a history of severe headaches/migraines, 24% report using deep breathing exercises, the highest prevalence of all mind/body therapies [6]. Unfortunately, what "deep breathing" entails is not defined in the survey or by participants. Although most proponents of mind/body thera-

pies would argue that breathing is a critical component of the intervention, no specific studies evaluate the sole benefit of deep breathing for headache. Many patients in pain often hold their breath or in moments of anxiety take shorter, more shallow, and frequent breaths; thus, deep breathing may help ease pain, anxiety, or panic. Despite the lack of research for this modality for headache, many providers may recommend it, with specific instructions on how to achieve ideal "deep breathing" [78]. Some argue that patients may be more receptive to this technique than less familiar interventions such as meditation. A survey of adolescents with headache demonstrated that 72% were interested in learning deep breathing, while only 21% wanted to learn the relaxation response or biofeedback, and none were interested in meditation [11]. Deep breathing for pain is not a new concept—e.g., in the Lamaze technique, deep breathing is taught to help ease the pain of childbirth. Migraine involves dysfunction of the autonomic nervous system [56–59], so targeting this dysfunction through deep breathing may provide headache benefit. Additional research into this modality for headaches is needed, especially evaluating its role in all mind/body therapies.

Summary: Mind Body and Chronic Daily Headache

Chronic daily headache is often refractory to conventional treatment options, and CAM treatments may provide relief. However, research of CAM treatments for chronic daily headache is limited, so research evidence is reviewed for CAM to treat headache. The mechanisms of mind/body approaches such as meditation, yoga, tai chi, and deep breathing suggest they should be helpful for headaches, especially considering their overlap with well-researched behavioral treatments, but research is just now emerging regarding true efficacy. Mindfulness meditation has the most research to date of all mind/body therapies for headaches. The evidence is promising but limited by methodologic concerns such as lack of active control groups, small sample sizes, and lack of

long-term follow-up. The one RCT of yoga for migraine suggests a benefit, but additional studies are needed. Other yoga studies for headache have been limited by significant methodologic concerns, and the yoga interventions have been time-intensive. Tai chi has minimal evidence to suggest benefit for tension-type headache. Research needs to be conducted to assess "deep breathing" as an independent modality for headache.

Part II summarizes manipulation-based treatment options (acupuncture, chiropractic, and massage) and other CAM treatments. Part III reviews the evidence regarding nutraceuticals and homeopathy for chronic daily headache and final conclusions from Parts I, II, and III.

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