# Mind–body interventions

## Applications in neurology

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### ABSTRACT

**Objective:** Half of the adults in the United States use complementary and alternative medicine with mind–body therapy being the most commonly used form. Neurology patients often turn to their physicians for insight into the effectiveness of the therapies and resources to integrate them into their care. The objective of this article is to give a clinical overview of mind–body interventions and their applications in neurology.

**Methods:** Medline and PsychInfo were searched on mind–body therapies and neurologic disease search terms for clinical trials and reviews and published evidence was graded.

**Results:** Meditation, relaxation, and breathing techniques, yoga, tai chi, and qigong, hypnosis, and biofeedback are described. Mind–body therapy application to general pain, back and neck pain, carpal tunnel syndrome, headaches, fibromyalgia, multiple sclerosis, epilepsy, muscular dysfunction, stroke, aging, Parkinson disease, stroke, and attention deficit–hyperactivity disorder are reviewed.

**Conclusions:** There are several conditions where the evidence for mind–body therapies is quite strong such as migraine headache. Mind–body therapies for other neurology applications have limited evidence due mostly to small clinical trials and inadequate control groups.

*Neurology*® 2008;70:2321–2328

### GLOSSARY

**ADHD** = attention deficit–hyperactivity disorder; **CAM** = complementary and alternative medicine; **PD** = Parkinson disease; **PRT** = progressive relaxation training; **QS** = quiet sitting; **RCT** = randomized controlled trial.

Neurology patients frequently ask their physicians about complementary and alternative medicine (CAM) as options for treatment. According to a 2002 survey, 62% of people in the United States used CAM, with mind–body medicine being the most commonly used form.[1] A small survey showed that 40 of 216 neurology clinic patients at an academic center used CAM.[2] Mind–body therapies focus on the relationships among the brain, mind, body, and behavior, and their effect on health and disease. Many of the techniques are associated with relaxation and thus may be helpful for disorders where psychological stress is a factor. Mind–body approaches encompass a large group of therapies such as hypnosis, meditation, yoga, biofeedback, tai chi, and visual imagery.[3] Some aspects are not discussed in this article, either because they have been integrated into common practice (e.g., group therapy or cognitive behavioral therapies) or there have been no neurologic intervention studies (e.g., spirituality). Mind–body therapies are often implemented by patients because of the low physical and emotional risk, the relatively low cost, and their ability to allow patients to take a more active role in their treatment. Furthermore, expanded research on the interactions between the CNS and the endocrine, immune, and peripheral autonomic nervous systems provides a mechanism by which mind–body medicine may be influencing health.[4] The objective of this article is to briefly define various mind–body interventions and assess the published evidence on their potential application

Supplemental data at www.neurology.org

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Funded in part by NIH U19 AT002656 (B.S.O.), NIH T32 AT002688 (H.W., B.S.O.), NIH 1 K23 AT01993-01 (S.-M.E.), NIH UL1 RR024140 (H.W.), MRF 0425 (S.-M.E.).

*Disclosure*: The authors report no disclosures.

to neurology. Other aspects of CAM with varying degrees of biologic plausibility and evidence are not discussed.

**MIND–BODY INTERVENTIONS** **Meditation.** While there are various meditation styles, all types of meditation practices incorporate self-observation of mental activity, attentional focus training, and cultivating an attitude that highlights process rather than content. A recent meta-analysis of meditation practices characterizes pure meditation practices such as mindfulness meditation and Transcendental Meditation as well as other mind–body practices that have a meditation component (yoga, tai chi, and qigong).[5] The central element of mindfulness is to acquire attentional control by focusing on events generated internally (bodily sensations, breath, thoughts, emotions) and externally (sights, sounds) at the current moment with nonjudgmental acceptance. Mindfulness meditation has been formalized for clinical interventions with Mindfulness Based Stress Reduction[6] and Mindfulness Based Cognitive Therapy.[7] Concentration meditation entails directing attention on some intentional process like the repetition of a word or phrase (mantra), or the breath. Transcendental Meditation is a concentration technique that is a registered trademark and the teachers of the technique must be formally certified. Some clinical studies of Transcendental Meditation demonstrate benefits[8-10] but the certification process has limited widespread clinical use. Brain changes during meditation have been observed in numerous EEG and neuroimaging studies[11] and there is some evidence for meditation effects on endocrine,[12] neurotransmitter,[13] and immune system[14] measures.

**Relaxation and breathing techniques.** Relaxation and breathing techniques utilize awareness of breathing rate, rhythm, and volume. Most often breathing techniques are used to minimize physiologic responses to stress, possibly by increasing parasympathetic response.[15] Also, they are often used in conjunction with relaxation techniques such as Jacobson's progressive muscular relaxation[16] and autogenic training.[17] A relatively simple respiration monitor that facilitates slowing one's breathing rate has been approved by the Food and Drug Administration for the reduction of blood pressure.[18]

**Yoga.** Yoga is an ancient Indian, non-religious mind–body approach that has components centering on meditation, mindfulness, breathing, and activity or postures. Varieties of Hatha yoga that center on postures are the most commonly practiced in the United States. While yoga may be beneficial for some diseases,[19] certain forms are likely contraindicated in neurologic disorders. For example, Bikram yoga, which is practiced in very hot temperatures, is likely risky for patients with multiple sclerosis.[20] Some practices such as Iyengar yoga incorporate props and supports, and may lend themselves more readily to people with neurologic and musculoskeletal disorders. Physiologically, yoga practice is noted to produce changes in heart rate, blood pressure, galvanic skin response, respiratory rate, fasting blood glucose (Type II diabetes mellitus and healthy), breath holding time, auditory and visual reaction times, and intraocular pressure.[5]

**Tai chi and qigong.** Tai chi and qigong are two traditional Chinese medicine techniques that incorporate body movement, breath, and attentional training to improve disease symptoms and maintain health. These practices have many similarities to yoga but, in contrast, contain body movement as a critical component. The practice of tai chi includes slow body positions that flow from one to the next continuously and that promote posture, flexibility, relaxation, well-being, and mental concentration.[21] The main difference between qigong and tai chi is that tai chi is a martial art. Tai chi movements practiced quickly can provide self-defense and are externally focused. Qigong cannot and is internally focused.[5] A similar technique from a Western context is "therapeutic eurythmy."[22]

**Hypnosis.** Hypnosis involves attention and focused concentration with a relative suspension of peripheral awareness.[23] There are three aspects of hypnosis: absorption, dissociation, and suggestibility.[24] Absorption is the tendency to become fully involved in a perceptual, imaginative, or ideational experience. Dissociation is the mental separation of experiential components that would ordinarily be processed together. Suggestibility is the heightened responsiveness to social cues leading to an enhanced compliance with hypnotic instructions. The brain changes associated with hypnosis have been documented by fMRI[25,26] and EEG[27] studies.

**Biofeedback.** Biofeedback is a medical treatment in which physiologic markers like heart rate, breathing rate, EMG, EEG, or electrodermal activity are measured and displayed back to the patient. The patient can then attempt to modulate physiology to achieve a certain feedback goal,

such as slowing heart or breath rate, or relaxing certain muscles. The desired feedback goal is based on the specific condition being treated. Numerous psychophysiologic studies have been conducted that examine the effect of biofeedback on physiology as well as various clinical conditions resulting in an extensive literature of varying quality.[28]

**APPLICATION TO NEUROLOGY** In order to examine effects of mind–body CAM treatments for patients with certain neurologic diseases, we searched the electronic databases Medline and PsychInfo for clinical trials on the terms mind–body and relaxation techniques, biofeedback, hypnosis, meditation, tai chi, yoga, breathing exercises, hypnosis, relaxation techniques and dementia, or Alzheimer disease, pain, headache, epilepsy, multiple sclerosis, Parkinson disease (PD), carpal tunnel syndrome, peripheral neuropathy, attention deficit–hyperactivity disorder (ADHD), and stroke. We also included relevant reviews. Evidence was assessed and rated according to the Natural Standard evidence-based validated grading rationale (http://www.nlm.nih.gov/medlineplus/druginfo/natural/grading.html) by H.W. and double checked by S.M.E. and B.S.O. (see table e-1 on the *Neurology*® Web site at www.neurology.org for full grading criteria). Although this is not a systematic review, we attempt to present a general clinical overview of mind–body therapies implemented for neurologic conditions (see table e-2 for the summary of evidence table and references for the reviewed studies for each neurologic condition).

**General pain.** Pain syndromes are the most commonly studied neurologic condition to which mind–body therapies are applied. Mind–body therapies including hypnosis and meditation may improve general pain symptoms and lessen the need for anesthetics. Hypnosis for analgesia is often superior to other non-pharmacologic treatments for producing changes in pain reports. Also, patients undergoing surgery with hypnosis need significantly less chemical analgesia. A mechanism for analgesic hypnosis has been demonstrated in a PET study revealing significant changes in pain-evoked activity within the anterior cingulate cortex consistent with the encoding of perceived unpleasantness, whereas the primary somatosensory cortex activation was unaltered.[29] Hypnosis also improved surgical outcomes compared to control groups after adjusting for variation in study sample size in a meta-analysis of 20 studies (D = 1.20; VarD = 0.83, 0.71 to 1.69, $p < 0.01$). Mindfulness meditation significantly improved pain ratings for participants in a 10-week Mindfulness Based Stress Reduction program[6] with reductions remaining in a follow-up study. A National Institute of Health panel found strong evidence for the use of relaxation techniques in reducing chronic pain in a variety of medical conditions and hypnosis in alleviating pain associated with cancer, and moderate evidence for biofeedback in relieving chronic pain. Additionally, in a systematic review of mind–body interventions for chronic non-malignant pain in older adults, there was some limited evidence for the efficacy of progressive muscle relaxation plus guided imagery for osteoarthritis pain and limited support for meditation and tai chi.

**Back pain, neck pain, and carpal tunnel syndrome.** Some specific pain syndromes may also benefit from mind–body interventions. Chronic back pain has been successfully treated using various mind–body techniques such as breathing techniques, relaxation training, therapeutic eurythmy,[30] and yoga. One randomized controlled trial (RCT) (n = 101) reported superior results with a 12-week yoga class compared to exercise or education (yoga vs education: mean difference, −3.4 [95% CI, −5.1 to −1.6] [$p < 0.001$]; yoga vs exercise: mean difference, −1.8 [95% CI, −3.5 to −0.1] [$p = 0.034$]). Although the evidence is still limited, the American College of Physicians and American Pain Society recently recommended the addition of yoga or progressive relaxation for patients with acute low back pain who do not improve with self-care options. Less evidence exists for carpal tunnel syndrome. One study demonstrated that yoga improved grip strength and reduced pain in carpal tunnel patients when compared to wrist splinting or no treatment at all, but the study received critical comments. Also, two systematic reviews since then note "limited or inconclusive evidence" for yoga as a therapy for carpal tunnel. One RCT (n = 393) for chronic neck pain reported no significant difference among dynamic muscle training, relaxation training, or ordinary activity.

**Headaches.** Chronic tension and mixed type headaches appear to benefit from mind–body interventions. Clinical trials for chronic tension-type headaches have found that relaxation training significantly reduced headache activity compared to talk therapy, self-monitoring, muscle relaxant (chlormezanone), information/education, and no treatment. Another study examined biofeedback training in combination with amitriptyline and

propanolol and found that the addition of biofeedback was more effective in the treatment of mixed headaches when compared to pure drug therapy. A more recent study found that a 15-week tai chi class (n = 47) was more effective in reducing headache impact and in improving perceptions of some aspects of physical and mental health compared to a wait-list control group. Mind–body therapies may be more effective in treating headaches compared to no treatment or in combination with standard care. However, when compared to each other, there may not be a significant difference. A systematic review of autogenic relaxation training reported equivalency among several different relaxation techniques in the treatment of headaches.

Mind–body interventions for migraine have been better studied than those for tension headache. The US Headache Consortium treatment guidelines for migraines now include cognitive and behavioral treatment recommendations based on evidence from 39 controlled trials. They suggest that relaxation training, thermal biofeedback combined with relaxation training, EMG biofeedback, and cognitive-behavioral therapy may be considered as treatment options for prevention of migraine and combined with preventive drug therapy to achieve additional clinical improvement for migraine relief based on a highest level evidence rating.

**Fibromyalgia.** Studies of mind–body interventions for fibromyalgia have been inconclusive. In a systematic review, mind–body therapy was found more effective for clinical outcomes compared to waiting list/treatment as usual or other control groups. When mind–body medicine was compared to active treatments the results were inconclusive, except for moderate/high intensity exercise where exercise was more effective. There was also moderate evidence that combining mind–body therapy with exercise or antidepressants may provide the most effective option and where future research should be directed. Since that review, tai chi was found to significantly improve the Fibromyalgia Impact Questionnaire and health-related quality of life scores and guided imagery plus usual care vs usual care alone showed improved functional status and self-efficacy. An additional RCT compared EMG biofeedback vs sham biofeedback and found significant decreases in mean pain VAS scores and tender points. One negative RCT (n = 128) revealed no difference between an education group and a mindfulness meditation and qigong group on various fibromyalgia outcomes, although both groups improved on the Fibromyalgia Impact Questionnaire, pain, and depression scores.

**Multiple sclerosis.** Multiple sclerosis research in mind–body medicine has been mostly exploratory[31] even though 33–65% of patients with multiple sclerosis use CAM.[32,33] In a 6-month yoga RCT (n = 69), participants in the yoga intervention showed significant improvement in measures of fatigue compared to a wait-list control and the improvement was comparable to an exercise control (stationary bicycle).

**Epilepsy.** Biofeedback, relaxation, yoga, and comprehensive behavioral approaches have been used to treat epilepsy with varying results. EEG biofeedback techniques for epilepsy are based on observations that several components of the EEG can be modified by training[34] to increase the mu or sensorimotor rhythm,[35] or low-frequency components termed "slow cortical potentials" or "DC-shift"[36,37] which may be similar to a mental relaxation procedure. One uncontrolled study of 25 patients undergoing 28 1-hour EEG biofeedback sessions found that six of the subjects were seizure free after 1 year, while data from another controlled trial using the same procedure were less positive and difficult to interpret. In an RCT, 18 patients with drug-refractory epilepsy in an electrodermal activity biofeedback group had reduced seizure frequency ($p = 0.02$) compared to the sham biofeedback control group ($p > 0.10$).

Hyperventilation such as in anxiety is a common trigger for generalized forms of epilepsy. Relaxed diaphragmatic breathing may reverse this effect by increasing $pCO_2$ and thus increasing seizure threshold.[38] Deep breathing is often a component of biofeedback, meditation, and relaxation training, and the increase in $pCO_2$ may be one mechanism of action. In an RCT comparing progressive relaxation training (PRT, n = 13) with quiet sitting (QS, n = 11), the mean decrease in seizure frequency was 29% for the PRT group ($p < 0.01$) but only 3% for the QS group ($p > 0.05$). One yoga meditation RCT reported a 62% decrease in seizure frequency at 3 months and 86% decrease at 6 months of intervention ($p < 0.001$) with 40% of participants in the treatment group becoming seizure free. Another mantra meditation controlled study reported a reduction in seizure frequency and duration over 1 year. A 1-year uncontrolled nadi shodana breathing and concentration meditation study (n = 20) found that 14 patients had a 50% reduction of seizure frequency and six became seizure free over 3 months.

The most promising mind–body approaches for control of epileptic seizures appear to be comprehensive behavioral programs, which may include lifestyle modification, aura interruption techniques,[39,40] and meditative relaxation. One RCT found a significant decrease in seizure frequency when comparing contingent relaxation with an attention control and no treatment group. Another controlled study found that 8 of 22 treated patients became seizure free after lifestyle counseling to eliminate trigger situations for juvenile myoclonic epilepsy. Other uncontrolled studies have found seizure reduction and elimination with comprehensive treatment.

**Muscular dysfunction.** A few biofeedback studies for pelvic floor dysfunction reveal clinical improvement. EMG biofeedback and neuromuscular stimulation included in pelvic floor muscle training for bladder dysfunction enhanced bladder function. A systematic review examining the efficacy of biofeedback treatment for various anorectal smooth muscle dysfunctions reported that biofeedback success rate was significantly higher for pelvic floor dyssynergia and fecal incontinence when compared to standard medical care.

**Stroke.** There has been a fair amount of mind–body research on risk factors for stroke, especially for hypertension. There is some evidence that mild reductions in blood pressure can be achieved with meditation or breathing exercises. A single exploratory study demonstrated changes in carotid artery intimal thickness.

Little mind–body research has been conducted in rehabilitation after stroke. One negative study examined physical therapy and a form of biofeedback, called "forceplate training," for poststroke balance. A recent systematic review pooling 13 trials (n = 269) compared EMG biofeedback plus standard physiotherapy to standard physiotherapy either alone or with sham biofeedback for the recovery of motor function in patients with stroke. A meta-analysis was impossible due to study heterogeneity and overall the results were limited due to small trials, generally poor design, and varying outcome measures.

**Aging.** Tai chi seems to have a significant effect on reducing the incidence of falls and fall injuries, fear of falling, balance, and overall health in the elderly. This finding is especially true for the prefrail elderly or people with lower levels of baseline physical function. Tai chi also seems to have an overall beneficial effect in "physical functioning" in older adults (65 to 96 years old) even decreasing daytime sleepiness. Whether this effect is due to the exercise component or mind–body component of tai chi is uncertain. In a study looking at the incidence of falls in the very old (mean age 84.7 years), the frailer and the more cognitively impaired of senior housing communities, there was no significant difference among a resistance training group, endurance training group, or tai chi group. When comparing different exercise programs including tai chi, which incorporated quality of life enhancement classes, all types of exercise significantly reduced the falling risk. Finally, an RCT of 135 relatively healthy 65- to 85-year-olds found that a 6-month yoga intervention produced benefits in physical measures (timed one-legged standing and flexibility) and in quality of life measures compared to exercise and wait-list control groups.

**PD.** We found no RCTs for mind–body interventions in people with PD. One small pilot program found that six out of eight people with PD reported perceiving a physical benefit attributed to tai chi practice with improved balance being the most frequently reported benefit. Another small uncontrolled study with 17 community-dwelling adults with PD who completed a 5-day, 90-minute/day tai chi class showed a significant pretest-posttest change in three physical performance measures. These preliminary pilot studies warrant larger controlled trials to study the effect of tai chi in people with PD.

**ADHD.** EEG neurofeedback has been widely used as a nonpharmacologic treatment in children and adults with ADHD but still has a limited amount of strong empirical evidence. The rationale for neurofeedback comes from operant conditioning studies in humans that demonstrated capacity for neurophysiologic training. Neurofeedback attempts to regulate the atypical patterns of cortical activation identified in neuroimaging and quantitative EEG studies in people diagnosed with ADHD. There have been many small clinical trials and even some demonstrating alterations in fMRI activation. However, despite there being numerous published studies assessing neurofeedback for ADHD, most are small and heterogeneous in quality and methods. One review found neurofeedback to be "probably efficacious" for the treatment of ADHD and that it merits consideration as a treatment for stimulant "nonresponders."[41] Many other reviews have been published but none are systematic.[42-44]

**Placebo effects.** Clinical studies of mind–body therapies are inherently more difficult than drug studies because of the absence of blinding of the

**Table** Resources

| Type | Resource |
|---|---|
| General | National Center for Complementary and Alternative Medicine: http://nccam.nih.gov/ |
| Yoga | Yoga Alliance: http://www.yogaalliance.org |
| | Yoga Research and Education Foundation: http://www.yrec.org/ |
| Meditation | NCCAM Meditation informational link: http://nccam.nih.gov/health/meditation/ |
| | Meditation Society of America: http://www.meditationsociety.com/ |
| | The World Wide Online Meditation Center: http://www.meditationcenter.com/ |
| Hypnosis | American Society of Clinical Hypnosis: http://www.asch.net/ |
| | American Psychotherapy and Medical Hypnosis Association: http://apmha.com/ |
| Tai chi/qigong | NCCAM Tai Chi information link: http://nccam.nih.gov/health/taichi/ |
| | American Tai Chi Association: http://www.americantaichi.org/ |
| | Qigong Institute: http://www.qigonginstitute.org |
| | National Qigong Association: http://www.nqa.org/ |
| Biofeedback | Association for Applied Psychophysiology and Biofeedback: http://www.aapb.org |

participant. Biofeedback is one of the few mind–body interventions that can potentially be blinded through the use of sham feedback.[45,46] Thus, placebo or expectancy effects which have a significant impact in many disorders are especially difficult to control for in mind–body clinical trials.[47,48] The potential benefit of a treatment in which the patient actively participates may be due to increased self-efficacy, the person's sense of ability to deal with a situation which, by itself, is associated with physiologic benefits.[49] Clinical trials try to address these issues by advancing beyond wait-list controls to attention or other active controls (e.g., education with homework). The expectancy of improvement from mind–body interventions needs to be assessed in clinical trials. The beneficial effect of mind–body techniques likely represents a sum of these nonspecific effects (expectancy and self-efficacy) and the actual physiologic benefit of the mind–body practice.

**CONCLUSIONS** There have been many studies using mind–body techniques in neurologic disorders. Most of the studies are not high quality, often due to lack of adequate controls and small numbers (table e-2). There are some specific disorders where there are relatively good data suggesting the utility of some of these techniques, such as biofeedback for migraine headache. The desire of patients to engage in mind–body techniques as an additional therapy to more conventional treatments needs to be recognized, especially since self-efficacy by itself may produce physiologic benefits. Patient preferences may be especially important when patients wish to avoid CNS active medications, as in the case of children or pregnant women. Neurologists should also consider these interventions when psychosocial stress is a factor or when patients have not responded to first-line conventional treatments. If a physician wants to recommend or facilitate these interventions, there are many national organizations available to aid in referral for interested patients with appropriate conditions (table). While a majority of insurance plans do not cover these therapies, there are an increasing number of insurance companies that do, especially with a physician referral. Also, as evidenced by the estimated $12–20 billion paid out-of-pocket for professional CAM health care providers, lack of insurance coverage may not be a deterrent for patients to utilize mind–body therapies.[50] Even if people are prepared to spend their own money, it would be preferable if the use of these interventions were guided by a physician with knowledge in this area.

## ACKNOWLEDGMENT

The authors thank Gibran Ramos for assistance with this project.

*Received December 14, 2007. Accepted in final form January 23, 2008.*

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