PAIN MEDICINE
Volume 8 • Number 4 • 2007

PAIN & AGING SECTION

Review Article

Mind–Body Interventions for Chronic Pain in Older Adults: A Structured Review

Natalia E. Morone, MD, MSc,* and Carol M. Greco, PhD†

*Department of Medicine, Division of General Internal Medicine and †Department of Psychiatry, University of Pittsburgh, Pittsburgh, Pennsylvania, USA

ABSTRACT

Study Design. We conducted a structured review of eight mind–body interventions for older adults with chronic nonmalignant pain.

Objectives. To evaluate the feasibility, safety, and evidence for pain reduction in older adults with chronic nonmalignant pain in the following mind–body therapies: biofeedback, progressive muscle relaxation, meditation, guided imagery, hypnosis, tai chi, qi gong, and yoga.

Methods. Relevant studies in the MEDLINE, PsycINFO, AMED, and CINAHL databases were located. A manual search of references from retrieved articles was also conducted. Of 381 articles retrieved through search strategies, 20 trials that included older adults with chronic pain were reviewed.

Results. Fourteen articles included participants aged 50 years and above, while only two of these focused specifically on persons aged ≥65 years. An additional six articles included persons aged ≥50 years. Fourteen articles were controlled trials. There is some support for the efficacy of progressive muscle relaxation plus guided imagery for osteoarthritis pain. There is limited support for meditation and tai chi for improving function or coping in older adults with low back pain or osteoarthritis. In an uncontrolled biofeedback trial that stratified by age group, both older and younger adults had significant reductions in pain following the intervention. Several studies included older adults, but did not analyze benefits by age. Tai chi, yoga, hypnosis, and progressive muscle relaxation were significantly associated with pain reduction in these studies.

Conclusion. The eight mind–body interventions reviewed are feasible in an older population. They are likely safe, but many of the therapies included modifications tailored for older adults. There is not yet sufficient evidence to conclude that these eight mind–body interventions reduce chronic nonmalignant pain in older adults. Further research should focus on larger, clinical trials of mind–body interventions to answer this question.

Key Words. Mind–Body and Relaxation Techniques; Mind–Body Relations (Metaphysics); Complementary Therapies; Aged; Pain Disorder

Reprint requests to: Natalia E. Morone, MD, MSc, 230 McKee Place, Suite 600, Pittsburgh, PA 15213, USA. Tel: 412-246-6930; Fax: 412-692-4838; E-mail: moronene@upmc.edu.

Introduction

Chronic nonmalignant pain is a common condition among the older population, occurring in up to 50% of community-dwelling older

 1526-2375/07/$15.00/359 359–375 doi:10.1111/j.1526-4637.2007.00312.x

adults [1]. It is associated with a significant amount of morbidity, such as depression [2,3], disability [4,5], and overall decreased quality of life [6]. Despite its widespread prevalence, many older adults live with pain because of inadequate treatment [7]. Reasons for this include lack of physician training in pain management in the older adult and increased susceptibility to medication side effects precluding their use [8,9]. Given the above, there is a compelling place for complementary mind–body therapies for pain relief in older adults, because these therapies do not involve pharmacotherapy and can address the psychological and emotional burden of chronic pain.

Most mind–body therapies have been studied in younger populations. Although it is reasonable to assume that older adults would respond in the same way as younger people to mind–body interventions, there is little evidence to support this. Additionally, we do not know whether mind–body therapies would be inherently less (or more) acceptable to an older population, or whether they would have uniquely beneficial effects in older adults. The latter may be the case, because mind–body therapies may have effects on function and cognition that may be independent from the effects on pain. This is particularly germane to the older adult, as maintaining functional independence is a high priority for them. Therefore, we considered it important to examine mind–body therapies in more detail and conducted a review of mind–body interventions for chronic nonmalignant pain in older adults. We were interested in the feasibility, safety, retention rates, and effect sizes for pain measures (when available) for the modalities reviewed.

We chose the following eight mind–body modalities to review: biofeedback, progressive muscle relaxation (PMR), meditation, guided imagery, hypnosis, tai chi, qi gong, and yoga. We chose these therapies because they are commonly used, have been studied in clinical trials, and are widely accepted mind–body therapies. The current review does not include cognitive-behavioral therapy (CBT), which is typically considered a category of psychotherapy, or patient educational programs such as the Arthritis Self Management Program [10], due to their general acceptance within the biomedical system of care. Although these well-accepted programs contain components such as relaxation or guided imagery, the mind–body components are not taught as extensively or as in-depth as they would be individually.

The National Center for Complementary and Alternative Medicine defines mind–body medicine in the following way:

> Mind-body medicine focuses on the interactions among the brain, mind, body, and behavior, and the powerful ways in which emotional, mental, social, spiritual, and behavioral factors can directly affect health. It regards as fundamental an approach that respects and enhances each person's capacity for self-knowledge and self-care, and it emphasizes techniques that are grounded in this approach. [11]

The eight treatments we reviewed share the characteristics described in the National Institutes of Health (NIH) definition of mind–body medicine. Each treatment emphasizes the importance of the patient's active participation in his or her health and well-being. Thus, these therapies require the patient to be self-motivated and self-disciplined with a willingness to explore the emotional, social, spiritual, and behavioral context of his or her illness. The first step in this self-exploration usually begins by cultivating a calm and peaceful mental and physical state. This is usually engendered by slowing breathing and focusing attention on the breath, or by visualizing a tranquil place. If the therapy is a movement-based mind–body therapy, this is usually done by synchronizing movement with breathing, or being mindful of body sensation during movement. These therapies take practice to become accustomed to them, and frequently home practice is suggested. They do not provide a "quick-fix" as might occur with taking a pain medication. They are also characterized by increased proficiency with time. Immediate effects of a session may include a decreased respiratory rate and heart rate as the relaxation response occurs. Otherwise, the mechanisms of action for mind–body therapies are largely unknown. Group sessions are common among mind–body therapies, and may include discussion that explores patients' experience with the mind–body technique and any insight discovered into the emotional, mental, social, spiritual, or behavioral dimensions of their condition.

Methods

We searched the MEDLINE (1966–March 2006), PsycINFO (1967–March 2006), AMED (1985–March 2006), and CINAHL (1982–March 2006) databases. Search terms used were: *mind–body and relaxation techniques*, *biofeedback*, *progressive muscle relaxation*, *meditation*, *mindfulness meditation*, *mindfulness*, *transcendental meditation*, *guided imagery*, *hypnosis*, *tai chi*, *tai ji*, *chi gong*, *yoga*, *aged*, *pain*,

persistent pain, *pain intractable*, *chronic disease*, and *older adults or older*. We also manually reviewed the reference lists of retrieved articles. We included articles of randomized controlled clinical trials or uncontrolled clinical trials of older adults with chronic nonmalignant pain published in the English language. Articles were excluded if they: (1) did not study chronic nonmalignant pain; (2) were not published in English; (3) were not intervention trials; (4) were review or theoretical articles (e.g., not a primary study); and (5) did not include any older adults. We had intended to include only those studies with adults 65 years of age and older. However, this was not possible in many of the modalities studied, and so studies that included a younger population were also reviewed. We did not review the "gray" literature, such as abstracts, or other unpublished materials, such as dissertations.

Studies were rated on quality (Table 1) based upon their consistency with CONSORT guidelines [12] and given a grade of high, moderate, low, or very low based on the guidelines formulated by the American College of Chest Physicians Task Force, which in turn are based on the guidelines formulated by the international GRADE group [13]. The "grade" is based on the confidence in the estimate of effect. For example, although a case series comparing older and younger persons' response to interventions is valuable for assessing safety and feasibility, it would receive a very low grade for contribution to quality of evidence for the intervention, because it would not meet most CONSORT guidelines and any estimate of effect is very uncertain. Study quality is also reduced when randomization procedures, inclusion and exclusion criteria, and blinding of evaluators is not clearly described. When further research is very unlikely to change our confidence in the estimate of effect, it would receive a high grade. A moderate grade reflects that future research may change the estimate, and a low grade reflects that further research is very likely to change the estimate. Effect sizes comparing treatment and control group change scores were calculated where possible and are presented in Table 1.

Results

The database search strategies yielded a total of 381 articles on the following modalities: biofeedback and relaxation (73), transcendental meditation (TM) (70), mindfulness meditation (150), hypnosis (29), guided imagery (10), tai chi (4), qi gong (5), and yoga (40). Of the 381 articles retrieved through search strategies, 20 were deemed appropriate for review based upon the above criteria.

Table 1 summarizes the 20 reviewed mind–body intervention trials that included older adults with chronic pain. Fourteen articles included participants aged 50 years and above, while only two of these studies focused specifically on persons aged ≥65 years. An additional six articles included both persons under and over 50 years of age. Thirteen articles were controlled trials, of which 12 described random assignment to intervention. An additional five uncontrolled pre–post trials were reviewed. The remaining two studies consisted of a clinical record review and a multiple baseline comparison of subject pairs.

There is considerable overlap among the interventions described, and many are used in combination with one another. For example, PMR, imagery, and biofeedback are frequently combined. Of the identified studies in this structured review, seven clearly combined more than one modality, such as relaxation + imagery, or biofeedback + other relaxation techniques (see column 5 of Table 1 for intervention details). For clarity of presentation in the following study descriptions, we have categorized studies into relaxation-based, concentration-based, and movement-based mind–body therapies.

Relaxation-Based Mind–Body Therapies: PMR and Biofeedback Training

Biofeedback and other relaxation-based therapies are recognized as beneficial for chronic pain [14]. Although several reviews and randomized controlled trials [15–18] of biofeedback and various other relaxation-based therapies for various chronic pain conditions support the utility of these methods for reducing chronic low back pain, headache, and rheumatologic pain, few studies have specifically evaluated biofeedback and other relaxation methods for treating pain in the older adult.

Progressive Muscle Relaxation

Progressive muscles relaxation (PMR) is a systematic relaxation method developed in the late 1920s by Jacobson [19]. In PMR, patients tense and then let go the tension in various muscle groups, from one end of the body to the other. With practice over days or weeks, enhanced awareness of the body and increased ability to relax quickly and easily can be gained. Typically, patients are taught

Table 1 Characteristics of included studies

Study	Design/ Methods	≥65 Years	Condition/Age/N	Intervention/Control/ Length of Treatment	Outcome Measures	Pain Effect Sizes/ Quality Grade†	Notes
Relaxation							
Lundgren and Stenstrom 1999 [25]	RCT	No	RA • age 28–70, mean = 58 • N = 68	PMR + imagery vs usual care • 10 sessions	AIMS 2 mobility, arm function* AIMS 2 pain	Unable to compute effect size Quality: low	11% attrition in PMR 13% in control • Attendance good but home practice low • No group differences found at 1-year follow-up (15% attrition overall, 32% among classroom group)
Rybarczyk et al. 1999 [27]	RCT	No	Chronic illness (at least 1/3 with chronic pain) • age 50–87, mean = 64.5 • N = 178	Mind–body wellness classes vs home video wellness program vs usual care: PMR, breathing, autogenics, imagery, + education • 8 sessions	MPQ-SF* Sleep* BAI* CES-D* *For class and home video vs usual care MSCL* for classroom vs usual care HPLP LSI	Effect size MPQ-SF: • Tx vs home video control 0.04 • Tx vs wait-list 0.31 Quality: low	
Rybarzyk et al. 2001 [26]	RCT	No	Chronic illness (at least 1/3 with chronic pain) • age ≥ 60 • N = 243	Wellness classes vs wait-list control (see Rybarczyk et al. [25])	MPQ-SF* (posttreatment but not 1-year follow-up) MSCL-Sleep* (post- and 1 year) BAI* at post CES-D* at post	Effect size MPQ-SF • Pre–post 0.2 • Pre-1 year 0.15 Quality: low	19% attrition: classroom, 20% attrition: control • Younger persons more likely than older to drop out of treatment group
Arena et al. 1988 [24]	Pre–post	No	Headache • age 62–80 • N = 10	PMR • 7 sessions	7/10 >50% reduction in headache at 3-month follow-up, 2 headache free	Unable to compute effect size Quality: very low	Attrition not reported • Efforts were made to ensure that elderly subjects understood instructions
Biofeedback							
Nicholson and Blanchard 1993 [29]	Multiple baseline across subject pairs	No	Headache • 61–80 • N = 14	PMR, EMG BF, CT, thermal BF for migraine patients/ symptom monitoring wait-list control • 12 sessions	7/14 of BF and 2/7 of control >50% improvement in headache GDS* STAI-state* STAI-trait	Unable to compute effect size Quality: very low	26% attrition • Treatment was adapted for elderly by increasing length of sessions and reducing muscle contraction level
Middaugh and Pawlick 2002 [35]	Clinical record review	No	Chronic pain • older 55–82 • younger 18–54 • N = 117	PMR, EMG BF, cognitive therapy, PT • 8–12 sessions	Pain VAS* (older patients' pain reduction > younger patients)	Unable to compute effect size Quality: very low	Attrition not reported • Nonstandardized multidisciplinary treatment • Age effects on obtainable physiologic endpoints noted • Program tolerated well by older patients

Kabela et al. 1989 [31]	Pre–post	No	Headache • age 60–77 • N = 18	PMR, some patients received BF and/or CT • 8–12 sessions	64% of sample had >50% improvement in headache 50% had >50% improvement in headache medication index 1-month follow-up	Effect size Headache Index: • pre–post 0.66 Quality: very low	11% attrition—prior to treatment • Unstandardized behavioral treatment, follow-up included • Treatment tailored to increase comprehension
Arena et al. 1991 [30]	Pre–post	No	Headache • age 62–71 • N = 8	EMG BF • 12 sessions	3 months following treatment, 4/8 >50% headache reduction, 2/8 had 35–45% headache reduction	Effect size Headache Index: • pre–post 1.04 Quality: very low	Attrition not reported • Treatment modified to ensure comprehension (e.g., longer sessions) • Follow-up included
Meditation							
Morone et al. 2005 [43]	RCT	Yes	Chronic low back pain • age 65 • N = 37	MBSR program vs wait-list control • 8 sessions	CPAQ* SF-36 physical function*	Effect size CPAQ: • pre–post 0.83 Effect size: SF-36 Physical Function Scale: • pre–post 0.46 Quality: moderate	32% attrition in intervention group, 6% attrition from control • Included 3-month follow-up
Kabat-Zinn 1982 [42]	Pre–post	No	Chronic pain • age 22–75 • N = 58	MBSR • 10 sessions	Pain Rating Index* Body Parts Problem Assessment MSCL* SCL-90-R GSI*	Effect size Pain Rating Index: • pre–post 0.70 Quality: very low	12% attrition
Guided imagery							
Baird and Sands 2004 [47]	RCT	Yes	OA women • age ≥ 65 • N = 28	Guided imagery + PMR vs usual care • 12 sessions	AIMS 2 pain* Self-reported mobility*	Unable to compute effect size Quality: very low	4% attrition • Adherence reported
Lewandowski 2004 [48]	RCT	No	Chronic pain • age 34–90, median = 61 • N = 42	Seven-minute guided imagery recording vs wait-list control • 3 times/day over 4 days	Pain VAS*	Effect size Pain VAS: • 1.14 Quality: low	3% attrition • Short-term study (4 days), good treatment adherence noted
Hypnosis							
Gay et al. 2002 [55]	RCT	No	OA patients • mean age 65 • N = 36	PMR vs hypnosis vs usual care • 8 sessions	Pain VAS* Pain medication* (for hypnosis and relaxation groups compared with usual care)	Effect size Pain VAS: • 1.34 hypnosis vs control • 0.59 hypnosis vs PMR • 0.76 relaxation vs control Quality: moderate	12% attrition • Pain reduction most rapid in hypnosis group, study included 6-month follow-up • No instructions for home practice • Pain medications decreased in hypnosis and relaxation groups

Table 1 Continued

Study	Design/ Methods	≥65 Years	Condition/Age/N	Intervention/Control/ Length of Treatment	Outcome Measures	Pain Effect Sizes/ Quality Grade†	Notes
Tai chi							
Hartman et al. 2000 [57]	RCT	No	Lower extremity OA • average age 68 (range 49–81) • N = 33	Tai chi vs meeting and telephone control • 24 hours of instruction	Satisfaction with health* Arthritis self-efficacy* Pain and functional measures**	Effect size AIMS Pain: • 0.79 Quality: moderate	6% attrition • One of few studies to include an attention control
Song et al. 2003 [58]	RCT	No	OA women • age ≥ 55 • N = 72	Tai chi vs telephone-contact control • 12 weeks	Joint pain and stiffness, physical function (K-WOMAC)*	Effect size Joint Pain change scores • 0.67 Quality: moderate	43% attrition in tai chi, 39% attrition in control
Kirsteins et al. 1991 [82]	2 controlled studies, random assign. unclear	No	RA • age 37–72 • N = 47 (study 1) • N = 28 (study 2)	Tai chi vs usual care • Study 1: 10 sessions over 10 weeks • Study 2: 10 sessions over 5 week.	Joint tenderness, swollen joint count 50-foot walk* (study 2 only) Grip strength	Effect size Joint Pain: • Study 1: 0.40 • Study 2: 0.26	50% attrition of controls, 20% attrition of tai chi of study 1 10% of usual care and 17% of tai chi attrition in study 2 • Samples of the 2 studies were not independent
Yoga							
Kolasinski 2005 [74]	Pre–post	No	Knee OA • mean age 58 (50–68) • N = 11	Yoga • 8 sessions	Pain and physical function (WOMAC)*	Unable to compute effect size Quality: very low	36% attrition
Sherman et al. 2005 [77]	RCT	No	Chronic low back pain • mean age 44 • N = 101	Yoga vs exercise vs self-care book • 12 sessions	RDS* Symptom bothersomness* Medication use*	Unable to compute effect size Quality: high	0% attrition in yoga, 6% attrition in exercise (attrition defined as attending no classes)
Garfinkel et al. 1994 [76]	RCT	No	OA of hands • age 52–79 • N = 25	Yoga + relaxation + education vs wait-list • 8 sessions	Pain (joint tenderness and hand pain during activity)*	Effect size Pain with Dolorimeter: • 1.57 right hand, 1.16 left hand Quality: low	4% attrition • Controls were crossed over into yoga
Garfinkel et al. 1998 [80]	RCT	No	Carpal tunnel syndrome • age 24–77, median = 52 • N = 51	Yoga vs usual care + wrist splint • 8 sessions	Pain VAS* Grip strength*	Effect size Pain VAS: • 0.41 Quality: moderate	15% attrition in yoga, 20% attrition in control

* $P < 0.05$; ** $P < 0.10$.

† Pain effect size = Cohen's *d* comparing change scores of treated and control groups (or treated group only in uncontrolled studies). Quality = study quality designated high, moderate, low, or very low.

AIMS 2 = Arthritis Impact Measurement Scales-2; BF = biofeedback; CES-D = Center for Epidemiologic Studies Depression scale; CPAQ = Chronic Pain Acceptance Questionnaire; EMG = Electromyographic; HPLP = Health Promoting Lifestyle Profile; LSI = life Satisfaction Index; K-WOMAC = Korean version of Western Ontario and McMaster University; MBSR = Mindfulness-Based Stress Reduction; MSCL = Medical Symptoms Checklist; MPQ = McGill Pain Questionnaire; MPQ-SF = McGill Pain Questionnaire short form; OA = osteoarthritis; RA = rheumatoid arthritis; SF-36 = Short Form 36-item Health Survey; SCL-90-R = Symptom Checklist 90-Revised; GSI = General Severity Index; VAS = visual analog scale; BAI = Beck Anxiety Inventory; CT = Cognitive Therapy; GDS = Geriatric Depression Scale; RCT = Randomized Controlled Trial; RDS = Roland Disability Scale; STAI = State-Trait Anxiety Inventory; Tx = Treatment.

PMR and then use a recording of the exercise for home practice. Over time, fewer and fewer muscle groups are tensed and released and, eventually, the person can relax the body at will without tensing beforehand. A combination of PMR, diaphragmatic breathing training, and biofeedback is often used in behavioral interventions for chronic pain in adults and children [17,20–23].

Few studies have evaluated PMR for chronic pain in an older population. In an uncontrolled pre–post study, Arena et al. [24] reported on the effects of PMR therapy in 10 older tension headache patients aged 62–80 years. Seventy percent of subjects showed >50% reduction in headache activity 3 months following the seven-session treatment, with two of the subjects reporting complete amelioration of headaches. The authors noted that subjects were asked to repeat back homework assignments at each session in order to facilitate understanding of the instructions.

Lundgren and Stenstrom [25] assigned 68 rheumatoid arthritis patients (mean age 57) to 10 weeks of PMR training plus imagery (taught via audiotapes rather than personal instruction) or usual care. Although muscle function was found to improve, there was no decrease in pain or in disease activity. This study included follow-up assessments up to 1 year, at which time no significant difference between groups was found. In this study, the age range was broad, ranging from 28 to 70 years, and no information was provided regarding efficacy for older vs younger subjects. The authors noted that, although attendance was good and dropout rates were low, few participants practiced their relaxation skills at home as they had been instructed to do.

Rybarczyk et al. [26,27] report on two randomized controlled studies of a multicomponent mind–body wellness program for older adults (age ≥ 60 years) with chronic illness, such as osteoarthritis/rheumatoid arthritis (27% of the sample), spinal stenosis/low back pain (11%), and/or diabetes (30%). The intervention included relaxation training (breathing, PMR, autogenic training, and imagery), information on mindfulness meditation, exercise, nutrition, and cognitive approaches. In the initial study, 178 subjects were randomly assigned to mind–body wellness classes, a video-based home wellness program, or usual care control. Both treatment groups reported significantly greater pain reduction than the wait-list control group on the McGill Pain Questionnaire [28], as well as improved sleep. These authors subsequently compared 113 wellness class participants and 130 wait-list controls post treatment and at 1-year follow-up. At the 1-year follow-up, the sleep improvement was maintained, but pain improvement was not, perhaps indicating a need for maintenance contacts.

Biofeedback

The term "biofeedback" refers to a mind–body therapy in which instrumentation is utilized to provide feedback to the patient regarding a physiologic process. Biofeedback has been used to help persons learn to regulate biological processes, such as heart rate, muscle tension, blood pressure, and vasoconstriction. Over time, the patient learns to control the biofeedback signal, which is typically an auditory or visual analog of the physiologic changes. The most frequent use of biofeedback is as a method of relaxation training, with the most frequently used methods being electromyographic (EMG) or muscle tension biofeedback, and thermal (peripheral skin temperature) biofeedback.

Studies that evaluate the benefits of biofeedback for older persons with pain typically compare older vs younger participants. Frequently, biofeedback is one of several treatment components offered, along with other relaxation methods and cognitive therapy. This multimodal approach is typical in the clinic setting and most likely maximizes patient motivation and potential benefits. Therefore, differentiating the beneficial effects of biofeedback vs other forms of relaxation training is not possible.

A wait-list controlled trial of biofeedback and relaxation for headache in older adults [29] was specifically tailored for older individuals, with a treatment length of 12 sessions. In this study, 14 participants aged 61–80 years with either tension headache, migraine, or mixed headaches received EMG biofeedback training along with PMR and cognitive therapy. Subjects with migraines or mixed headache also received thermal biofeedback. Seven of these participants received the treatment after having completed a wait-list, diary-only condition. Although the small sample size precludes inferential statistical testing of relative benefits, the authors report that 2/7 of the control group and 7/14 of the biofeedback group exhibited improvement, which was defined as 50% reduction in headache activity. In this study, the treatment was adapted by lengthening sessions to 90 minutes and avoiding full muscle contraction during PMR in order to prevent discomfort.

Several prospective but uncontrolled studies of biofeedback for headaches in the older adult sup-

port the notion that older individuals can learn self-regulation skills to their benefit. Arena et al. [30] reported on a series of eight adults aged 62–71 years with tension headache who received 12 sessions of biofeedback. Treatment sessions were modified slightly in order to facilitate comprehension; for example, sessions were slightly longer than is typical, and extra care was taken to evaluate whether subjects understood the concepts. Three months following the treatment, 50% of subjects had maintained significant decreases in headache activity, and three of the remaining four subjects reported moderate reductions in headache of 35–45%. In a prospective study of unstandardized behavioral treatment that included relaxation and biofeedback as well as cognitive strategies, 64% of the 16 older adults in the headache sample had greater than 50% improvement in headache at 1-month follow-up [31].

Multimodal, multidisciplinary chronic pain rehabilitation programs frequently include biofeedback training for relaxation, in addition to other forms of relaxation such as diaphragmatic breathing and PMR. Cognitive therapy and physical therapy are frequently offered in multidisciplinary programs as well [32,33]. In a series of publications based upon older and younger participants in a multidisciplinary chronic pain program, Middaugh and colleagues [34] found that older patients (55–78 years) did not have more difficulty than younger patients with the biofeedback/relaxation component of the overall program, and were consistent with younger pain patients in terms of finger temperature response to PMR training. Both older and younger persons were able to improve the ability to relax muscles at the site of pain (e.g., upper cervical area) in response to EMG biofeedback training, with 100% of the 20 younger patients and 75% of the 17 older patients meeting EMG success criteria. The older group reported significant reduction in pain from admission to discharge.

In a further study with a larger sample size, Middaugh and Pawlick [35] compared 58 older (55–82 years) and 59 younger (18–54 years) participants in a multimodal pain treatment program who received biofeedback as well as CBT, medication management, and physical therapy. Although treatment components were consistent, some patients received inpatient treatment and some were outpatients. The number of biofeedback sessions ranged from 8 to 12. Patients received auditory or visual EMG biofeedback at the site of pain, such as the lumbar or trapezius muscles. Outcome measures included peripheral temperature change, respiration rate, and self-report of pain. Older patients exhibited comparable results to younger persons, such as reductions in respiration rate and increase in skin temperature. The authors note, however, that older persons did not achieve the same end points in terms of temperature and respiration, but concluded that physical factors related to aging could account for this. Older patients reported greater reductions in pain ratings than younger patients. Although the design of the study precludes distinguishing the precise efficacy of biofeedback from other program components, the results support the idea that older adults with long-standing pain problems respond as well as younger individuals do to a multimodal pain treatment program that includes biofeedback.

In summary, several biofeedback studies have addressed the ability of older adults with chronic pain to learn physiologic management, as well as benefit from this treatment. These reports suggest that the skills of physiologic management can be learned adequately by older chronic pain patients. Normal effects of aging on organs, such as decreased lung volume, may affect comparisons of outcome of older vs younger patients. Most of the studies reviewed are limited by small sample sizes, included multiple treatment modalities or did not include a control group. No randomized controlled trials that only study biofeedback within an older population have been reported.

Concentration-Based Mind–Body Therapies: Meditation, Guided Imagery, and Hypnosis

Meditation

Two common forms of meditation are mindfulness meditation and TM. Mindfulness meditation is taught in the mindfulness-based stress reduction (MBSR) program developed at the University of Massachusetts Medical Center and is now offered in many academic centers across the country. The program has also been operationalized and studied in many clinical trials. Simply, it involves bringing nonjudgmental moment-to-moment awareness to thoughts, sensations, or emotions as they arise. TM involves bringing awareness to a word or syllables that are continuously and silently repeated. While mindfulness meditation comes in different forms—sitting meditation, walking meditation, loving-kindness meditation, or the body scan, TM typically involves one format. This is resting comfortably in a sitting position with the eyes closed while silently repeating the assigned word or syl-

lables. While the MBSR program in clinical trials typically involves weekly classes in a group format, TM in clinical trials also involves one-on-one initial instruction and some group classes. Both types of meditation require daily meditation practice, and both will provide guided meditation tapes to aid development of the meditation technique. As we have discovered while conducting this review, few studies have looked at older adults, and even fewer at older adults with persistent pain. Only two clinical trials of mindfulness meditation for persistent pain were found that included an older population, but none was found for TM. Thus, even though TM has been extensively studied in clinical trials [36,37] and has been shown to be feasible in an older population [38,39], the authors could not find any studies of TM for persistent pain in an older age group.

Two recent reviews by Baer [40] and Grossman et al. [41] present compelling evidence for the benefit of the MBSR program in stress, anxiety, depression, and pain. An early study of Kabat-Zinn [42] examined the effects of the MBSR program on 58 subjects with chronic pain of varying etiology and with an age range of 22–75 years. There was no control group. Subjects had significant improvement immediately after completing the program on measures of pain and mood. Morone et al. [43] conducted a preliminary study of 37 older adults (mean age of 74 years) with chronic low back pain and randomized them to an 8-week MBSR program or a wait-list control. The intervention was feasible among this population, with significant improvement in self-reported pain acceptance and physical function as compared with the control group. As with many of the mind–body studies we review in this article, because of the small size of this pilot study, the results need to be interpreted with caution.

Articles by McBee et al. [44] and Smith [45] describe the authors' experience teaching MBSR to older adults and frail older adults. They both were able to successfully teach the program, but McBee et al. found that they needed to reduce the session time to 1 hour when working with the frail older adult in a nursing home setting.

Guided Imagery

Guided imagery sessions can occur in the presence of an individual trained in guided imagery, or can occur with audio tapes or CDs. Typically, a guided imagery session will begin with a relaxation exercise to focus attention and relieve tension of the patient before the actual guided imagery occurs. The initial exercise may involve a breathing exercise or visualizing a "safe" place. The session will then move into more specific guided images. Van Kuiken, in her 2004 meta-analysis [46], found four types of imagery that are practiced. One involves pleasant imagery—such as imagery of a peaceful location. A second involves physiologically focused imagery—imagery of fighting disease like white blood cell's attacking cancer cells. A third involves mental rehearsal—such as successfully performing a task like public speaking. Mental reframing involves imagery that reinterprets a past experience and its associated emotions. The fourth type is receptive imagery that involves scanning the body for diagnostic or reflective purposes.

There have been very few studies of guided imagery in older adults. Baird et al. [47] randomized 28 women with osteoarthritis who were at least 65 years of age to either 12 weeks of guided imagery with PMR or a control group. Participants were required to do two 10- to 15-minute guided imagery sessions with PMR twice a day. Eighteen were randomized to the intervention group and 10 to the control group (usual care). One subject dropped out of the intervention group, and 88.8% of subjects reported doing guided imagery at least once a day during the study period. There were significant reductions in pain and significant increase in mobility at the end of the trial. Because this study combined two modalities, it is impossible to separate out the effects of imagery from PMR. However, this study demonstrates the feasibility of guided imagery as an intervention in older adults with chronic pain and suggests benefits in pain reduction and increased mobility.

Lewandowski [48] randomized 44 adults with chronic pain, defined as daily pain that was a level 4 or higher on the Wong–Baker FACES [49] for at least the previous 3 months to a guided imagery intervention or a wait-list control. Subjects received a 7-minute guided imagery tape that they were to do three times a day for 4 days. The median age of the population was 61 years. Only two participants dropped out of the intervention group. Most participants practiced the guided imagery three times a day, as revealed in their diaries. The guided imagery group showed a significant reduction ($P < 0.05$) in the visual analog scale (VAS) as compared with the control group. This study was small, and guided imagery was conducted for a very short period of time. Nevertheless, the results also indicate that guided imagery is feasible in older adults.

Hypnosis

Hypnosis is defined by the American Society of Clinical Hypnosis as "a state of inner absorption, concentration and focused attention" [50]. Hypnosis is typically induced by a trained therapist. A hypnosis session usually has several components. It includes induction of the hypnotic state by the hypnotherapist who then gives suggestions once an adequate hypnotic state is induced, and then guides the patient out of the hypnotic state [51]. Sessions are typically individual, but can be in a group. Sessions vary in number, but may be as few as one or as many as a dozen. Patients can also be taught self-hypnosis and be provided with tapes for home practice.

Hypnosis has been used to treat a wide variety of medical conditions for over 200 years. A recent study by Patterson and Jensen [52] reviewed randomized, controlled clinical trials of hypnosis for acute and chronic pain. Acute pain conditions included medical procedures such as bone marrow aspiration, burn wound dressing changes, labor pain, and a variety of surgical procedures. Hypnosis resulted in significant reductions in self-reported measures of pain as compared with no treatment, usual care, or an attention control in about half of the studies reviewed, for three studies it was as good as, but no better than, the above comparison conditions, and one study had mixed results. For chronic pain, self-reported measures of pain also significantly improved for conditions such as fibromyalgia and headache. However, it was noted that, in chronic pain conditions, hypnosis was not found to be superior to relaxation training or autogenic training. A meta-analysis in 2000 [53] looked at both experimentally induced pain and clinical pain conditions, and concluded that hypnosis was an effective analgesic.

Another recent study of hypnosis for chronic pain by Jensen and Patterson [54] reviewed 19 controlled trials of hypnosis for chronic pain for such conditions as headache, cancer-related pain, fibromyalgia, osteoarthritis, low back pain, temporomandibular pain disorder, disability-related pain, and mixed chronic pain problems. The authors concluded that hypnosis resulted in more pain reduction than no treatment. Additionally, pain reduction was maintained up to 12 months of follow-up in some studies.

Many of the trials reviewed above include older adults over the age of 65 years. However, we identified only one trial of hypnosis for pain that was targeted to an older population. This was the trial by Gay et al. [55] comparing hypnosis with relaxation to a wait-list control for osteoarthritis pain. Thirty-six subjects were randomized to one of the three groups. Participants in the hypnosis group received eight individual 30-minute Erikson hypnosis sessions. Participants in the relaxation group received eight individual sessions of guided Jacobson relaxation, which involved progressively tensing and relaxing muscles of the body. The main outcome variable was pain intensity using the VAS. It showed that both the hypnosis and relaxation group significantly improved, compared with the control group at 8 weeks. The hypnosis and relaxation group were not significantly different from each other. Only the hypnosis group maintained improvement at 3 months compared with the control, and there was no significant difference between any group at 6 months.

As a result of the many clinical and experimental trials of hypnosis demonstrating significant benefit over a control condition, hypnosis has been supported by the American Psychiatric Association [56] and the NIH [14]. Many of the trials included older adults, but did not exclusively target them. Nevertheless, this is compelling evidence that hypnosis is feasible in older adults and can significantly reduce pain.

Movement-Based Mind–Body Therapies: Tai Chi, Qi Gong, and Yoga

Tai Chi and Qi Gong

Tai chi and qi gong are practices traditionally used in China for thousands of years and currently becoming popular lifestyle health practices as forms of low-impact exercise and stress management training in the West. Originating in Chinese martial arts, both tai chi and qi gong involve slow, controlled motions and focused breathing, and are thought to enhance the body's energy or qi/chi.

Tai chi chuan, typically called tai chi in the United States, is widely practiced by older adults in China and has become increasingly popular in Western countries. Tai chi "forms" or exercises typically include a standard series of gentle fluid movements, mental concentration, and controlled breathing.

Hartman et al. [57] assigned 33 community-dwelling adults with lower extremity osteoarthritis and mean age of 68 years to tai chi classes (totaling 24 hours) or a control group that consisted of usual care plus group meetings and telephone contacts. Quality of life, functional outcomes, and perceived arthritis self-efficacy were evaluated. Health satisfaction and overall arthritis self-efficacy were significantly improved in the tai

chi group compared with control. The differences between groups on pain and functional mobility measures (such as single-leg balance and chair rises) were in the predicted direction and approached, but did not reach statistical significance ($P < 0.1$). Although this study was limited by small sample size, several design strengths are worth mentioning. This study included an attention-control group rather than wait-list or usual care alone, which supports the idea that the active treatment benefits are not accounted for merely due to time and attention of the therapist. The Hartman et al. study included objectively measured functional outcomes, such as chair rise and 50-foot walk, rather than solely self-reported function.

One study using tai chi for older adults aged 55 years and above with chronic pain was found. This study focused on 72 women with osteoarthritis randomly assigned to tai chi or a telephone-contact control condition [58]. Joint pain and stiffness, as well as physical function, were significantly improved with treatment. However, the results of this study are difficult to interpret due to the high dropout rate (43% attrition in the tai chi participants).

There are a number of tai chi studies in healthy older adults or those with conditions other than pain. Several of these include large numbers of participants and excellent study designs. A selection of these trials is described here in order to illustrate the feasibility and safety of this intervention for older adults, as well as the potential for preserving function in this vulnerable group.

A number of clinical trials have evaluated tai chi chuan as an intervention to improve health and physical function and reduce risk factors for falls in older adults. Benefits to participants in a sample of 94 inactive subjects with a mean age of 73 years, included improved perceived physical function and exercise self-efficacy in comparison with a wait-list control [59]. Young et al. [60] assigned 62 subjects aged 60 years and over with hypertension to a 12-week tai chi or aerobic exercise program. Both groups exhibited significant reduction in blood pressure, and there was no difference between groups. Wolf et al. [61] randomly assigned 200 community-dwelling adults aged ≥70 years to tai chi, computerized balance training, or group education. Tai chi was associated with 47.5% reduced risk of multiple falls, and fear of falling was reduced relative to the education control group. Wolf and colleagues [62] also studied the effects of tai chi vs wellness education on physical function, heart rate, and blood pressure in 311 frail older adults (defined as more than 70 years old, in supervised living, and having experienced a fall within the last year). Chair-rise time, body mass index, heart rate, and systolic blood pressure decreased in the tai chi group, but increased among wellness education participants from baseline to 1-year follow-up.

There are a small number of studies of tai chi in healthy older adults without chronic pain that evaluated pain as an outcome. Ross et al. [63] focused on balance, mood, and pain in their uncontrolled pilot study of 17 community-dwelling older adults aged 68–92 years who were not taking pain medications. A statistically significant improvement in pain as assessed via a VAS was found, as well as improvement in self-rated mood. Notably, the participants' pain level was low at pretreatment, averaging 1.5 on a 10-cm VAS scale. Irwin et al. [64] used a randomized wait-list control design to evaluate whether tai chi could increase herpes zoster virus (shingles) cell-mediated immunity as well as health status. The 36 participants were aged 60 years or over, had previous exposure to the herpes zoster virus, and were excluded if they had a chronic pain condition. Cell-mediated immunity was significantly increased after 15 weeks of three times weekly tai chi classes (tai chi group) and not significantly changed in the control group. The physical function scale and role-physical scales of the SF-36 were improved among those who completed the tai chi intervention relative to controls. Not surprisingly, tai chi was not associated with significant reduction in the bodily pain scale of the SF-36, possibly due to floor effects.

Qi gong, like tai chi, is a traditional Chinese exercise practice involving gentle movement and focused breathing. Within the Chinese tradition, it is explained as a method to unblock the energy of the body, or qi, and facilitate its healthy flow. No studies were located that evaluated qi gong for chronic pain in older adults, and only one study was found that evaluated pain as an outcome measure in persons with chronic illness. Two studies of qi gong that included older adults are described here, as they support feasibility and safety as well as potential for improved function.

Cheung et al. [65] evaluated the effects of Guolin qi gong, which includes slow walking, arm movements, and twisting of the trunk, on blood pressure in participants with mild hypertension. The age range was 18–75 years. The 91 participants were randomly assigned to 22 hours of qi

gong classes or conventional exercise that was matched for intensity. Both groups were assigned homework practice. Both groups exhibited statistically significant improvement in SF-36 bodily pain, with no relative benefit for either group. Significant blood pressure and heart rate decreases were also found in both groups. There was a 21% dropout rate among qi gong participants and 11% dropout rate in the exercise group. A recent study by Stenlund et al. [66] of 12 sessions of qi gong and group discussion vs usual care for 109 cardiac rehabilitation patients found improvements in perceived physical activity level as well as objectively measured balance and coordination among the qi gong participants, but not the control group. Pain was not measured in this study. Attrition was 14% among qi gong participants and 11% in controls. The scarcity of qi gong trials in the English-language literature in contrast to the greater number of tai chi studies may reflect the differing popularity of these approaches at the present time in the West. These approaches, which each combine low-impact controlled exercise, breathing, and meditative awareness, deserve study in older adults with chronic pain.

Yoga

Yoga originated from Indian culture over 2000 years ago. The type of yoga known as Hatha yoga has been popularized in American culture. It usually involves holding the body in a sequence of postures or *asanas* for a certain period of time, breathing exercises and meditation. The postures in Hatha yoga make up the bulk of a yoga session, which may typically last 1–2 hours. Frequently, the postures are done sequentially with the aim of increasing flexibility and strength. The breathing and meditation exercises are intended to calm and focus the mind and to develop greater awareness [67]. The possible therapeutic benefits of yoga have been studied for a wide array of medical conditions. (See Kirkwood et al. [68] for a systematic review of yoga for anxiety, and Raub [69] for a review of yoga's effects on musculoskeletal and cardiopulmonary function.)

The growing popularity of yoga has led researchers to investigate yoga in older adults. An early trial by Haber in 1983 [70] investigated a 10-week yoga program in 106 older adults residing in two senior centers as compared with a control group that participated in popular group activities available at the senior center. Dropout rate was 16% of black participants and 22% of white participants. White, but not black, participants significantly improved on measures of hypertension and psychological well-being. Oken et al. [71] published a randomized controlled trial of yoga in healthy seniors. In total, 135 older adults with a mean age of 72 years were randomized to a 6-month weekly yoga class, exercise class, or a wait-list control group. The intervention was completed by 86% of the subjects in the yoga arm and 81% of subjects in the exercise arm. No significant change was found in the primary outcome measure of attention among the three groups. However, significant changes were found in measures of quality of life and the physical function measures of one-leg stand and chair sit and reach in the yoga group, but not the exercise group or the wait-list control group.

An uncontrolled trial of Iyengar yoga for gait in 23 older adults found significant improvement in measures of peak hip extension and stride length [72]. Eighty-three percent of participants completed the intervention. Other preliminary studies of yoga in older adults have been conducted to look at the effects of yoga on hyperkyphosis [73].

These studies establish that yoga is feasible in an older population. Fewer studies have looked at yoga for the treatment of persistent pain in older adults. Kolanski et al. [74] studied yoga for symptoms of knee osteoarthritis in 11 older adults with a mean age of 58 years (range 50–68). The intervention was 8 weekly 1- to 1.5-hour Iyengar yoga sessions. Seven participants completed the intervention. They significantly improved on measures of pain and physical function on the WOMAC (Western Ontario and McMaster Universities) Osteoarthritis Index [75]. Garfinkel et al. [76] conducted a randomized controlled trial of yoga for treatment of osteoarthritis of the hands vs a wait-list control in 26 adults aged 52–79 years. The intervention was 8 weekly 1-hour yoga sessions. One subject dropped out of the control group. Significant improvement was noted in joint tenderness and hand pain during activity.

Three controlled trials of yoga for chronic low back pain included both younger and older adults [77–79]. Sherman et al. [77] and Williams et al. [78] found that yoga significantly improved measures of function and pain which persisted on 26-week and 3-month follow-up, respectively. A controlled trial of yoga for carpal tunnel syndrome also included a wide age range of subjects [80]. Compared with control, subjects significantly improved on measures of pain and grip strength.

These trials also present compelling evidence that yoga is safe and can significantly reduce pain in older adults.

Discussion

We were able to identify and review the literature of mind–body interventions for older adults with chronic pain. As the field of mind–body medicine is in its infancy, it was not surprising that there were few controlled trials and these tended to have small numbers of participants and lacked a comparison group. Yet, the trials we reviewed indicated that mind–body therapies were especially well suited to the older adult with chronic pain. This was because of their gentle approach, which made them suitable for even the frail older adult. Additionally, their positive emphasis on self-exploration was a potential remedy for the heavy emotional, psychological, and social burden that is a hallmark of chronic pain. The overall recommendation of this review is that more trials be conducted specifically on older adults with chronic nonmalignant pain. Alternatively or in addition, secondary analyses comparing older and younger subjects of previously published trials of mind–body interventions for pain would represent an important addition to the literature.

Feasibility and Safety of Mind–Body Interventions

Feasibility of mind–body interventions can be determined by evaluating interest and recruitment, subject retention and completion of the intervention, and adverse event rates. All eight mind–body therapies reviewed were feasible for the older adult. Subjects were interested in participating in the studies to their completion, and dropout rates ranged from 0% to 43%. This range is typical of exercise group or classroom interventions [81].

Among the studies reviewed, there were no reports of adverse events or safety issues. One tai chi study [82] provided the anecdotal report that one-third of the subjects experienced knee, shoulder, or lower back soreness early in the intervention, and that this resolved without any modifications to the exercise or practice schedule in all but one of the subjects.

Our review included a number of studies that described modifications tailored to the older adult with chronic pain, such as increased length or number of treatment sessions [29,30], modification of tense-relax, and tai chi movements, in order to decrease risk of injury or pain exacerbation [29,57], and procedures for ascertaining whether subjects understood the treatment and the homework assignments [24]. Authors of a study of frail older adults in nursing homes noted the importance of keeping treatment sessions brief [44]. The modifications suggested appear sensible and appropriate for maximizing safety and cognitive understanding of the treatments. Without direct comparisons of these modifications, it is not possible to determine the optimal number of treatment sessions, length of sessions, or needed modifications to exercises for older participants. However, these issues have not been adequately addressed in the behavioral, exercise, or mind–body intervention literature in general. As more studies of mind–body interventions for older persons with pain are planned and implemented, the unique needs of this group should be carefully addressed.

Efficacy of Mind–Body Interventions for Pain in the Older Adult

The majority of randomized controlled trials we reviewed for pain in older adults were limited by small sample size, which reduced power to detect treatment effects. Additionally, few studies included trial profiles, and only two [43,77] used intention-to-treat analyses. We found only two randomized controlled trials focused on pain in older adults aged ≥65 years [43,47], and numbers of patients per group ranged from 12 to 19. Among older persons with osteoarthritis, PMR with imagery may be beneficial for pain reduction and self-reported function relative to usual care [47]. Although mindfulness meditation was associated with improvement in physical function and pain acceptance among older adults with low back pain [43], self-reported pain was not reduced post intervention nor at 3-month follow-up. With the exception of Hartman et al. [57], none of the trials included an attention-control condition. In this study, there was a trend for tai chi to improve pain and function relative to the attention-control condition, but power to detect group differences was limited due to sample size. Middaugh et al.'s [35] study, which compared the effects of biofeedback in older and younger chronic pain patients, supports the idea that biofeedback is beneficial in older as well as in younger persons, and may be associated with even greater perceived pain reduction in the older adult; however, this study did not include a control. Because of the current scarcity of randomized controlled trials in this area, conclusions regarding the efficacy of mind–body ther-

apies for chronic pain in the older adult must be tentative. Based on this review, there is some support for the efficacy of relaxation for reducing pain of osteoarthritis, and limited support for meditation and tai chi for improving function or coping for chronic low back pain or osteoarthritis, respectively.

Several controlled trials included a broad age range of subjects with pain or chronic illness. When we include these trials, all of which measured pain as an outcome variable, there is support for yoga [71,76,77], guided imagery [48], hypnosis and PMR [55], and a multicomponent mind–body class for pain reduction [26,27]. However, one relaxation intervention study for rheumatoid arthritis patients [25] did not find beneficial effects on pain beyond usual care. This last study stands in contrast to other studies incorporating relaxation for rheumatoid arthritis [83] and other chronic pain conditions, and the authors note that their use of audio-taped relaxation instructions, rather than personal instruction and low rate of homework practice, may have accounted for this.

Future Directions

Because traditional pain treatment is limited in older adults due to the well-known side effects of analgesics, particularly nonsteroidal anti-inflammatory drugs and opioids, in this population more research is needed in the mind–body therapies reviewed to determine their utility. Key features of future research should address modifications to the treatment protocol that may be required in older populations: such as shortened session times, and modified instructions that take into account cognitive impairment or hearing/vision/mobility loss. Outcome measures of function and cognition, which are of particular interest to the aging population and on which chronic pain can have an impact, should also be included. Key elements of design that should be considered in clinical trials of mind–body interventions include randomization with a suitable control. The latter would most commonly include a control for the time and attention given to the intervention group, such as an education control. Inclusion criteria need to be carefully thought through in the older population. They are more likely to have an increased number of comorbidities and mobility restrictions. If inclusion criteria are too strict, recruitment may be impossible, but if too relaxed, adherence to the intervention may not occur. The trial flow should be clearly delineated. Questions regarding expectancy of treatment effect should be asked of all participants. Trials should include a follow-up period (3–12 months commonly), to evaluate persistence of treatment effects over time. Measures should include more comprehensive measures of pain and not a simple VAS [84,85].

In conclusion, the small numbers of trials of mind–body therapies for chronic pain in the older adult are beginning to shed light on the potential benefits of these interventions. The many questions they leave unanswered provide ample opportunities for future research.

Acknowledgments

During the time of this work Dr. Morone was supported by the NIH Roadmap Multidisciplinary Clinical Research Career Development Award Grant (K12 RR023267) from the NIH.

Dr. Greco was supported by a Training and Career Development Award (K23 AR051314) from the National Institute of Arthritis, Musculoskeletal and Skin Diseases, and a Health Professional Investigator Award from the American College of Rheumatology's Research and Education Foundation.

References

1 Helme RD, Gibson SJ. The epidemiology of pain in elderly people. Clin Geriatr Med 2001;17:417–31.
2 Bair MJ, Robinson RL, Katon W, Kroenke K. Depression and pain comorbidity: A literature review. [see comment]. Arch Intern Med 2003; 163:2433–45.
3 Fishbain DA, Cutler R, Rosomoff HL, Rosomoff RS. Chronic pain-associated depression: Antecedent or consequence of chronic pain? A review. Clin J Pain 1997;13:116–37.
4 Ettinger WH Jr, Fried LP, Harris T, et al. Self-reported causes of physical disability in older people: The Cardiovascular Health Study. CHS Collaborative Research Group. J Am Geriatr Soc 1994;42:1035–44.
5 Flor H, Fydrich T, Turk DC. Efficacy of multidisciplinary pain treatment centers: A meta-analytic review. Pain 1992;49:221–30.
6 Woo J, Ho SC, Lau J, Leung PC. Musculoskeletal complaints and associated consequences in elderly Chinese aged 70 years and over. J Rheumatol 1994;21:1927–31.
7 Gagliese L, Melzack R. Chronic pain in elderly people. Pain 1997;70:3–14.
8 Weiner DK. Pain and aging: A call to those with the power of inquiry, the skills to teach, and the desire to heal. Pain Med 2006;7:57–9.

9 Cooper JK, Kohlmann T. Factors associated with health status of older Americans. Age Ageing 2001;30:495–501.
10 Lorig K, Holman H. Arthritis self-management studies: A twelve-year review. Health Educ Q 1993;20:17–28.
11 Health Information. Mind–Body Medicine. National Center for Complementary and Alternative Medicine; 2006. [Online]. Available at: http://nccam.nih.gov/health/backgrounds/mindbody.htm (accessed August 1, 2006).
12 Moher D, Schulz KF, Altman DG, Consort G. The CONSORT statement: Revised recommendations for improving the quality of reports of parallel-group randomized trials. Ann Intern Med 2001; 134:657–62.
13 Guyatt G, Gutterman D, Baumann MH, et al. Grading strength of recommendations and quality of evidence in clinical guidelines: Report from an American College of Chest Physicians task force. Chest 2006;129:174–81.
14 Integration of Behavioral and Relaxation Approaches Into the Treatment of Chronic Pain and Insomnia. NIH Technol Statement; 1995. 1–34 [online]. Available at: http://consensus.nih.gov/1995/1995BehaviorRelaxPainInsomniata017html.htm (accessed August 1, 2006).
15 Astin JA. Mind–body therapies for the management of pain. Clin J Pain 2004;20:27–32.
16 Holroyd KA, Penzien DB. Client variables and the behavioral treatment of recurrent tension headache: A meta-analytic review. J Behav Med 1986;9:515–36.
17 Malone MD, Strube MJ, Scogin FR. Meta-analysis of non-medical treatments for chronic pain. [see comment] [erratum appears in Pain 1989;37:128]. Pain 1988;34:231–44.
18 Flor H, Birbaumer N. Comparison of the efficacy of electromyographic biofeedback, cognitive-behavioral therapy, and conservative medical interventions in the treatment of chronic musculoskeletal pain. J Consult Clin Psychol 1993;61:653–8.
19 Jacobson E. Progressive Relaxation. A Physiological and Clinical Investigation of Muscular States and Their Significance in Psychology and Medical Practice. Chicago, IL: University of Chicago Press; 1974.
20 Greco CM, Rudy TE, Manzi S. Effects of a stress-reduction program on psychological function, pain, and physical function of systemic lupus erythematosus patients: A randomized controlled trial. Arthritis Rheum 2004;51:625–34.
21 Devineni T, Blanchard EB. A randomized controlled trial of an internet-based treatment for chronic headache. Behav Res Ther 2005;43:277–92.
22 Marcus DA, Scharff L, Mercer S, Turk DC. Nonpharmacological treatment for migraine: Incremental utility of physical therapy with relaxation and thermal biofeedback. Cephalalgia 1998;18:266–72; discussion 242.
23 Scharff L, Marcus DA, Masek BJ. A controlled study of minimal-contact thermal biofeedback treatment in children with migraine. J Pediatr Psychol 2002;27:109–19.
24 Arena JG, Hightower NE, Chong GC. Relaxation therapy for tension headache in the elderly: A prospective study. Psychol Aging 1988;3:96–8.
25 Lundgren S, Stenstrom CH. Muscle relaxation training and quality of life in rheumatoid arthritis. A randomized controlled clinical trial. Scand J Rheumatol 1999;28:47–53.
26 Rybarczyk B, Demarco G, Delacruz M, Lapidos S, Fortner B. A classroom mind/body wellness intervention for older adults with chronic illness: Comparing immediate and 1-year benefits. Behav Med 2001;27:15–27.
27 Rybarczyk B, Demarco G, Delacruz M, Lapidos S. Comparing mind–body wellness interventions for older adults with chronic illness: Classroom vs home instruction. Behav Med 1999;24:181–90.
28 Melzack R. The short-form McGill Pain Questionnaire. Pain 1987;30:191–7.
29 Nicholson NL, Blanchard EB. A controlled evaluation of behavioral treatment of chronic headache in the elderly. Behav Ther 1993;24:395–408.
30 Arena JG, Hannah SL, Bruno GM, Meador KJ. Electromyographic biofeedback training for tension headache in the elderly: A prospective study. Biofeedback Self Regul 1991;16:379–90.
31 Kabela E, Blanchard EB, Appelbaum KA, Nicholson N. Self-regulatory treatment of headache in the elderly. Biofeedback Self Regul 1989;14:219–28.
32 Turk DC, Zaki HS, Rudy TE. Effects of intraoral appliance and biofeedback/stress management alone and in combination in treating pain and depression in patients with temporomandibular disorders. J Prosthet Dent 1993;70:158–64.
33 Reid MC, Otis J, Barry LC, Kerns RD. Cognitive-behavioral therapy for chronic low back pain in older persons: A preliminary study. Pain Med 2003;4:223–30.
34 Middaugh SJ, Levin RB, Kee WG, Barchiesi FD, Roberts JM. Chronic pain: Its treatment in geriatric and younger patients. Arch Phys Med Rehabil 1988;69:1021–6.
35 Middaugh SJ, Pawlick K. Biofeedback and behavioral treatment of persistent pain in the older adult: A review and a study. Appl Psychophysiol Biofeedback 2002;27:185–202.
36 Walton KG, Schneider RH, Nidich SI, et al. Psychosocial stress and cardiovascular disease. Part 2. Effectiveness of the Transcendental Meditation program in treatment and prevention. Behav Med 2002;28:106–23.
37 Canter PH, Ernst E. Insufficient evidence to conclude whether or not transcendental meditation decreases blood pressure: Results of a systematic

review of randomized clinical trials. J Hypertens 2004;22:2049–54.
38 Alexander CN, Langer EJ, Newman RI, Chandler HM, Davies JL. Transcendental meditation, mindfulness, and longevity: An experimental study with the elderly. J Pers Soc Psychol 1989;57:950–64.
39 Schneider RH, Staggers F, Alxander CN, et al. A randomised controlled trial of stress reduction for hypertension in older African Americans. Hypertension 1995;26:820–7.
40 Baer RA. Mindfulness training as a clinical intervention: A conceptual and empirical review. Clin Psychol Sci Prac 2003;10:125–43.
41 Grossman P, Niemann L, Schmidt S, Walach H. Mindfulness-based stress reduction and health benefits: A meta-analysis. J Psychosom Res 2004;57:35–43.
42 Kabat-Zinn J. An outpatient program in behavioral medicine for chronic pain patients based on the practice of mindfulness meditation: Theoretical considerations and preliminary results. Gen Hosp Psychiatry 1982;4:33–47.
43 Morone NE, Weiner DK, Greco CM. Randomized trial of mindfulness meditation in older adults for the treatment of chronic low back pain. J Gen Intern Med 2005;20(suppl 1):58.
44 Mcbee L, Westreich L, Likourezos A. A psychoeducational relaxation group for pain and stress management in the nursing home. J Soc Work Long Term Care 2004;3:15–28.
45 Smith A. Clinical uses of mindfulness training for older people. Behav Cogn Psychother 2004;32:423–30.
46 Van Kuiken D. A meta-analysis of the effect of guided imagery practice on outcomes. J Holistic Nurs 2004;22:164–79.
47 Baird CL, Sands L. A pilot study of the effectiveness of guided imagery with progressive muscle relaxation to reduce chronic pain and mobility difficulties of osteoarthritis. Pain Manag Nurs 2004;5:97–104.
48 Lewandowski WA. Patterning of pain and power with guided imagery. Nurs Sci Q 2004;17:233–41.
49 Wong DL, Baker CM. Pain in children: Comparison of assessment scales. Pediatr Nurs 1988;14:9–17.
50 Definition of Hypnosis. American Society of Clinical Hypnosis. [Online]. Available at: http://asch.net/genpubinfo.htm (accessed August 1, 2006).
51 Stewart JH. Hypnosis in contemporary medicine. Mayo Clin Proc 2005;80:511–24.
52 Patterson DR, Jensen MP. Hypnosis and clinical pain. Psychol Bull 2003;129:495–521.
53 Montgomery GH, Duhamel KN, Redd WH. A meta-analysis of hypnotically induced analgesia: How effective is hypnosis? Int J Clin Exp Hypn 2000;48:138–53.
54 Jensen M, Patterson DR. Hypnotic treatment of chronic pain. J Behav Med 2006;29:95–124.
55 Gay MC, Philippot P, Luminet O. Differential effectiveness of psychological interventions for reducing osteoarthritis pain: A comparison of Erikson. Eur J Pain 2002;6:1–16.
56 Regarding Hypnosis. Position Statement. American Psychological Association Document Reference No. 610001. [Online]. Available at http://www.psych.org/edu/other_res/lib_archives/196101.pdf (accessed August 1, 2006).
57 Hartman CA, Manos TM, Winter C, et al. Effects of t'ai chi training on function and quality of life indicators in older adults with osteoarthritis. J Am Geriatr Soc 2000;48:1553–9.
58 Song R, Lee EO, Lam P, Bae SC. Effects of tai chi exercise on pain, balance, muscle strength, and perceived difficulties in physical functioning in older women with osteoarthritis: A randomized clinical trial. J Rheumatol 2003;30:2039–44.
59 Li F, Harmer P, Mcauley E, et al. Tai chi, self-efficacy, and physical function in the elderly. Prev Sci 2001;2:229–39.
60 Young DR, Appel LJ, Jee S, Miller ER 3rd. The effects of aerobic exercise and t'ai chi on blood pressure in older people: Results of a randomized trial. J Am Geriatr Soc 1999;47:277–84.
61 Wolf SL, Barnhart HX, Kutner NG, et al. Selected as the best paper in the 1990s: Reducing frailty and falls in older persons: An investigation of tai chi and computerized balance training. J Am Geriatr Soc 2003;51:1794–803.
62 Wolf SL, O'Grady M, Easley KA, et al. The influence of intense tai chi training on physical performance and hemodynamic outcomes in transitionally frail, older adults. J Gerontol A Biol Sci Med Sci 2006;61:184–9.
63 Ross MC, Bohannon AS, Davis DC, Gurchiek L. The effects of a short-term exercise program on movement, pain, and mood in the elderly. Results of a pilot study. J Holistic Nurs 1999;17:139–47.
64 Irwin MR, Pike JL, Cole JC, Oxman MN. Effects of a behavioral intervention, tai chi chih, on varicella-zoster virus specific immunity and health functioning in older adults. Psychosom Med 2003;65:824–30.
65 Cheung BM, Lo JL, Fong DY, et al. Randomised controlled trial of qigong in the treatment of mild essential hypertension. J Hum Hypertens 2005;19:697–704.
66 Stenlund T, Lindstrom B, Granlund M, Burell G. Cardiac rehabilitation for the elderly: Qi gong and group discussions. Eur J Cardiovasc Prev Rehabil 2005;12:5–11.
67 Riley D. Hatha yoga and the treatment of illness. Altern Ther Health Med 2004;10:20–1.
68 Kirkwood G, Rampes H, Tuffrey V, Richardson J, Pilkington K. Yoga for anxiety: A systematic review of the research evidence. Br J Sports Med 2005;39:884–91.

69 Raub JA. Psychophysiologic effects of Hatha yoga on musculoskeletal and cardiopulmonary function: A literature review. J Altern Complement Med 2002;8:797–812.
70 Haber D. Yoga as a preventive health care program for white and black elders: An exploratory study. Int J Aging Hum Dev 1983;17:169–76.
71 Oken BS, Zajdel D, Kishiyama S, et al. Randomized, controlled, six-month trial of yoga in healthy seniors: Effects on cognition and quality of life. Altern Ther Health Med 2006;12:40–7.
72 Dibenedetto M, Innes KE, Taylor AG, et al. Effect of a gentle Iyengar yoga program on gait in the elderly: An exploratory study. Arch Phys Med Rehabil 2005;86:1830–7.
73 Greendale GA, Mcdivit A, Carpenter A, Seeger L, Huang MH. Yoga for women with hyperkyphosis: Results of a pilot study. Am J Publich Health 2002;92:1611–4.
74 Kolasinski SL, Garfinkel M, Tsai AG, et al. Iyengar yoga for treating symptoms of osteoarthritis of the knees: A pilot study. J Altern Complement Med 2005;11:689–93.
75 Bellamy N, Buchanan WW, Goldsmith CH, Campbell J, Stitt LW. Validation study of WOMAC: A health status instrument for measuring clinically important patient relevant outcomes to antirheumatic drug therapy in patients with osteoarthritis of the hip or knee. J Rheumatol 1988;15:1833–40.
76 Garfinkel MS, Schumacher HR Jr, Husain A, Levy M, Reshetar RA. Evaluation of a yoga based regimen for treatment of osteoarthritis of the hands. J Rheumatol 1994;21:2341–3.
77 Sherman KJ, Cherkin DC, Erro J, Miglioretti DL, Deyo RA. Comparing yoga, exercise, and a self-care book for chronic low back pain: A randomized, controlled trial. Ann Intern Med 2005;143: 849–56.
78 Williams KA, Petronis J, Smith D, et al. Effect of Iyengar yoga therapy for chronic low back pain. Pain 2005;115:107–17.
79 Galantino ML, Bzdewka TM, Eissler-Russo JL, et al. The impact of modified Hatha yoga on chronic low back pain: A pilot study. Altern Ther Health Med 2004;10:56–9.
80 Garfinkel MS, Singhal A, Katz WA, et al. Yoga-based intervention for carpal tunnel syndrome: A randomized trial. JAMA 1998;280:1601–3.
81 Warsi A, Lavalley MP, Wang PS, Avorn J, Solomon DH. Arthritis self-management education programs: A meta-analysis of the effect on pain and disability. [see comment]. Arthritis Rheum 2003;48:2207–13.
82 Kirsteins AE, Dietz F, Hwang SM. Evaluating the safety and potential use of a weight-bearing exercise, tai-chi chuan, for rheumatoid arthritis patients. Am J Phys Med Rehabil 1991;70:136–41.
83 Bradley LA, Young LD, Anderson KO, et al. Effects of psychological therapy on pain behavior of rheumatoid arthritis patients. Treatment outcome and six-month followup. Arthritis Rheum 1987; 30:1105–14.
84 Dworkin RH, Turk DC, Farrar JT, et al. Core outcome measures for chronic pain clinical trials: IMMPACT recommendations. [see comment]. Pain 2005;113:9–19.
85 Turk DC, Dworkin RH, Burke LB, et al. Developing patient-reported outcome measures for pain clinical trials: IMMPACT recommendations. Pain 2006;125:208–15.